

# Assessment of delirium in children admitted into the Intensive Care Unit: psCAM-ICU Tool\*

Evaluación del delirium en niños ingresados en la Unidad de Cuidados Intensivos: Herramienta psCAM-UCI

Avaliação do delirium em crianças internadas na Unidade de Terapia Intensiva: ferramenta psCAM-UTI

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## Abstract

**Background:** Delirium has been identified as a risk factor for the mortality of critically ill patients, generating great social and economic impacts, since patients require more days of mechanical ventilation and a prolonged hospital stay in the intensive care unit (ICU), thus increasing medical costs.

**Objective:** To describe the prevalence and characteristics of delirium episodes in a sample of 6-month to 5-year-old children who are critically ill.

**Methods:** Cohort study at a Pediatric Intensive Care Unit (PICU) in Bogotá (Colombia). Participants were assessed by the Preschool Confusion Assessment Method for the ICU (psCAM-ICU) within the first twenty-four hours of hospitalization.

**Results:** One quarter of the participants (25.8%) presented some type of delirium. Among them, two sub-types of delirium were observed: 62.5% of the cases were hypoactive and 37.5% hyperactive. Moreover, from them, six were male (75%) and 2 female (25%). Primary diagnosis was respiratory tract infection in 62.55% of the patients, while respiratory failure was diagnosed in the remaining 37.5%.

**Conclusions:** The implementation of delirium monitoring tools in critically ill children provides a better understanding of the clinical manifestation of this phenomenon and associated risk factors in order to contribute to the design of efficient intervention strategies.

**Descriptors:** Delirium; Child; Preschool; Critical Care; Pediatrics; Psychomotor Agitation; Nursing (source: DeCS, BIREME).

## Resumen

**Introducción:** el delirium se ha identificado como un factor de riesgo para la mortalidad de pacientes en estado crítico, lo que genera un mayor impacto social y económico, teniendo en cuenta que los pacientes requieren más días de ventilación mecánica y una estancia hospitalaria prolongada en la unidad de cuidados intensivos (UCI), lo que incrementa los costos médicos de su estadía.

**Objetivo:** describir la prevalencia y las características de los episodios de delirium en una muestra de niños de seis meses a cinco años en estado crítico.

**Métodos:** estudio de cohorte en una Unidad de Cuidados Intensivos Pediátricos (UCIP) en Bogotá (Colombia). Los participantes fueron evaluados por el método de evaluación de confusión preescolar para la UCI (psCAM-UCI) dentro de las 24 horas iniciales del período de hospitalización.

**Resultados:** una cuarta parte de los participantes (25,8 %) presentó algún tipo de delirium. Entre ellos, se observaron dos subtipos de delirium: el 62,5 % de los casos era hipoactivo y el 37,5 % hiperactivo. Además, el 75% (6) de los participantes delirantes eran hombres y el 25 % (2) mujeres. En 62,5 % de los pacientes el diagnóstico primario fue infección de las vías respiratorias, mientras que la insuficiencia respiratoria fue diagnosticada en el 37,5 % restante.

**Conclusiones:** la implementación de herramientas de monitoreo del delirium con niños en estado crítico proporciona una mejor comprensión de la presentación clínica de este fenómeno y los factores de riesgo asociados, con lo cual es posible contribuir al diseño de estrategias de intervención eficientes.

**Descriptorios:** Delirium; Preescolar; Pediatría; Cuidados Críticos; Agitación Psicomotora; Enfermería (fuente: DeCS, BIREME).

## Resumo

**Introdução:** o delirium foi identificado como um fator de risco para a mortalidade de pacientes graves, o que gera maior impacto social e econômico, visto que os pacientes necessitam de mais dias de ventilação mecânica e internação prolongada na unidade de terapia intensiva (UTI), o que aumenta os custos médicos para a sua estadia.

**Objetivo:** descrever a prevalência e as características dos episódios de delirium em uma amostra de crianças de 6 meses a 5 anos, gravemente doentes.

**Métodos:** estudo de coorte em uma Unidade de Terapia Intensiva Pediátrica (UTIP) em Bogotá (Colômbia). Os participantes foram avaliados pelo método de avaliação de confusão pré-escolar para a UTI (psCAM-UTI) dentro das primeiras 24 horas do período de internação.

**Resultados:** um quarto dos participantes (25,8%) apresentou algum tipo de delirium. Entre eles, dois subtipos de delirium foram observados: 62,5% dos casos eram hipoativos e 37,5% hiperativos. Além disso, 75% (6) dos participantes delirantes eram do sexo masculino e 25% (2) feminino. Em 62,5 % dos pacientes, o diagnóstico primário foi infecção das vias respiratórias, enquanto a insuficiência respiratória foi diagnosticada em 37,5 % restante.

**Conclusões:** a implementação de instrumentos de monitorização do delirium com crianças gravemente doentes permite uma melhor compreensão da apresentação clínica do fenômeno e dos fatores de risco associados, de forma a contribuir para o desenho de estratégias de intervenção eficazes.

**Descritores:** Delirium; Pré-escolar; Pediatría; Cuidados Críticos; Agitação Psicomotora; Enfermagem (fonte: DeCS, BIREME).

## Introduction

Delirium is an altered state of consciousness characterized by fluctuating or acute changes in the mental state, lack of attention and the impossibility to receive, process, storage, and recover information (1, 2). Among Intensive Care Units (ICU), delirium in mechanically ventilated adults is between 60 and 80%, and between 20 and 60% in non-ventilated but critically ill patients (3). Schieveld *et al.* observed that delirium prevalence in general hospitalization patients oscillates between 10 and 30%, whereas in ICU admitted and terminal patients reaches 50 and 80%, respectively (4).

Current literature about delirium prevalence during childhood is scarce. There is a lack of studies among samples of critically ill children and few studies have used validated measurement instruments to diagnose the presence of delirium in populations of critically ill pediatric patients. According to emerging studies, delirium prevalence in ICU hospitalized children oscillates between 5 and 10%, being probably underestimated due to the absence of reliable and valid assessment tools (4-7).

Traube *et al.* (8) reported a delirium prevalence of 17% in hospitalized children. The disorder manifested during the first three days of hospital admittance and, on average, lasted for two days. Additionally, these authors identified that most of the patients (46-50%) presented a hypoactive delirium that increased the duration of their hospital stay at the ICU and was associated independently with mortality (8). In another study with an international sample of 835 children, researchers identified that 25% of the participants presented a delirium episode that, in most of the cases, was associated with infectious and inflammatory diseases. According to this study, mechanical ventilation, physical restrictions, and the use of benzodiazepines, vasopressors, narcotics and anticonvulsant medications, are predisposing factors for delirium episodes (9).

Colville *et al.* examined children memories about their stay at the Pediatric Intensive Care Unit (PICU) and found that 33% of patients reported psychotic symptoms such as hallucinations, perturbations, and fears, which suggest the presence of delirium during hospitalization (10). Similarly,

a delirium prevalence of 24% was observed in a sample of children, accompanied by the presence of secondary fluctuations associated with mechanical ventilation, sedation overdose, alterations in sleep-wake cycle, oxygen therapy, and invasive mechanical ventilation as predisposing factors. On this regard, some authors suggest the need of validating measurement tools to detect delirium in pediatric patients (11, 12).

According to a study conducted by Turkel *et al.* (13), mortality and morbidity rates increase 20% when delirium is not properly identified. These authors also reported that the most common signs of delirium in children are perturbation, fluctuating symptoms, alterations in attention, irritability, agitation, emotional lability, and confusion, whereas these type of episodes in adults are generally characterized by the presence of memory alterations, depressed affect, and speech disorders. Based on this information, medical staff needs to implement proper evaluation tools for the diagnosis of delirium in order to prevent the onset of complications.

A standardized method for assessing delirium in critically ill pediatric patients has not been consistently implemented in the medical practice. As a consequence, it is difficult to obtain proper and precise diagnosis and treatment (3, 14, 15). However, the Preschool Confusion Assessment Method for the ICU (PSCAM-ICU) is a reliable measurement instrument of delirium in pediatric patients, due to the possibility of its application in both ventilated and non-ventilated cases. This is demonstrated through the findings by Smith *et al.* (16), who support the suitability of this tool for three reasons: i) it takes only two minutes to obtain an accurate evaluation, ii) has a valid and sufficient structure that allows the identification of the delirium sub-type, and iii) allows the design of efficient intervention strategies to counter the short and long effect consequences of delirium. Van Tuijl *et al.* (17) report that 15% of the patients who are admitted to the PICU are children under the age of 5 and, therefore, considered a highly vulnerable population due to the implications of being in a unfamiliar context, a situation that leads to a higher risk of presenting a delirium episode. For this reason, further research is required on the use of the PSCAM-ICU with pediatric samples in order to effectively diagnose and treat delirium.

Based on the above, this study is aimed to describe the prevalence and characteristics of delirium in a

sample of critically ill children, aged 6 months to 5 years and 11 months, using the Preschool Confusion Assessment Method for the ICU (pSCAM-ICU).

## Methods

### Study design

Cohort study conducted in the Pediatric Intensive Care Unit at Hospital Universitario Fundación Santa Fe (Bogotá, Colombia) from February to May 2018. It was calculated by a sample size for a given proportion.

### Inclusion criteria

Pediatric patients under 5 years hospitalized at the PICU, regardless of the diagnosis, either ventilated or not ventilated, sedated or awoken. Spanish speakers who scored three or more in the Richmond Agitation-Sedation Scale (RASS).

### Exclusion criteria

Patients who were terminally ill, had visual or hearing problems, or diagnosed with cognitive impairments, were excluded from the study.

### Sample

The final sample consisted of 31 patients who fitted the inclusion criteria.

### Ethical approval

The Ethical Corporative Research Committee of the Hospital Universitario Fundación Santa Fe (Bogotá, Colombia) and the Research and Ethics committee of the Universidad Nacional de Colombia approved the research protocol. Parents or legal guardians of children provided approval for their participation in the research project by signing an informed consent form.

### Instruments

We used a questionnaire for socio-demographic variables and clinical antecedents. The Preschool Confusion Assessment Method for the ICU (pSCAM-ICU) (3) was also used as an instrument for data collection. This instrument was validated in Spanish with the authorization of Dr. Smith (18). The pSCAM-ICU instrument is a valid and reliable

tool for the assessment of delirium in critically ill infants and preschoolers who present frequent delirium episodes (Kappa = .96, sensitivity 75%, and specificity = 91%) (19). The method constitutes a consistent procedure for the evaluation of the presence of delirium, based on four main criteria: i) acute or fluctuant changes of the mental state, ii) inattention, iii) altered level of consciousness, and iv) sleep-wake cycle disturbances.

Additionally, an essential component of the pSCAM-ICU is the evaluation of the state of consciousness of the patient by the use of the RASS (20). This scale is an easy-to-use and practical tool that includes the sedation and agitation states as central components of the assessment. RASS has proved to be a valid assessment method that can be used with critically ill children by providing an accurate estimation of the level of consciousness of ventilated or not ventilated patients.

RASS was initially designed as a tool for adults, demonstrating good reliability and validity levels for the evaluation of the consciousness state. Although, several PICU worldwide have used this scale, finding acceptable and reliable results in pediatric populations, other PICU choose not to use this method due to some limitations in its use with children. However, Kerson *et al.* (20) compared the use of RASS performance in adult and children populations, concluding that the method yielded reliable and precise results by identifying risk factors that contribute to the patients' sedation and agitation levels.

### Procedure

A pilot test was conducted with a non-probabilistic sample of 8 hospitalized patients at the PICU, aged between 6 months and 5 years. The research team assessed patients who met the inclusion criteria. The nurse, who completed a data collection form, conducted a first assessment of patients. Afterwards, the intensive care doctor conducted an independent evaluation following the same procedures as the nurse and completing the data collection form. Finally, a child psychiatrist conducted a diagnosis guided by the neurocognitive criteria specified by the Diagnostic and Statistical Manual of Mental Disorders DSM-5 (1).

## Data analysis

Data was analyzed using Excel and R-Project. A screening of the initial collected data was conducted in order to detect the presence of atypical data, entering errors and typos that could potentially alter the analysis. Additionally, the main researcher of the project looked through the data to assess the clinical plausibility of the information (i.e. if the information made sense in a clinical context). These procedures were aimed to identify and correct possible sources of error in the subsequent analysis.

A descriptive analysis of the central tendency and frequency statistics of the data was conducted to estimate the prevalence of delirium in the critically ill children. Pearson correlation coefficients and Chi-Squared test of independence were conducted in order to estimate if the presence of delirium was associated with different characteristics of the patients, such as their diagnosis, ventilator parameters, medication, and clinical conditions in the moment of assessment.

## Results

### Descriptive analysis

The cohort of the study included 31 patients, 12 female (38.7%) and 19 male (61.3%) subjects, aged between 6 months and 5 years and 11 months, with an average age of 2.2 years (DS = 1.5 years). The most common diagnosis for admission into the PICU were respiratory failure (42%), bronchiolitis (9.7%), respiratory crisis (6.45%), acute respiratory infection (6.45%), and other non-respiratory primary diagnosis (35.4%), as shown in Table 1.

### Delirium prevalence

Eight of the 31 participants included in the study (25.8%) presented an episode of delirium. From them, six were male (75%) and two female (25%). Their primary diagnosis was acute respiratory infection (62.5%, five cases) and respiratory failure (37.5%, three cases).

### Sub-type of delirium

Sixty-two percent of the patients who were delirious presented the hypoactive sub-type, whereas 37.5% were classified on the hyperactive sub-type.

**Table 1.** Primary diagnosis of patients admitted to the PICU

Diagnosis	n	%
Respiratory failure	13	41.94
Acute bronchiolitis	3	9.68
Acute asthma	2	6.45
Acute respiratory infection	2	6.45
Abdominal septic shock origin	1	3.23
Postoperative peritoneal shunt ventricle	1	3.23
Polytrauma; head trauma	1	3.23
Postoperative release flanges	1	3.23
Postoperative escharotomy and placement amniotic membrane	1	3.23
Hemolytic uremic syndrome	1	3.23
Obstructive syndrome Bronco	1	3.23
Multilobar pneumonia	1	3.23
Recurrent wheezing syndrome	1	3.23
Viral pneumonia	1	3.23
Terminal ileum mechanical obstruction	1	3.23
<b>Total</b>	<b>31</b>	<b>100.00</b>

Source: Authors.

### Quantitative measures

Several physiological measures were registered during the patient's stay at the PICU. Table 2 summarizes the descriptive statistics of systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, respiratory rate, and temperature conditions. Patients who were identified as delirious presented significantly higher SBP and DBP rates compared to non-delirious patients (range between 110 mmHg systolic and 69.7 mmHg diastolic). On average, this group of children presented 27 breaths per minute and the difference with the non-delirious group was not statistically significant (Table 2).

### Laboratory tests

Sixteen out of the 31 participants had record of laboratory tests on hemoglobin, hematocrits, leucocytes and platelets levels on the day of the assessment. Five of these 16 patients were classified as delirious. The results show that, on average, the delirious patients showed significantly greater levels of leucocytes and lower levels of platelets. Table 3 presents the correlation of the quantitative variables studied.

## Hospital stay

The information regarding the length of stay at the PICU, days of stay at other areas of the hospital, number of days of orotracheal intubation, high flow nasal cannula, and low flow nasal cannula, separated by delirious and non-delirious patients, is presented in Table 4. Results suggest that the duration of the stay at the PICU was longer for the group of patients who presented an episode of delirium ( $M = 10$ ), compared to patients who did

not ( $M = 7$ ). The same pattern was observed in the general hospital stay (7.5 vs 2.2 days, respectively), as seen in Table 4.

## Medication

The treatment of half of the delirious patients included benzodiazepines, narcotics (33%) and analgesics (16.6%), showing the role of these predisposing factors in the presence of delirium in critically ill patients.

**Table 2.** Physiological measures

Measurements	Total sample	Patients with delirium	Patients without delirium
<b>PAS</b>			
Average	98.0	110.0	95.1
SD	14.8	15.5	13.4
Minimum	70.0	96.0	70.0
Half	95.0	107.0	93.0
Maximum	136.0	136.0	128.0
<b>PAD</b>			
Average	63.0	69.7	61.4
SD	12.8	16.8	11.4
Minimum	44.0	52.0	44.0
Half	61.0	66.5	61.0
Maximum	93.0	93.0	87.0
<b>FC</b>			
Average	130.4	131.2	130.2
SD	21.1	19.9	21.8
Minimum	77.0	108.0	77.0
Half	130.0	132.5	130.0
Maximum	170.0	159.0	170.0
<b>FR</b>			
Average	31.3	27.3	32.2
SD	10.3	12.0	9.8
Minimum	16.0	16.0	20.0
Half	31.0	24.0	31.0
Maximum	62.0	48.0	62.0
<b>Temperature</b>			
Average	36.5	36.8	36.4
SD	0.4	0.5	0.3
Minimum	36.0	36.2	36.0
Half	36.4	36.7	36.4
Maximum	37.7	37.7	37.1

Source: Authors.

**Table 3.** Laboratory analysis

Measurements	Total sample	Patients with delirium	Patients without delirium	$P < 0.005$
Counting	31	8	23	
<b>Hemoglobin</b>				
Average	12.3	12.2	12.4	0.14
SD	1.4	1.1	1.6	
Minimum	9.5	11.0	9.5	
Half	12.4	13.0	12.2	
Maximum	14.7	13.0	14.7	
<b>Hematocrit</b>				
Average	35.9	35.6	36.1	0.39
SD	4.2	3.5	4.6	
Minimum	28.4	31.0	28.4	
Half	35.4	37.0	35.0	
Maximum	42.7	39.6	42.7	
<b>Leucocytes</b>				
Average	7,622.2	8,160.0	7,377.7	0.37
SD	4,798.6	610.7	5,846.4	
Minimum	10.1	7,600.0	10.1	
Half	8,000	8,000	8,000	
Maximum	16,500	9,200	16,500	
<b>Platelets</b>				
Average	277,875.0	202,600.0	312,090.9	0.38
SD	109,092.5	85,042.9	104,105.2	
Minimum	63,000	86,000	63,000	
Half	291,000	213,000	327,000	
Maximum	445,000	307,000	445,000	

Source: Authors.

**Table 4.** Day hospital stay

Measurements	Total sample	Patients with delirium	Patients without delirium	CI 95%
<b>PICU days</b>				
Average	7.8	10.0	7.3	CI (5.69-9.98)
SD	5.8	5.0	6.0	
Minimum	2.0	7.0	2.0	
Half	7.0	8.0	6.0	
Maximum	32.0	20.0	32.0	
<b>Hospitalization days</b>				
Average	3.3	7.5	2.2	CI (1.40-5.12)
SD	5.1	8.	3.3	
Minimum	0.0	1.0	0.0	
Half	2.0	3.0	1.0	
Maximum	23.0	23.0	17.0	
<b>Intubation days</b>				
Counting	5	2.0	3	CI (-0.76-3.47)
Average	8.4	1.0	13.3	
SD	13.3	0.0	16.2	
Minimum	1.0	1.0	4.0	
Half	4.0	1.0	4.0	
Maximum	32.0	1.0	32.0	
<b>High flow nasal cannula days</b>				
Counting	22	5	17	CI (2.43-4.73)
Average	4.6	4.6	4.6	
SD	2.4	2.3	2.5	
Minimum	1.0	1.0	1.0	
Half	5.0	5.0	5.0	
Maximum	11.0	7.0	11.0	
<b>Under nasal cannula days</b>				
Counting	27	5	22	CI (1.78-2.93)
Average	2.7	3.6	2.5	
SD	1.4	1.3	1.3	
Minimum	1.0	2.0	1.0	
Half	2.0	3.0	2.0	
Maximum	5.0	5.0	5.0	

PICU: Pediatric Intensive Care Unit; SD: standard deviation; CI: confidence Interval.

Source: Authors.

## Discussion

The cohort of the study included 31 patients, 12 female (38.7%) and 19 male (61.3%), aged between 6 months and 5 years and 11 months, with an average age of 2.2 years (DS = 1.5 years). The most common diagnosis for admission into the PICU were respiratory failure (42%), bronchiolitis (9.7%), respiratory crisis (6.45%), and acute respiratory infection

(6.45%). On one hand, our results are consistent with previous literature that shows that delirium is more prevalent among boys than girls and is independently associated with mortality rates (21). On the other hand, our results about the diagnosis for hospital admission contrast with the literature that shows that respiratory insufficiency is the primary diagnosis criteria (8).

Two main criteria were used to diagnose the presence of delirium in the sample of the study: first, according to the gold standard diagnosis, a child psychiatrist diagnosed the presence of this disorder by following the DSM-5 criteria; second, if two independent evaluators coincided that the patient presented a delirium episode. Under the first criteria, the prevalence of delirium was 16.1% (5 patients), whereas for the second criteria the prevalence was 25.8%, due to the addition of 3 cases who obtained a positive result in the instrument used by the independent medical professionals.

From the group of delirious children, six were male (75%) and two female (25%), and their primary diagnosis was acute respiratory infection in 5 cases (62.5%) and respiratory failure in 3 (37.5%). The prevalence rates observed in this study are consistent with studies that have reported that, on average, 17.8% of PICU patients present delirium (3, 9, 22-24). Finally, previous studies have shown an association between delirium and mortality of 5.24%. In our study, the mortality rate was zero (8).

## Quantitative measurement

According to the quantitative information collected from the physiological measures, patients who presented a delirium episode showed greater and statistically significant SBP and DBP rates (110 and 69.7 mmHg, respectively), as well as lower levels of respiratory frequency; although the difference with the non-delirious group was not statistically significant (23). It is not possible to contrast our results with previous literature, since we did not find studies examining the association between arterial hypertension and delirium.

Our results regarding the length of the hospital stay replicate previous findings that suggest a strong association between delirium and the number of days patients have to stay at the hospital (9). Particularly, we observed that the stay at the PICU was longer for the group of patients who presented an episode of delirium ( $M = 10$ ) than for

patients who did not ( $M = 7$ ). The same pattern was observed in the general hospital stay (7.5 vs 2.2 days, respectively), which means that this association increases the costs of the PICU (8).

Patients identified as delirious presented significantly higher rates of SBP and DBP than non-delirious patients (range between 110 mmHg systolic and 69.7 mmHg diastolic). On average, this group of children presented 27 breaths per minute, but the difference with the non-delirious group was not statistically significant.

Our results show that delirious patients had benzodiazepines (50%), narcotics (33%) and analgesics (16.6%) as part of their treatment. Consequently, these medications can be considered as predisposing factors of delirium episodes in pediatric populations. Similar results have been found in the existent literature that suggest that children treated with benzodiazepines and narcotics are more likely to develop delirium episodes (8, 25, 26).

Considering that children who receive mechanical invasive ventilation at the PICU also receive psychoactive medications (27), this is one of the most influential factors that can be regulated in order to avoid the occurrence of delirium episodes (28). Nonetheless, in our study, we did not observe direct associations between the use of invasive ventilatory procedures and the presence of delirium episodes, even when the use of the psychotropic medications that accompany these procedures could contribute to the development of acute brain dysfunction.

### Limitations

Due to the limited availability of the independent evaluators, the two independent assessments were conducted within a one-hour period difference. Besides, fluctuations in the progression of the delirium could relate to the administration of sedatives, opioids, and other psychoactive medications that alter assessment results.

### Conclusions

To our knowledge, there were no studies assessing the presence of delirium in pediatric samples in Latin American using the pscam-ICU. Therefore, this study is the point of departure for further research on the monitoring of delirium in Latin America.

Additionally, worldwide, there are only two adaptation studies, one in Puerto Rico and other in Japan.

Delirium was observed to be common among critically ill children and infants and independently associated with mortality. Our results suggest that in the Colombian context there is greater prevalence of this health problem (25.8%) than in North American samples (20%). Implementing adequate assessment tools to detect the presence of delirium constitutes an appropriate approach to the understanding of its clinical characterization, associated risk factors, and possible intervention strategies. Nurses play an integral role in the early detection and reduction of the incidence of delirium at ICU environment. It is important to carry out intervention studies to determine the best practices to limit the exposure to risk factors that influence the presence of delirium in critically ill preschool patients.

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