

# Current status of pediatric neurocritical care in Argentina

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## ABSTRACT

**Introduction.** Patients with neurocritical injuries account for 10-16 % of pediatric intensive care unit (PICU) admissions and frequently require neuromonitoring.

**Objective.** To describe the current status of neuromonitoring in Argentina.

**Methods.** Survey with 37 questions about neuromonitoring without including patients' data. Period: April-June 2017.

**Results.** Thirty-eight responses were received out of 71 requests (14 districts with 11 498 annual discharges). The PICU/hospital bed ratio was 21.9 (range: 4.2-66.7). Seventy-four percent of PICUs were public; 61 %, university-affiliated; and 71 %, level I. The availability of monitoring techniques was similar between public and private (percentages): intracranial pressure (95), electroencephalography (92), transcranial Doppler (53), evoked potentials (50), jugular saturation (47), and bispectral index (11). Trauma was the main reason for monitoring.

**Conclusion.** Except for intracranial pressure and electroencephalography, neuromonitoring resources are scarce and active neurosurgery availability is minimal. A PICU national registry is required.

**Key words:** traumatic brain injury, status epilepticus, intensive care units, pediatrics, intracranial pressure.

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## INTRODUCTION

Acute neurological injuries are a common cause of morbidity and mortality in pediatrics<sup>1</sup> and a frequent reason for hospitalization, which accounts for 10-16 % of pediatric intensive care unit (PICU) admissions in Argentina and 8-10 % in series from other regions,<sup>3,4</sup> with a growing trend. As per the data of the Pediatric Index of Mortality 3 (PIM3) validation study, which included 49 PICUs from Argentina between 5/15/16 and 2/15/17, this group of patients accounted for 13.7 % of admissions, and the most common diagnosis were convulsive *status epilepticus*, trauma and infections (70 % of all admissions), followed by vascular conditions, hydrocephalus and tumors. Even though this group of patients does not represent the most frequent reason for admission (respiratory diseases do), its associated high mortality rate (9.5 % vs. 8.0 %, overall mortality) gives relevance to it.<sup>2</sup>

For these reasons, and given that a planned and careful establishment of a PICU may reduce mortality up to 50 %, <sup>5,6</sup> it is critical to know its specific response capacity in Argentina. Even though the Argentine Society of Pediatrics (Sociedad Argentina de Pediatría, SAP)—through the National Committee of Emergencies and Critical Care—and the Argentine Society of Intensive Care (Sociedad Argentina de Terapia Intensiva, SATI)—through its Pediatric Intensive Care Chapter—developed specific standards<sup>7</sup> that include a section regarding requirements for the care of patients with this condition, no national assessment of such capacity has been carried out to date.

With the aim of describing the current status of pediatric neurocritical care in Argentina, this study was conducted based on an electronic survey.

## METHODS

Given that there is no PICU national registry, nor is there a national official regionalization policy, a search of units was performed based on the following criteria: 1) publications in the last 10 years; 2) participation in the SATI quality program (SATI-Q);<sup>8</sup> and 3) those in charge of

other PICUs were contacted for belonging to one of the two main scientific societies in the country (SAP and SATI).

A survey consisting of 15 general questions about the PICU and 18 specific questions about neurocritical care was developed; questions included neuromonitoring strategies such as intracranial pressure (ICP) monitoring, electroencephalography, transcranial Doppler (TCD), brainstem auditory evoked potentials (BAEPs), jugular bulb oxygen saturation (SjO<sub>2</sub>), bispectral index (BIS), brain tissue oxygen pressure (PbtO<sub>2</sub>), cerebral microdialysis (CMD), and 4 questions regarding neurocritical treatment and monitoring indications (see *Annex* for details). The survey was done with Google Forms® and was emailed to the selected PICU points of contact; each PICU could only answer the form once. This survey was filled in at each PICU and submitted electronically to the principal investigator. None of the questions included data of individual patients. Data were collected between April and June 2017.

A statistical, descriptive analysis was done; categorical data were described as number and proportion (%), and numerical data as mean and standard deviation or median and interquartile range. Categorical outcome measures were compared with the  $\chi^2$  test, and numerical outcome

measures with the Student's t test or the Wilcoxon rank-sum test, as applicable.

Data were downloaded directly from the electronic form collection sheet, saved in .csv format, and analyzed with the free R software, version 3.3.3 (2017-03-06), and the RStudio graphical interface, version 1.0.143.

## RESULTS

Seventy-one key PICUs were identified based on the criteria mentioned above; the points of contact at the units were invited to participate and 38 of them submitted their responses (53.3 %). Data submitted corresponded to 14 autonomous districts (12 provinces and the Autonomous City of Buenos Aires [CABA]); in total, 11 498 annual discharges were reported (mean: 303; range: 50-999). The mean total PICU/pediatric bed ratio was 21.9 (range: 4.2-66.7) (*Table 1*).

Out of the 38 units, 10 were private (26 %) and 28, public (74 %). Public units accounted for 75 % of discharges. There were 23 university PICUs (61 %): such institutional affiliation corresponded to 50 % of private PICUs (n = 5) and 64 % (n = 18) of public ones. Sixty-three percent (n = 23) reported having an active post-basic residency program (20 % of private PICUs and 79 % of public ones), and 71 % (n = 27) classified themselves as level I (80 % of private units and

TABLE 1. Current status of pediatric neurocritical care in Argentina. Participating units by geographical district

Province	Institutions (n)	Hospital beds (n)	PICU beds (n)	Annual discharges* (n)
Buenos Aires	13	1016	159	3333
CABA	12	1215	146	3771
Chubut	1	18	5	120
Córdoba	2	320	23	1020
Corrientes	1	130	15	250
Entre Ríos	1	180	14	300
Formosa	1	12	6	154
Mendoza	1	200	16	500
Neuquén	1	30	7	130
Santa Fe	1	190	12	440
Tucumán	1	220	16	280
Catamarca	1	70	10	170
Salta	1	230	16	480
San Juan	1	52	24	550
Total	38	3883	469	11 498

\* For 2016.

CABA: Autonomous City of Buenos Aires.

68 % of public ones) (Table 2).

Regarding the Department of Neurosurgery, only 21 % (n = 8) referred having a neurosurgeon on 24-hour duty (pediatric or general) (Table 3); all of these institutions were public. The 10 private centers stated having a pediatric neurosurgeon on call.

The distribution of neuromonitoring methods used in the PICUs was similar between public and private units (Figure 1); being ICP and electroencephalography the most widely available, and PbtO<sub>2</sub>, BIS and CMD, the least (all comparisons were not statistically significant). The number of monitored patients in the previous 12 months was higher in the most densely populated regions (Figure 2). The most frequently used monitoring methods reported by the units were ICP (n = 36), electroencephalography (n = 36), TCD (n = 20), SjO<sub>2</sub> (n = 18), and BAEPs (n = 19).

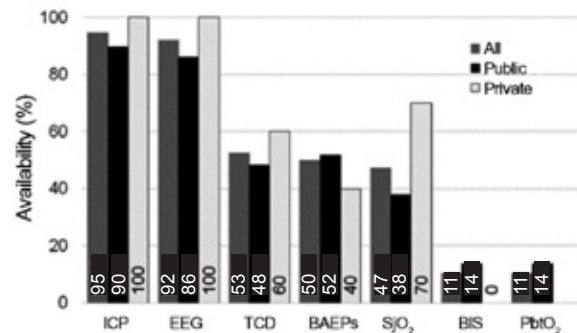
The most common reason for monitoring was clearly head trauma (76 % of PICUs, n = 29), and the rest was distributed among tumors (n = 3), *status epilepticus* (n = 3) and central nervous system (CNS) infections (n = 1). The most commonly monitored trauma injuries were subdural hematoma (n = 10), intraparenchymal

hematoma (n = 8), epidural hematoma (n = 6), and diffuse axonal injury (n = 4).

## DISCUSSION

Neurocritical monitoring is one of the cornerstones to limit the progression of acute neurological injuries and the development

FIGURE 1. Availability of monitoring methods



ICP: intracranial pressure monitoring; EEG: electroencephalography; TCD: transcranial Doppler; BAEPs: brainstem auditory evoked potentials; SjO<sub>2</sub>: jugular bulb oxygen saturation; BIS: bispectral index; PbtO<sub>2</sub>: brain tissue oxygen pressure. Cerebral microdialysis (CMD) was not included in the figure since no center reported its availability.

TABLE 2. Categorization of pediatric intensive care units according to financing

Dependence	PICU category	PICU (n)	PICU (%)	Annual discharges (mean, range)
Private	Level-I PICU	8	80,0	289 (50-800)
	Level-II PICU	2	20,0	260 (120-400)
Public	Level-I PICU	19	67,9	355 (120-999)
	Level-II PICU	9	32,1	214 (60-650)
Total		38		

PICU: pediatric intensive care unit.

TABLE 3. Type of Department of Neurosurgery according to payor

Dependence	Department of Neurosurgery	n (%)
Private	Pediatric neurosurgery with an on-call service	10 (100.0)*
Public	Pediatric neurosurgery with an on-call service	12 (42.9)*
	General neurosurgery with an on-call service	5 (17.9)*
	Pediatric neurosurgery on 24-hour duty	5 (17.9)*
	General neurosurgery on 24-hour duty	4 (14.3)*
	None	2 (7.1)*
Total		38 (100.0)

\* Percentages within each dependence.

of secondary injuries whose etiology can be traumatic, vascular, infectious, tumoral or hypoxic.<sup>9,10</sup> The combination of different modalities of neuromonitoring is part of multimodal monitoring, which is widely used in adult patients, but rarely in pediatrics.<sup>10</sup> In spite of the low level of evidence supporting its use, the neuromonitoring methods included in this

survey are those with a higher consensus among pediatric intensivists.

The rate of response to this survey was 53.3 %, which corresponded to the centers with more beds and discharges of neurocritical patients. Given the lack of a reference framework, it is not possible to infer the representativeness of the analyzed sample. The National Registry of

FIGURE 2. Availability of monitoring methods by unit, city and financing

Province	City	Financing	ICP	EEG	TCD	BAEPs	SjO <sub>2</sub>	PbtO <sub>2</sub>	BIS	Patients monitored in the last year
B. Aires	Azul	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	0
B. Aires	Bahía Blanca	Public	Present	Present	Absent	Present	Absent	Absent	Absent	9
B. Aires	El Palomar	Public	Present	Present	Absent	Absent	Present	Absent	Absent	15
B. Aires	F. Varela	Public	Present	Present	Absent	Present	Absent	Absent	Absent	5
B. Aires	La Plata	Public	Present	Present	Absent	Absent	Absent	Present	Present	20
B. Aires	M. del Plata	Private	Present	Present	Absent	Present	Absent	Absent	Absent	4
B. Aires	Olavarría	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	5
B. Aires	P. Nogués	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	15
B. Aires	Pilar	Private	Present	Present	Absent	Present	Absent	Absent	Absent	3
B. Aires	San Justo	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	6
B. Aires	San Martín	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	1
B. Aires	San Martín	Public	Present	Present	Absent	Present	Absent	Absent	Absent	3
B. Aires	Tandil	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	1
CABA	CABA	Private	Present	Present	Absent	Present	Absent	Absent	Absent	3
CABA	CABA	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	1
CABA	CABA	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	1
CABA	CABA	Public	Present	Present	Absent	Absent	Absent	Present	Present	66
CABA	CABA	Public	Present	Present	Absent	Absent	Present	Present	Present	30
CABA	CABA	Public	Absent	Absent	Absent	Absent	Absent	Absent	Absent	0
CABA	CABA	Public	Present	Present	Absent	Present	Absent	Absent	Absent	4
CABA	CABA	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	50
CABA	CABA	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	3
CABA	CABA	Private	Present	Present	Absent	Present	Absent	Absent	Absent	4
CABA	CABA	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	5
CABA	CABA	Private	Present	Present	Absent	Absent	Absent	Absent	Absent	5
Chubut	P. Madryn	Public	Present	Present	Absent	Present	Absent	Absent	Absent	2
Córdoba	Córdoba	Public	Present	Present	Absent	Absent	Present	Absent	Absent	45
Córdoba	Córdoba	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	15
San Juan	San Juan	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	20
Salta	Salta	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	10
Corrientes	Corrientes	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	15
Entre Ríos	Paraná	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	48
Formosa	Formosa	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	6
Mendoza	Guaymallén	Public	Present	Present	Absent	Present	Absent	Present	Present	30
Neuquén	Neuquén	Public	Present	Present	Absent	Present	Absent	Absent	Absent	10
Santa Fe	Santa Fe	Public	Present	Present	Absent	Absent	Absent	Absent	Absent	20
Tucumán	SM Tucumán	Public	Present	Present	Absent	Present	Absent	Absent	Absent	18
Catamarca	Catamarca	Public	Present	Present	Absent	Present	Absent	Present	Absent	15

Present | Absent

CABA: Autonomous City of Buenos Aires.

ICP: intracranial pressure monitoring; EEG: electroencephalography; TCD: transcranial Doppler; BAEPs: brainstem auditory evoked potentials; SjO<sub>2</sub>: jugular bulb oxygen saturation; BIS: bispectral index; PbtO<sub>2</sub>: brain tissue oxygen pressure.

Health Facilities<sup>11</sup> does not have this piece of data. The only related official approximation is the 2013 statistics of hospital discharges,<sup>12</sup> which reports 24 497 pediatric discharges (from 1 month to 14 years old) due to neurological causes and head trauma, and no distinction is made between critical and general patients. Even though surveys have been questioned as a method to gather reliable information,<sup>13</sup> they sometimes are the quickest and simplest way to have a first approach to a given topic.

The distribution of PICUs with multimodal monitoring is highly concentrated in the metropolitan area and in the most densely populated geographical areas. The discussion on regionalization points out the need to have: 1) a tool to categorize units, 2) an institution that verifies such categorization, and 3) the epidemiological profile of the treated population. The findings of this report disclose a great variability of characteristics: units with 4-34 beds, the prevalence of small units (less than 10 beds) in the private sector and smaller cities, and bigger PICUs (10 beds or more) in the public sector and big urban areas.

For the purpose of unifying the concept of a PICU in Argentina, the National Committee of Emergencies and Critical Care of SAP and the Pediatric Intensive Care Chapter of SATI defined standards for the categorization of pediatric intermediate and intensive care units in health care facilities in 2014,<sup>7</sup> which provided recommendations on four items assessed in this study in relation to neuromonitoring: (1) computed tomography (CT) in the institution available 24 hours per day (required), (2) equipment to measure ICP (required), and (3) TCD (desirable), which were available in 100 %, 95 % and 95 %, respectively. Even though 95 % met the neurosurgery requirement proposed by these guidelines (a neurosurgeon experienced in pediatrics, on call or on duty), only 25 % reported having such professional on duty. The guidelines of the Society of Critical Care Medicine, with its latest update in 2004,<sup>14</sup> offer consistent recommendations in relation to the three proposed items.

## CONCLUSION

Even though the data provided by this type of survey leads to limited conclusions, the results reveal the need for a national PICU registry. More than half of PICUs were university-affiliated, had an active post-basic residency program and

were level I. Resources were similarly distributed between PICUs with private and public financing; most of them were in urban or densely populated areas. Almost every hospital reported having a Department of Neurosurgery, but only 20 % on duty. ■

## Collaborators

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## Survey on knowledge, prescription habits, and management of fever among pediatricians at a children's hospital

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### ABSTRACT

**Introduction.** There are discrepancies in relation to pediatricians' approach to fever. Our objective was to describe the knowledge, prescription habits, and drug and non-drug treatment indications for fever among physicians at a children's hospital in the Autonomous City of Buenos Aires.

**Material and methods.** Observational, descriptive, analytical, cross-sectional study conducted at Hospital de Niños Ricardo Gutiérrez in 2018.

**Results.** A total of 100 surveys were completed: 37 % of pediatricians always indicated physical methods, whereas 54 % did so occasionally; 68 % alternated antipyretic agents, while 72 % considered this practice increased the risk for toxicity; and 32 % stated that early management reduced the risk for seizures.

**Conclusions.** Pediatricians have prescription habits and indicate drug and non-drug treatments for fever that have demonstrated little effectiveness.

**Key words:** fever, antipyretic agents, health care staff, surveys and questionnaires.

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### INTRODUCTION

Although there are several recommendations for the management of fever,<sup>1,2</sup> different studies have described discrepancies in relation to pediatricians' approach.<sup>3-6</sup> Anxiety and uncertainty regarding the potential severity of fever, or fever phobia, lead parents to make repeated consultations or request alternating or combined antipyretic agents.

These conditions may explain the discrepancies described in management. The objective of this study was to describe the knowledge, prescription habits, and drug