

## ORIGINAL ARTICLE

### NURSING STAFF SIZING IN PEDIATRIC INTENSIVE CARE UNITS: WORKLOAD VERSUS LEGISLATION

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#### ABSTRACT

**Objective:** To compare nursing staff sizing in the relevant legislation according to the workload. **Method:** Prospective documentary study conducted in the 2017- 2018 period in six pediatric intensive care units for children in Paraná. The workload was measured with the use of the Nursing Activities Score; the sizing was based on legislation and work schedules. Data were compared, and a bootstrap confidence interval of 95% was used in statistical analysis.

**Results:** Considering 58 beds, 80 medical records and 412 assessments of care and workload, the nursing staff was oversized, if compared to the stipulations of the Normative Resolution No 543/2017 of Brazil's Federal Council of Nursing (COFEN) in two units, and in four units, according to Normative Resolution No 26/2012 of the National Health Surveillance Agency (ANVISA).

**Conclusion:** The findings indicate the need for changes to obtain a proper staff sizing, including workload, and changes in legislation. When only the normative resolutions are considered, oversizing or undersizing may occur.


**DESCRIPTORS:** Workload; Motion-Time Studies; Neonatal Intensive Care Units; Pediatric Intensive Care Units; Nursing Human Resources.


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## **DIMENSIONAMENTO DE PESSOAL DE ENFERMAGEM EM UNIDADES DE TERAPIA INTENSIVA INFANTIL: CARGA DE TRABALHO VERSUS LEGISLAÇÃO**

### **RESUMO**

*Objetivo:* comparar o dimensionamento da equipe de enfermagem com o estabelecido segundo a carga de trabalho e a legislação.

*Método:* estudo documental prospectivo realizado de 2017 a 2018 em seis unidades de terapia intensiva infantil no Paraná. A carga de trabalho foi mensurada pelo Nursing Activities Score; o dimensionamento foi baseado na legislação e escala de trabalho. Os dados foram comparados e a análise estatística utilizou intervalo de confiança bootstrap de 95%.

*Resultados:* considerando-se 58 leitos, 80 prontuários e 412 avaliações de cuidado e carga de trabalho, o dimensionamento mostrou-se elevado em relação ao estipulado pela Resolução 543/2017 do Conselho Federal de Enfermagem em duas unidades, e em quatro pela Resolução 26/2012 da Agência Nacional de Vigilância Sanitária.

*Conclusão:* os achados indicam necessidade de mudanças para adequado dimensionamento, incluindo-se a carga de trabalho, e mudanças na legislação. Ao se considerar unicamente as resoluções, é possível incorrer em super ou subdimensionamento.

**DESCRITORES:** Carga de Trabalho; Estudos de Tempo e Movimento; Unidades de Terapia Intensiva Neonatal; Unidades de Terapia Intensiva Pediátrica; Recursos Humanos de Enfermagem.

## **DIMENSIONAMIENTO DE EQUIPO DE ENFERMERÍA EN UNIDADES DE TERAPIA INTENSIVA INFANTIL: CARGA DE TRABAJO VERSUS LEGISLACIÓN**

### **RESUMEN:**

*Objetivo:* comparar el dimensionamiento entre la carga de trabajo efectiva del equipo de enfermería y lo que establece la legislación.

*Método:* estudio documental prospectivo que se realizó de 2017 a 2018 en seis unidades de terapia intensiva infantil en Paraná. La carga de trabajo se midió por Nursing Activities Score; el dimensionamiento se basó en la legislación y en la escala de trabajo. Se compararon los datos y el análisis estadístico utilizó intervalo de confianza bootstrap de 95%.

*Resultados:* considerándose 58 camas, 80 prontuarios y 412 evaluaciones de cuidado y carga de trabajo, el dimensionamiento se mostró elevado en relación a lo estableció la Resolución 543/2017 del Consejo Federal de Enfermería en dos unidades, y en cuatro por la Resolución 26/2012 de la Agencia Nacional de Vigilancia Sanitaria.

*Conclusión:* se constató la necesidad de cambios para adecuar el dimensionamiento, incluyéndose la carga de trabajo, y cambio en la legislación. Considerándose solamente las resoluciones, es posible incurrir en super o sub dimensionamiento.

**DESCRIPTORES:** Carga de Trabajo; Estudios de Tiempo y Movimiento; Unidades de Terapia Intensiva Neonatal; Unidades de Terapia Intensiva Pediátrica; Recursos Humanos de Enfermería.

## INTRODUCTION

In the context of hospital care, it is worth highlighting the importance of proper sizing of the nursing staff to promote patient safety and reduce the association between health complications and increased costs<sup>(1)</sup>. Staff sizing is the systematic process aimed to forecast the quantity and quality needed to meet the nursing needs of patients<sup>(2)</sup>. Undersizing leads to higher workload and negative impacts for health professionals, in addition to impairing the quality of patient care and contributing to the occurrence of adverse events<sup>(3)</sup>.

An integrative review conducted in Brazil found that increase in workload has a negative impact on the nursing team and increases the risks of occupational accidents, interfering with the health-disease process<sup>(4)</sup>. A study carried out in 75 hospitals in the US with 11,160 adult patients, assessed the association between inadequate sizing of the nursing staff, work environment and survival rate after cardiac arrest, and found that each additional patient per nurse on the medical-surgical units was associated with a 5% lower likelihood of surviving cardiac arrest<sup>(5)</sup>. This result corroborates a previous study that reported that an increase in the workload that resulted in an additional patient per nurse was associated with a 7% higher likelihood of death within 30 days of hospital admission<sup>(6)</sup>.

In the context of child care, a study carried out in Italy in 63 Neonatal Intensive Care Units (NICU) analyzed the relationship between number of tasks, average number of nurses and the workload performed, and found differences in the organizational characteristics between the units and uneven distribution of nurses in relation to the volume of activities<sup>(7)</sup>.

Balance between workload and available health professionals favors patient safety and the quality of life of health workers. Therefore, legal parameters are necessary, especially in care settings for critically ill patients who demand complex care.

In Brazil, the minimum requirements for the operation of Intensive Care Units (ICU) are established by Resolution No. 26/2012 of the National Health Surveillance Agency (ANVISA)<sup>(8)</sup>. Although this resolution sets a minimum nurse-to-patient ratio of one nurse for every ten patients and a minimum nursing technician/patient ratio of one nursing technician for every two patients, it does not consider workload.

On the other hand, the Federal Nursing Council (COFEN), through Resolution COFEN N° 543/2017<sup>(9)</sup>, established a period of time for care and a percentage distribution among nurses, technicians and nursing assistants for each patient in the period of 24 hours, according to the necessary care (minimum, intermediate, semi-intensive, high dependency or intensive care). The nurse-to-patients ratio in intensive care recommended is 1-1.33, and the distribution must be compatible with the workload, plus 15% relative to the Technical Safety Index (IST), to cover absences due to benefits and absenteeism<sup>(9)</sup>.

Proper sizing is essential in neonatal and pediatric intensive care, and should consider the workload, recognized as the best indicator available to measure the number of professionals. According to researchers, a properly sized team performs high quality work, generates patient safety and improves professional satisfaction<sup>(10)</sup>. Thus, by contributing to the equalization of available professionals and to safety, an appropriate dimensioning reduces the costs derived from complications and rationalizes health expenses, adapting human resources to the real needs of care<sup>(10)</sup>.

Some instruments were developed and validated to measure nursing workload, such as the Nursing Activities Score (NAS), which measures workload in different work environments and between different shifts, contributing to the analysis of the need for personnel<sup>(11)</sup>. The NAS has seven categories and 23 items; the result, presented in a score, represents the percentage of time spent in a 24-hour period by the nursing team in direct patient care, and ranges from 0% to 100%, or more. In this calculation, scores above 100% indicate the need for more than one professional to provide patient care<sup>(12)</sup>.

An integrative review carried out in Brazil found that although clinical nurses,

supervisors and hospital coordinators are familiar with staff sizing methods, they do not always use them correctly. The review highlights the need for systematic use of a staff sizing that is suitable to the particularities of each institution<sup>(13)</sup>. One of the studies listed in this review that applied the NAS in an ICU reported a deficit of 41% of professionals, especially nurses, as well as a high workload of the nursing team<sup>(13)</sup>.

Another study carried out in Brazil showed a significant gap of health professionals in relation to the high demand for activities, whose workload reached 568.6 points, with a deficit of 16.1 workers<sup>(14)</sup>. Regarding pediatric ICUs, a study that used the NAS showed that this methodology allows to measure the work demand and calculate the most reliable size, proving to be adequate in neonatology<sup>(14)</sup>.

Therefore, studies on the sizing of the nursing staff in a pediatric ICU and its implications, can support managers in assertive decision-making and guide improvement actions in the teams to ensure workers' health and patient safety. Thus, the following question is posed in the present study: what is the size required for the nursing staff, according to the workload measured by the NAS, in the light of COFEN Resolutions No. 543/2017 and ANVISA No. 26/2012? And the study aims to compare the sizing of the nursing staff of pediatric intensive care units (PICU) in the relevant regulations and according to the workload.

## METHOD

Prospective documentary study conducted in six pediatric intensive care units of five institutions of the Hospitals Network under the Health Department of the State of Paraná, hereby called A, B, C, D and E. The researchers collected the data on the last seven days of the month, between April 2017 and January 2018. Data from ICUs A and B, C and D was collected in April, May and June 2017, respectively, and data from ICU E was collected in January 2018. The NAS instrument was used to estimate the nursing workload based on a multicenter study in 15 countries<sup>(15)</sup>, which was later translated and validated in Brazil<sup>(12)</sup>. After analyzing the instruments, the researchers applied them to ten medical records in order to identify difficulties in the use and standardization of data collection. Such data were not part of the study.

The instrument was applied to all medical records of patients present in the week of data collection in the ICUs, as follows: three NICUs, one pediatric intensive care unit (PICU) and one pediatric and neonatal intensive care unit (PICU/NICU). Patients admitted to hospital for less than 24 hours were excluded.

For the collection of data related to workload, the patients' medical records were evaluated, daily, from 2 pm on. Information not recorder in the medical records and related to routine care, such as support for family members, administrative and managerial activities, was obtained by direct contact with the unit's nursing professionals, who agreed to participate in the study. The sizing of the local nursing team was obtained by consulting the work schedule of the month of data collection; the number of beds was recorded and used in the calculation of the Nursing Staff Sizing.

The workload was represented by the number of hours of work required. For the calculation, each point of the NAS was considered to be equivalent to 14min40sec<sup>(12)</sup>; the daily score was obtained by applying Formula 1:

$$\mu\text{NAS} \times 14,40 = \text{HOURS OF CARE}/24\text{HS}/\text{ICU}$$

where  $\mu\text{NAS}$ = average NAS score.

For the calculation of the Nursing Staff Sizing (DPE) according to the NAS, Formula 2, proposed by Brazilian researchers<sup>(16)</sup>, was used:

$$\text{PE} = (\text{E. } (\mu\text{NAS}/100)) + 15\%$$

where: PE = number of nursing professionals required; E = number of nursing teams; and  $\mu$ NAS = mean of NAS points. The 15% relative to the Technical Safety Index (IST) was added to the result obtained. The average workload for each study unit was obtained by adding the points assigned to each patient and divided by the number of beds

To compare staff sizing guided by the application of the NAS with the regulations of the relevant legislation, the following resolutions were examined: ANVISA's Resolution No. 26/2012<sup>(8)</sup>, which sets a minimum ratio of one nurse for every ten beds and fraction and one nursing technician for every two beds and COFEN Resolution No 543/2017<sup>(9)</sup>, which considers a ratio of one nursing professional for 1.33 patients; 18 hours of intensive nursing care in 24 hours; distribution of 52% of nurses and 48% of nursing technicians, increased by 15% related to the Technical Safety Index (IST).

The results were arranged and stored in an Excel database, with double data entry, checking for inconsistencies and corrections. A bootstrap confidence interval of 95% was used in statistical analysis for the average variability of the workload of each ICU.

The results obtained were compared with relevant regulations (Resolutions ANVISA No 26/2012<sup>(8)</sup> and COFEN No 543/2017<sup>(9)</sup>) and with the staff sizing recorded in the work schedule of each ICU during the month of data collection.

The study is part of the research project titled "Study of workload, professional qualification in nursing and occurrence of health incidents", approved by the Ethics Committees of the involved institutions under Protocol CEP / SD / UFPR No. 1,790,695 and Protocol CEP / HT / SESA No. 1,837,653. Data collection started after the signing of the Free and Informed Consent Form (TCLE) by the nursing professionals who participated in the study. The patients/guardians were not required to sign the TCLE, as they were not observed or handled. Only the medical records and the nursing team were consulted.

## RESULTS

The sample consisted of 80 medical records of neonatal /pediatric patients, in 58 beds, which generated 412 NAS applications in the last seven days of each month of collection. The average workload ranged from 55.73% to 93.09%; it was higher in the PICU of Hospital A and lower in the NICU of Hospital C (Figure 1).

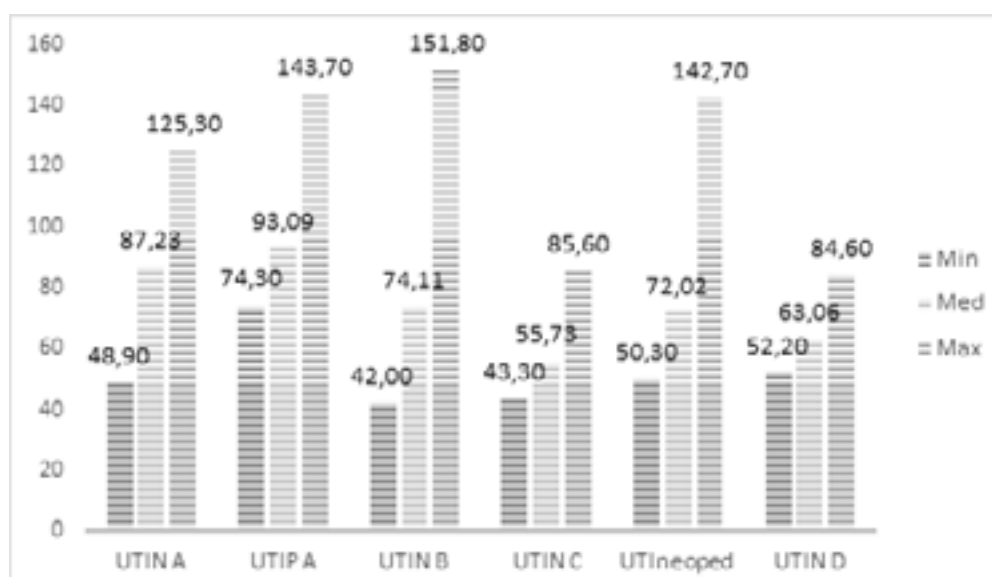


Figure 1 – Average Nursing Activities Score per pediatric intensive care unit and hospital. Curitiba, PR, Brazil, 2018



The number of hours of care required, based on the average points of NAS and transformed into time units, are shown in Table 1, together with the number of hours set by the legislation<sup>(8,9)</sup>.

Table 1 - Number of hours or care required according to the Nursing Activities Score, per intensive care unit and hospital. Resolutions COFEN No 543/2017 and ANVISA No 26/2012. Curitiba, PR, Brazil, 2018

Hospital	HOURS REQUIRED					
	NAS	NAS Standard deviation	COFEN 543/2017	Significance COFEN	ANVISA 26/2012	Significance ANVISA
Hospital A NICU	20.96 hours	3,75	18 hours	<0.01*	14.4 hours	<0.01*
Hospital A PICU	22.53 hours	2,87	18 hours	<0.01*	14.4 hours	<0.01*
Hospital B NICU	18.24 hours	5,42	18 hours	0.36	14.4 hours	<0.01*
Hospital C NICU	13.38 hours	2,16	18 hours	0.96	14.4 hours	<0.01*
Hospital D (PICU/NICU)	17.17 hours	3,82	18 hours	1.00	14.4 hours	0.99
Hospital E NICU	15.13 hours	2.02	18 hours	1.00	14.4 hours	0.04

\* Values less than 0.01 considered significant.

The Nursing Staff Sizing (DPE) according to the NAS (which makes no distinction between professional occupations), the relevant legislation and work schedule are presented in Table 2.

Table 2 - Nursing Staff Sizing according to the Nursing Activities Score, legislation and work schedule of pediatric intensive care units. Curitiba, PR, Brazil, 2018

Hospital/ICU/No of beds	NAS	COFEN 543/2017	ANVISA 26/2012	Work Schedule
Hospital A/ NICU /20	76	70	48	69
Hospital A/ NICU /10	36	35	24	36
Hospital B/ NICU /10	32	35	24	36
Hospital C/ NICU /10	21	35	24	26
Hospital D/PICU/ NICU/10	34	35	24	40
Hospital E/ NICU /07	10	24	20	23

## DISCUSSION

The average workloads of the nursing staff of the units investigated ranged from 55.73 to 93.09% and were mostly higher than recommended when compared to studies that used the NAS, whose indexes were 59%<sup>(17)</sup>, 63.2%<sup>(14)</sup>, 56%<sup>(18)</sup> and 91.1%<sup>(19)</sup>.

The variation of nursing workload across the units and hospitals is corroborated by another study conducted in 19 ICUs in seven countries, which considered the daily average of the NAS and obtained the following results: 44.5% (Spain); 51% (Netherlands); 54% (Brazil); 57% (Egypt); 64.6% (Greece); 83% (Poland) and 101.8% (Norway). The authors concluded that the differences in workload can be attributed to the type of ICU and the characteristics of the patients<sup>(20)</sup>.

The variation in nursing workload is part of health care, given the severity, necessary procedures and therapeutic plan, in addition to the occupancy rate. In this regard, a study carried out in the US that evaluated the workload in NICUs concluded that 62% of patients demanded low nursing workloads<sup>(21)</sup>.

This study found that the NICU of hospital C had the lowest average workload (55.73%) compared to the others. However, during the data collection period, the occupancy rate in this unit was low, with a consequent lower frequency of NAS assessment, unlike the other units. Therefore, it should be stressed that when staff sizing considers only the number of beds, there will possibly be an imbalance between workload and available professionals.

Similar NAS results can occur in different ICUs because the instrument is applied regardless of the severity of the disease, diagnosis and type of ICU, which allows its standardized use in all units<sup>(15)</sup>. Therefore, the NAS is a valuable instrument to establish a balance between workload and available professionals, being more precise than the provisions of the Brazilian legislation regarding Nursing Staff Sizing.

The results showed that the PICU of the present study, when compared to the other ICUS, had the highest average score for workload (93.09%). This may have occurred because some children were hospitalized for a long period due to chronic and autoimmune diseases, which require longer care and are more likely to cause complications. It should be emphasized that prolonged hospitalization is considered one of the factors that lead to higher nursing workload<sup>(22)</sup>, and insufficient patient-to-nurse ratio<sup>(23)</sup>.

Regarding the number of hours of nursing care, it was found that more hours of care were spent in the following ICUs: PICU of hospital A (22.53 hours) and in the NICUs of hospitals A (20.96 hours) and B (18.24 hours), compared to what is set by COFEN Resolutions N° 543/2017<sup>(9)</sup> (18 hours) and ANVISA N° 26/2012<sup>(8)</sup> (14.4 hours). This suggests that the patients in these units require a greater demand for care in relation to what is established in the legislation.

On the other hand, in hospitals C, D and E, the number of hours required was lower than the number of hours set in COFEN Resolution N° 543/2017<sup>(9)</sup>, which may indicate that children hospitalized in the referred ICUs are classified as demanding semi-intensive care and, possibly, do not demand the same amount of care given to critical patients. A similar result was found in a study carried out in nine NICUs in Italy, where 39% of the children were considered to be in semi-intensive care<sup>(24)</sup>.

In the present study, after conversion of the daily average number of NAS to points, it was possible to measure the number of nursing professionals needed. At this stage, it was found that the NICU of hospital A was the only one with a higher workload for the number of professionals allocated, indicating that seven more professionals would be needed. However, in the PICU of hospital A and in the units of hospitals B, C, D and E, the number of available professionals was higher in relation to the workload. Thus, when only what the stipulations of the legislation are considered, there is shortage of personnel, which may imply risks to patient safety and the health of nursing workers, resulting in a Nursing Staff

Sizing inconsistent with the work performed. In the ICUs examined, there was sometimes undersizing, sometimes oversizing of personnel when the number of nursing professionals was compared the calculated result, considering the workload and the relevant legislation.

The peculiarities of each NICU must be considered in the present study. In hospital B, for patients on contact precautions, the nurse/patient ratio is one to one, with overtime pay whenever necessary. During the collection period in this unit, there were four patients on contact precaution, which may justify the increase in the number of professionals compared to the sizing of the NAS. In the NICU of hospital C, a low occupancy rate was observed during the data collection period. However, when a 100% occupancy rate is projected, which is not uncommon in ICUs, a shortage of professionals is expected, because the difference between the number of professionals obtained by the NAS and the existing team was only one nursing professional. The PICU/NICU of hospital D had 6 nursing professionals more than the number of professionals obtained in the sizing of the NAS. During the data collection period, the nursing team went through an adjustment process, with new hires, which may justify the greater number of professionals available. The greatest difference between the sizing obtained with the application of the NAS and the local work schedule was observed in the NICU of hospital E. This unit had a low occupancy during the period of data collection, with four patients in a unit that can assist seven patients and, according to the team's report, it has already housed 13 patients and an excess of patients is not unusual there.

The Nursing Staff Sizing established by ANVISA's Resolution No. 26/2012<sup>(8)</sup>, resulted in a lower number of nursing professionals compared to the NAS, in hospitals A, B and D. According to the literature<sup>(25)</sup>, this Resolution directly violates the Nursing Practice Act, since it does not include care to critically ill patients at risk of death as an activity exclusively performed by nurses. This Resolution set a fixed number of nurses, which is lower than what is required to provide safe and high quality care in accordance with what is established by law, without assessing the care and the need of critical patients. Moreover, according to the authors the referred legislation set a nurse-to-patient ratio lower than that of nursing technicians<sup>(25)</sup>.

The units investigated are guided by ANVISA's Resolution No. 26/2012<sup>(8)</sup>, which provides for the minimum requirements for the operation of the ICU, and adopts a Nursing Staff Sizing where the ratio is one nurse and two nursing technicians for every 10 beds. However, this legislation is restrictive, as it does not consider the workload, recognized as the best indicator in neonatal and pediatric intensive care<sup>(10)</sup>.

The discrepancies between the Resolutions<sup>(8,9)</sup> can also interfere with the implementation of strategies and policies that contribute to the quantitative and qualitative adequacy of nursing professionals in the ICUs in Brazil.. This condition can generate conflicts between administrators of health institutions and nursing coordinators, making it difficult to promote actions targeted to the continuous improvements in the care process and in working conditions<sup>(26)</sup>.

Thus, we stress the importance of the sizing of the available nursing professionals for pediatric ICUs based on the care demands of each service, and not only as it is proposed in the current Brazilian legislation.

One limitation of this study is that it does not classify patients in critical or semi-critical care, which may have influenced the workload obtained. Its important contribution concerns the discrepancy identified between the sizing required by different methodologies and the recommendations of ANVISA's Resolution No. 26/2012, and these recommendations are the most widely used in ICUs. This fact, therefore, points to the need to for this legislation to be revised, as it can compromise the quality of nursing care and patient safety.

The present study aims to assist managers in assertive decision-making, in order to guide the appropriate staff sizing based on the systematic assessment of nursing care demands and institutional policies, and according to each work process, not limited to legislation.



## CONCLUSION

The Nursing Staff Sizing in pediatric ICUs of hospitals belonging to the Hospital Network subordinated to the Health Department of the State of Paraná does not meet the requirements of an adequate sizing, as it does not measure the workload and does not consider the fact that each ICU has its own peculiarities. These findings establish the need for changes to improve workload and sizing in pediatric ICUS.

It is suggested that the Nursing Practice Act be revised with regard to nursing staff sizing, since nurses are supposed to make this sizing, but the law does not establish legal parameters for its equalization. Transforming COFEN Resolution No 543/2017 into an article on Nursing Staff Sizing of the Nursing Practice Act is also recommended, as this law considers patient severity in the calculation of nursing staff sizing.

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