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VASOATIVAS E SEDATIVOS/ANALGÉSICOS EM TERAPIA INTENSIVA PEDIÁTRICA\*

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## USE OF SAFETY BARRIERS IN THE PREPARATION OF VASOACTIVE DRUGS AND SEDATIVES/ANALGESICS IN PEDIATRIC INTENSIVE CARE\*

Carla Susana Martinez Julca<sup>1</sup>, Patrícia Kuerten Rocha<sup>2</sup>, Andreia Tomazoni<sup>3</sup>, Bruna Figueiredo Manzo<sup>4</sup>, Sabrina de Souza<sup>5</sup>, Jane Cristina Anders<sup>6</sup>

**ABSTRACT:** Objective: to analyze the use of safety barriers in the preparation of vasoactive drugs and sedatives/analgesics. Method: quantitative study, with 204 observations during the preparation of medications in a Pediatric Intensive Care Unit in the Pediatric Hospital of the State of Santa Catarina, between March 2016 and May 2017. The barriers analyzed were: type of prescription; transcription of the medication, identification of the patient and data on the label; label attachment; double checking; preparation of continuous infusions; and interruptions. The data were analyzed using descriptive statistics. Results: the safety barriers were related to written prescription (93.6%); transcription of the medication on the label (87.7%); patient identification on the label only by the first name (96%); data relating to the medication on the label failing to include the transcription of the route of administration (99.4%); double checking (34.6%); and interruptions during the preparation (52.9%). Conclusion: this study alerts the area to the need to implement barriers so as to promote safe clinical practice.

**DESCRIPTORS:** Patient safety; Medication errors; Intravenous administration; Medication systems, hospital; Pediatric nursing.

### UTILIZAÇÃO DE BARREIRAS DE SEGURANÇA NO PREPARO DE DROGAS VASOATIVAS E SEDATIVOS/ANALGÉSICOS EM TERAPIA INTENSIVA PEDIÁTRICA

**RESUMO:** Objetivo: analisar a utilização de barreiras de segurança no preparo de drogas vasoativas e sedativos/analgésicos. Método: estudo quantitativo, com 204 observações durante o preparo de medicamentos em uma Unidade de Terapia Intensiva Pediátrica no Hospital Pediátrico do Estado de Santa Catarina, de março de 2016 a maio de 2017. As barreiras analisadas foram: tipo de prescrição; transcrição da medicação, identificação do paciente e dados no rótulo; local de fixação; dupla checagem; preparo de infusões contínuas; interrupções. Os dados foram analisados por estatística descritiva. Resultados: as barreiras de segurança foram relacionadas à prescrição escrita (93,6%); transcrição da medicação em rótulo (87,7%); identificação do primeiro nome do paciente no rótulo (96%); dados da medicação no rótulo sem a transcrição da via de administração (99,4%); dupla checagem (34,6%); interrupções durante o preparo (52,9%). Conclusão: este estudo alerta a área sobre a necessidade da implementação de barreiras no intuito de uma prática clínica segura.

**DESCRIPTORES:** Segurança do paciente; Erros de medicação; Administração intravenosa; Sistemas de medicação no hospital; Enfermagem pediátrica.

### UTILIZACIÓN DE BARRERAS DE SEGURIDAD EN LA PREPARACIÓN DE DROGAS VASOACTIVAS Y SEDANTES/ANALGÉSICOS EN TERAPIA INTENSIVA PEDIÁTRICA

**RESUMEN:** Objetivo: analizar el uso de barreras de seguridad en la preparación de drogas vasoactivas y sedantes/analgésicos. Método: estudio cuantitativo, con 204 observaciones durante la preparación de medicamentos en una Unidad de Terapia Intensiva Pediátrica en el Hospital Pediátrico del Estado de Santa Catarina, de marzo de 2016 a mayo de 2017. Las barreras analizadas fueron: tipo de prescripción; transcripción de la medicación, identificación del paciente y datos en el rótulo; local de fijación; doble verificación; preparación de infusiones continuas; interrupciones. Se hizo el análisis de los datos por medio de estadística descriptiva. Resultados: se asociaron las barreras de seguridad a la prescripción escrita (93,6%); transcripción de la medicación en rótulo (87,7%); identificación del primer nombre del paciente en el rótulo (96%); datos de la medicación en el rótulo sin la transcripción de la vía de administración (99,4%); doble verificación (34,6%); interrupciones durante la preparación (52,9%). Conclusión: este estudio hace un alerta sobre la necesidad de la implementación de barreras con el objetivo de llegar a una práctica clínica segura.

**DESCRIPTORES:** Seguridad del paciente; Errores de medicación; Administración intravenosa; Sistemas de medicación en el hospital; Enfermería pediátrica.

\*Article derived from the Master's dissertation "Safety barriers in the preparation and administration of potentially dangerous medications in a pediatric intensive care unit". Universidade Federal de Santa Catarina, 2016.

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## ● INTRODUCTION

The Pediatric Intensive Care Units (PICU) are characterized as places where the care is more complex, allowing the undertaking of therapies which include the use of vasoactive drugs and sedatives/analgesics<sup>(1)</sup>. The vasoactive drugs' main function is to improve tissue perfusion and provide oxygen to the vital organs<sup>(2)</sup>, while the sedatives are used to reduce discomfort and anxiety during the procedures undertaken and to reduce patient-ventilator asynchrony during the use of mechanical ventilation<sup>(3)</sup>. The role of the analgesics is to reduce and prevent the patient's pain, resulting from the critical clinical state<sup>(4)</sup>.

These drugs are considered to be potentially dangerous and require the use of safety barriers, due to the risk of producing irreversible harm to the patient when used inadequately<sup>(5)</sup>, particularly in pediatric care, as the child may present a probability of suffering harm that is three times greater when compared to the adult patient<sup>(6-7)</sup>.

In this scenario, in order to reduce errors, safety barriers may be used during the preparation of vasoactive drugs and sedatives. The nursing team, responsible for preparing these drugs, must implement safety barriers in order to reduce the probability of committing errors, thus providing care that is safe and of good quality. The safety barriers are defined as a set of measures or filters that may be used by the health team in order to minimize risks inherent to care provision, thus preventing errors from affecting and harming the patient<sup>(8-10)</sup>.

As examples of safety barriers in the preparation of medications, one can cite the double checking of medications, the nine rights of medicine administration, protocols and the management of potentially dangerous medications and handwashing protocols, among others. These measures reduce the chance of committing errors and promote safer care to the patient during the use of medications<sup>(11)</sup>.

As a result, numerous safety strategies and barriers may be applied in the health services in order to reduce the errors made during the process of preparing medications. Nevertheless, one can observe that simple barriers of great proven efficacy, such as the correct identification of the patient during preparation of medications, are not totally implanted in the institutions<sup>(12)</sup>.

In specific, in order to prevent errors during the preparation of potentially dangerous medications in pediatric care, The Joint Commission established recommendations, emphasizing the standardization of dosages and the provision of scientific information about the correct use of these drugs<sup>(13)</sup>. In addition to this, the implementation of safety protocols in the health services regarding the management of these drugs is also one of the strategies mentioned by the World Health Organization (WHO)<sup>(14)</sup>.

In this context, one strategy adopted by the Australian Ministry of Health consists of a specific professional for the role of calculating the dosages of medications in the health services, so as to detect possible errors in the process of preparation and administration of potentially dangerous drugs<sup>(15-16)</sup>.

Considering that the preparation of potentially dangerous drugs during the hospitalization of the pediatric patient is part of the therapeutic routine, the implementation of safety barriers could be an advantageous strategy in this process, ensuring patient safety.

In this regard, due to the scarcity of literature on this topic, it is appropriate to explore the safety barriers that are used by nursing professionals during care provision in the health services<sup>(17)</sup>. The present study, therefore, aims to analyze the safety barriers in the preparation of vasoactive drugs and of sedatives/analgesics in a Pediatric Intensive Care Unit.

## ● METHOD

Quantitative, descriptive and exploratory research, undertaken in a PICU of a Pediatric Hospital in the State of Santa Catarina, March 2016 – May 2017.

In order to define the study population and calculate the sample size, an investigation was undertaken into the records for vasoactive drugs and sedatives/analgesics prepared and administered in the PICU

over a period of six months. Consequently, a record was obtained of 66 vasoactive drugs and 240 sedatives/analgesics. The calculation of the sample size was undertaken for both the vasoactive drugs and for the sedatives/analgesics, using the statistical program SEStaNet® (UFSC), with a confidence level of 95%, resulting in a sample of 56 vasoactive drugs and 148 sedatives/analgesics.

Data collection took place in four stages. The first was the development of the data collection instrument, based in the recommendations of the American Society of Health Pharmacists<sup>(18)</sup>, Brazil's National Health Surveillance Agency (Agência Nacional de Vigilância Sanitária)<sup>(14)</sup> and the Institute for Safe Medication Practices<sup>(19)</sup> regarding safety barriers during the process of preparation and administration of medications. The instrument was divided into three blocks, the first relating to the participant's professional characteristics, the second to the safety barriers in the preparation of medications, and the third to the safety barriers in the administration of the medications.

In this study, the following safety barriers were analyzed: type of drug prescription; transcription of the medication on the label; identification of the patient on the label; data on the label (medication, route, time, dose and infusion speed); place where the label is attached; double checking; preparation of continuous infusions; and interruptions.

In the second stage of data collection, a pretest was undertaken of the data collection instrument by two nurses who are specialists in Pediatric Intensive Care and in the issue of patient safety, so as to improve the instrument.

In the third stage, meetings were held with management and the nursing team of the PICU in question, presenting the research proposal and the invitation to the team to participate. Lastly, in the fourth stage, random observations were undertaken in the ICU, in the morning and afternoon shifts.

The inclusion criteria were: professionals with over three months experience in preparing potentially dangerous medications; and, as an exclusion criteria, preparation of potentially dangerous medications in emergency situations.

In order for the study to be undertaken, the nursing team of the PICU was invited to participate; of the 24 technicians invited, 17 accepted to participate in the study, voluntarily signing the terms of free and informed consent. The nurses invited stated that the preparation of medications is a task usually entrusted to the nurse technicians, while the nurses generally supervise these actions. As a result, the nurses invited did not participate in the study.

The preparation of the following medications was observed: fentanyl, midazolam, ketamine, dexmedetomidine, vecuronium bromide, epinephrine, atropine, dobutamine, dopamine, norepinephrine, vasopressin, milrinone and amiodarone.

The data obtained were tabulated in the Microsoft Excel® 2016 program and were analyzed through descriptive statistics. The study complied with the ethical precepts of research and was approved by the Ethics Committee of the institution investigated, involving research with human beings, under number 1641960.

## ● RESULTS

A total of 17 nurse technicians participated in the study, of whom 13 (76%) were female. The participants' minimum age was 25 years old, and the maximum age was 50 years old. Of these, seven (41%) had worked in the PICU for between five and 10 years; six (35.2%) had worked there for less than five years, and four (23.52%) for over 10 years. Regarding the time since the professionals qualified, the mean was 10 years.

Regarding workload, the mean was 34 hours per week. In relation to further qualifications, three (17%) professionals had completed higher education with a specialization, four (23%) had completed higher education, two (12%) had not completed higher education and eight (47%) had no education beyond technician in nursing. It is highlighted that none of these professionals had received training to prepare vasoactive drugs and sedatives/analgesics in the past year.

During the study, 204 observations were made during the preparation of potentially dangerous

medications, of which 56 (27.5%) were vasoactive drugs and 148 (72.5%) were sedatives/analgesics, as shown in Table 1.

Table 1 – Distribution of the frequencies of vasoactive medications and sedatives/analgesics used in a Pediatric Intensive Care Unit. Florianópolis, SC, Brazil, 2016

Vasoactive medications	n (%)	Sedatives/analgesics	n (%)
Epinephrine	27 (48.2)	Midazolam	56 (37.8)
Norepinephrine	9 (16.7)	Fentanyl	50 (33.7)
Milrinone	8 (14.2)	Ketamine	24 (16.2)
Dopamine	5 (8.9)	Dexmedetomidine	10 (6.7)
Dobutamine	4 (7.1)	Fentanyl+ Midazolam	8 (5.4)

In relation to the safety barriers in the preparation of vasoactive drugs and sedatives/analgesics, the results demonstrated that 13 (6.4%) prescriptions were undertaken verbally. Specifically, 1.8% of vasoactive drugs were prescribed verbally, and 55 (98.2%) were prescribed in writing. In the case of the sedatives/analgesics, 12 (8.1%) were prescribed verbally and 136 (91.9%) were prescribed in writing.

When the transcription of the medication on the label was analyzed, it was ascertained that the PICU had established a printed label to be filled out with the data for the patient and the medication, which was to be used in all transcriptions. As a result, the transcription of the medication was undertaken in 179 (87.7%) medications, of which 52 (92.8%) were related to vasoactive drugs, and 127 (85.8%) to sedatives/analgesics.

Furthermore, the identification of the patient on the label of the medication was ascertained with the child's complete name in six (3.4%) labels, with the child's first name in 172 (96%), and the complete name and nickname in one (0.6%).

In relation to the identification of the drugs, of the 204 drugs prepared, 25 (12.2%) were not identified, resulting in 179 (87.7%) preparations of medications identified through the label. Thus, during the analysis of the data on the label in relation to the identification of the medication, route, time, dose and infusion speed, it was ascertained that 178 (99.4%) did not write out the route of administration (Table 2). Furthermore, the label identifying the medications was attached in 32 (17.3%) of these, with the predominant place of fixation being on the syringe – 24 (74%) and eight (25.8%) on the burette.

Table 2 – Identification of medications without labels during preparation of vasoactive drugs and of sedatives/analgesics in a Pediatric Intensive Care Unit. Florianópolis, SC, Brazil, 2016

Data on the label	Yes (%)	No (%)
Name of the drug	179 (100)	0 (0)
Time	178 (99.4)	1 (0.6)
Route	1 (0.6)	178 (100)
Dose	179 (100)	0 (0)
Infusion speed	178 (99.4)	1(0.6)

Double checking was undertaken during preparation of the drugs on 68 (34.6%) of occasions. Furthermore, the medications were prepared with double or triple doses on 80 (39.4%) of occasions, with the aim of increasing the duration of the infusion when it was a continuous infusion.

It was ascertained that during preparation of medications, the professionals were interrupted on

108 (52.9%) occasions, of which 64 (59.2%) were for reasons associated with care (assessment of the patient, the alarm on the infusion pump, cardiorespiratory arrest, additional tests), and 22 (20.4%) for personal reasons (checking cell phone, parallel conversations). Regarding the number of interruptions, 48 (44.4%) observations were interrupted once, with nurse technicians being the professionals who interrupted the most during the preparation of drugs, in 46 (42.5%) observations. Specifically, interruptions during the preparation of vasoactive drugs took place in 32 (57.1%) observations and of sedatives/analgesics in 76 (51.3%) (Table 3).

Table 3 – Interruptions during the preparation of vasoactive drugs and sedatives/analgesics in a Pediatric Intensive Care Unit. Florianópolis, SC, Brazil, 2016

Interruptions		Vasoactive drugs n (%)	Sedatives/Analgesics n (%)
Number of times	Once	17 (53)	31 (40.7)
	Twice	7 (21.8)	28 (36.8)
	Three times	5 (15.6)	11(14.4)
	More than three times	3 (9.3)	6 (7.8)
Reason for interruptions	Personal matters	5 (15.6)	17(22.3)
	Telephone calls	7 (21.8)	5 (6.5)
	Alarms sounding on infusion pumps	4 (12.5)	6 (7.8)
	Professional reasons	16 (50)	48(63.1)
Professional	Nurse technician	12 (37.5)	34 (44.7)
	Nurse	3 (9.3)	18 (23.6)
	Physician	7 (21.8)	7 (9.2)
	Pharmacist	1 (3.1)	0 (0)
	Others *	5 (15.6)	8 (10.5)

\*Others: physiotherapist, cleaning team, dentists.

## ● DISCUSSION

Preparation of medications can be a complex and risky process, as the results of this study demonstrated that although some safety barriers were being used by the nursing professionals, they had not been institutionalized, which implies weaknesses in the optimization and efficacy of the same<sup>(20)</sup>.

As a result, the empowerment and training of the team regarding the management of potentially dangerous medications is fundamental, in order to strengthen the provision of quality and safe care<sup>(21)</sup>. It is emphasized that in the last year, the nursing professionals had not been trained with regard to safety barriers in the managing of these medications.

In one quantitative study undertaken in Jordan, 255 nurses were interviewed in order to analyze the individual factors that influence medication errors. It was ascertained that these factors were mainly lack of training of the nurses with regard to the correct handling of the medications<sup>(22)</sup>.

Regarding the medical prescription, it was ascertained that the majority were undertaken in writing; nevertheless, there were situations where prescribing was undertaken verbally, which can increase the probability of errors. One integrative literature review undertaken between November 2015 and February 2017 investigated the strategies, safety incidents, and stages of the medication process in pediatric care. It demonstrated that the medical prescription is the stage which presents the most adverse events during the process of drugs preparation, as the pediatric patients require dosage calculation based on their exact weight. As a result, they suggest – as a strategy – the implementation

of electronic medical prescriptions, with a system for alerts, and protocols for the management of dosages<sup>(23)</sup>.

Regarding the double checking of medications, it was verified in the results that this strategy is not standardized in the unit studied, and that it is undertaken by a minority of the professionals. Double checking consists of two professionals conferring simultaneously and independently in order to identify possible errors during the preparation. This practice is recommended for all services and particularly in the use of potentially dangerous medications, as it significantly reduces errors in this process<sup>(10)</sup>.

The transcription of the prescription of the medication on the label is a barrier to be carried out by the nursing team. The aim is to prepare the medication following indications of the medical prescription<sup>(24)</sup>. It was ascertained in the study that the use of this barrier was undertaken in most observations. Nevertheless, it is necessary to standardize this practice in the PICU service.

One study undertaken in a PICU in Iran, between 2013 and 2014, with the aim of determining the incidence of errors, analyzed 512 doses of medications. It estimated that transcription errors had a 4.88 chance of occurring in each 100 prescriptions. The errors occurred due to the information transcribed erroneously, and were related to omission, wrong time, wrong presentation of the medication and the wrong dose<sup>(25)</sup>.

A study undertaken in Uruguay, in pediatric inpatient units, that aimed to identify the prevalence of prescribing errors and errors undertaken in the transcription of the medications, analyzed 276 prescriptions and 448 transcriptions undertaken by the nursing team. It showed a prevalence of errors of 66 for each 100 transcriptions. The main errors were related to the infusion dose – 52 (11.7%), incorrect dose – 33 (7.5%) and incorrect route – 16 (3.5%)<sup>(24)</sup>.

Regarding the patient data filled out on the label of the preparation, it is important to correctly identify the information relating to the child so as to avoid failures in this procedure<sup>(20)</sup>. The correct identification of the medications that can cause harm to the patient is also recommended, particularly with regard to the potentially dangerous medications<sup>(10)</sup>.

It should be highlighted that in the present study, the child's complete name was transcribed on only a few occasions. However, it is emphasized that the unit is made up of a small number of beds and that, moreover, each staff member is responsible for the care of two or, at the maximum, three children, thus reducing the chance of committing an error in identification. Furthermore, the transcription of the complete name may not take place because of the failure to implement safety strategies for the correct identification of the child.

Regarding the use of the label as a safety barrier during the preparation of potentially dangerous medications, the study evidenced that – among the data regarding identification of the medication on the label – the correct route was not always transcribed. This situation may be related to the fact that the PICU has a pre-printed label for filling out with data relating to the patient and the medication. This label was developed by the nursing team to identify the medication to be prepared, and has spaces for filling out the data of the patient, date, infusion dose, starting time, finishing time and the name of the person responsible for preparing the medication.

One study undertaken in a PICU in Saudi Arabia in 2011, aiming to determine the incidence and types of prescription errors, analyzed 2380 medical records. It ascertained that the error rate was 56 for each 100 medications, this being 525 (22.1%) errors in dose and 285 errors related to the correct route<sup>(26)</sup>. As a result, the importance is emphasized of implementing the route of the medication on the label for the preparation of potentially dangerous drugs in order to prevent mistakes in their administration<sup>(10)</sup>.

Furthermore, the label must be fixed on the device in which the medication is stored, in order to act as a barrier and avoid confusion when there is more than one medication on the tray<sup>(27,12)</sup>.

It is also emphasized that the preparation of potentially dangerous medications for continuous infusions is one of the common activities in PICU, due to the need for the child to receive these medications gradually and inexact doses. As a result, the study demonstrated that the doses prepared need to be doubled or tripled so as to make the medication available for a period as long as 24 or 36

hours. However, when prepared in this way, there is the risk of a fold error happening, due to the interruptions mentioned or to the lack of double checking<sup>(10)</sup>.

In relation to the interruptions during the preparation of the medications, these situations may be considered to constitute a risk in the preparation of potentially dangerous medications. One study undertaken in Turkey, that aimed to identify the interruptions during the preparation and administration of medications in pediatric units, observed the preparation of 2340 doses of 200 types of medications, and obtained as a result 847 (36.1%) interruptions. Of these, 616 (72.7%) interruptions related to the preparation; they were mainly caused by the children's mothers – 188 (22.2%), physicians – 151 (17.8%), and nurses – 144 (17%)<sup>(28)</sup>. These results corroborate the findings of the present study, demonstrating that the interruptions which occur during the stage of preparation of medications can result in situations of error.

In this regard, it is necessary to construct a specific protocol, so as to standardize the process of preparing potentially dangerous medications<sup>(10)</sup>. When the safety barriers are implemented in the institutions, satisfactory results are achieved, as shown in one quasi-experimental study, where the intervention was to implement the use of a white vest with the words "Please do not interrupt" printed on it during the preparation of 3714 medications. After the use of this measure, in two weeks the interruptions reduced from 2355 to 1359; while the interruptions undertaken by members of the health team went from 773 (32.8%) to 442 (32.5%); regarding interruptions resulting from telephone calls, these went from 345 (14.6%) to 136 (10%) and questions regarding the stocking-up of materials went from 57 (2.4%) to 26 (1.9%)<sup>(29)</sup>.

It follows that safety barriers, when implemented, must be worked with by the entire health team, so as to optimize the results anticipated, promoting greater safety for the patients<sup>(30)</sup>.

This study's limitation lies in the fact that it is an observational study where, principally, during the first observations, the team could have changed its normal behavior. In addition to this, due to an issue of safety for the researcher, the night shift was not observed, which could have added to the data found.

## ● CONCLUSION

The use of safety barriers during the preparation of vasoactive drugs and sedatives/analgesics in PICU is a strategy which is being undertaken by the health service, and which is characterized by measures that are simple and which can demonstrate a significant difference in reducing errors. However, they need standardization in order to improve efficiency and promote greater patient safety, as in the example of the written prescription, the use of specific labels for transcribing medications which address the essential information of the patient and of the medication, double checking and the professional's concentration during the preparation of the drugs, avoiding interruptions in this process.

It is necessary, therefore, to promote institutional changes for the standardization of safety barriers, along with training of the professionals, in conjunction with the construction of an institutional protocol relating to the preparation and management of potentially dangerous drugs.

In addition to this, this study contributes to the area of Nursing by evidencing the need for the implementation of barriers so as to avoid errors in the preparation and administration of potentially dangerous drugs, capable of leading to morbidity and mortality in patients. This should be published, as it evidences how the nursing practices are being undertaken, indicating guidelines for providing safe care.

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