



## Evaluating pharmaceutical waste disposal in pediatric units\*

Avaliação do descarte de resíduos de medicamentos em unidades pediátricas

Evaluación del descarte de residuos de fármacos en unidades pediátricas

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### ABSTRACT

**Objective:** To verify the disposal of pharmaceutical waste performed in pediatric units. **Method:** A descriptive and observational study conducted in a university hospital. The convenience sample consisted of pharmaceuticals discarded during the study period. Handling and disposal during preparation and administration were observed. Data collection took place at pre-established times and was performed using a pre-validated instrument. **Results:** 356 drugs disposals were identified (35.1% in the clinic, 31.8% in the intensive care unit, 23.8% in the surgical unit and 9.3% in the infectious diseases unit). The most discarded pharmacological classes were: 22.7% antimicrobials, 14.8% electrolytes, 14.6% analgesics/pain killers, 9.5% diuretics and 6.7% antiulcer agents. The most used means for disposal were: sharps' disposable box with a yellow bag (30.8%), sink drain (28.9%), sharps' box with orange bag (14.3%), and infectious waste/bin with a white bag (10.1%). No disposal was identified after drug administration. **Conclusion:** A discussion of measures that can contribute to reducing (healthcare) waste volume with the intention of engaging reflective team performance and proper disposal is necessary.

### DESCRIPTORS

Medical Waste; Pharmaceutical Preparations; Pediatric Nursing.

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## INTRODUCTION

The ecological issue has been widely discussed by society in recent decades, aiming at concepts such as environmental preservation, improving quality of life and sustainability. According to the *Instituto Brasileiro de Geografia e Estatística* (Brazilian Institute of Geography and Statistics – IBGE) in its National Survey of Basic Sanitation (*Pesquisa Nacional de Saneamento Básico* – PNSB, 2008), 259,547 tons of waste are collected daily, of which 8,909 are waste generated by health services. Among the 4,469 municipalities studied, 41.5% did not have any type of treatment for such waste<sup>(1)</sup>.

Healthcare Waste (HCW) (RSS in Brazil – *Resíduos de Serviços de Saúde*) is any material that poses a risk to public health due to the presence of biological materials that are capable of causing infections; hazardous chemicals; sharps and radioactive waste materials<sup>(2-3)</sup>. HCW is classified into five groups according to their characteristics, according to the Resolutions of the National Environmental Council (*Conselho Nacional do Meio Ambiente* – CONAMA) number 358/2005<sup>(2)</sup> and the Collegiate Board (RDC) of the National Sanitary Surveillance Agency (*Agência Nacional de Vigilância Sanitária* – ANVISA) number 306/2004<sup>(3)</sup>. According to federal legislation, pharmaceutical waste is classified as Group B waste which poses risks to public health and to the environment due to its chemical characteristics, including all classes of pharmaceuticals, chemotherapeutic drugs, and all others considered dangerous, in accordance with the Brazilian Regulatory Standard (*Norma Brasileira Regulamentadora* – NBR) 10004 of the Brazilian Association of Technical Standards (*Associação Brasileira de Normas Técnicas* – ABNT)<sup>(2-3)</sup>.

In the State of São Paulo, the Sanitary Surveillance Center ordinance (CVS-21)<sup>(4)</sup> regulates techniques on the management of Pharmaceutical Hazardous Waste (*RPM* in Brazil – *Resíduos Perigosos de Medicamentos*), classifying it as chemical waste that presents a risk to human health and the environment. They are separated into two types according to the quantity and concentration of pharmaceuticals, namely *RPM* type 1 and *RPM* type 2.

Within the hospital setting, pediatric units can be highlighted as waste producers, including vaccines and drug residues that exceed therapeutic demand or that are past their expiration date. Due to a lack of products available which are compatible with pediatric patients, professionals are obliged to manipulate the drugs in an attempt to achieve the required dosage, often discarding surplus product<sup>(5)</sup>. In conjunction with pharmaceutical disposal, there is a lack of preparation on behalf of professionals in relation to the different types of waste and the correct way to dispose of it. Studies carried out seeking to identify nursing team knowledge about HCW report that the nurses declared having some knowledge about the subject and that they consider the nurses' participation in managing this waste fundamentally important<sup>(6-10)</sup>.

Thus, the present study aimed to verify pharmaceutical waste disposal by professionals in pediatric units of a university hospital in the city of São Paulo.

## METHOD

A descriptive and observational study conducted in four pediatric units of a university hospital in São Paulo (clinical, surgical, infectious diseases and intensive care (ICU) units).

The physical structure of the units as well as the containers available for the pharmaceutical waste disposal in these sectors were observed prior to data collection.

The sample consisted of pharmaceuticals discarded during the study period, characterizing a convenience sample. Saline and glycoside solutions were excluded from the study since their physicochemical characteristics pose no danger to the environment or to human health<sup>(2-3)</sup>.

Data collection was performed by two undergraduate nursing students who observed the pharmaceutical waste disposal performed by the professionals working in the studied units.

A pre-test of the data collection instrument was performed. After necessary adjustments, the instrument used included variables related to the study site (clinical, surgical, infectious disease and ICU units); Medication or solution (name of the pharmaceutical); presentation form of the drug (liquid, oil, powder/lyophilized powder, cream, dragée/sugar-coated tablet, gel, paste, pill/tablet, capsule, others); Type of primary packaging (plastic ampoule, glass ampoule, tube, plastic vial, vial ampoule, blister, plastic bag, others); Place of disposal after preparation or after administration, with variables referring to the disposal site (room, isolation, corridor, nursing station, utility room, procedure room, not applicable); Volume of discarded drug; disposed in its commercially available form or in solution; and disposal means (regular bin with black bag, recyclable waste/bin with transparent bag, infectious waste/bin with white bag, hazardous chemicals waste/bin, sharps disposable box with yellow bag, sharps hazardous chemicals disposable box with orange bag, sluice sinks and slop hoppers, the medicine room sink drain, the patient's bedroom sink drain, watertight containers, others).

Data were collected in the morning and evening from March to May 2012. Fourteen (14) collection periods were performed at each unit of the study at two time intervals, occurring from 8 to 10 am and 2 to 4 pm.

Collected data were organized in Excel® spreadsheets and after analysis they were presented in tables and figures according to absolute and relative frequency.

Data collection was only carried out after the approval of the Research Ethics Committee of the Institution under Opinion number 5563/12, with authorization from the Teaching and Research Coordinator of the Hospital Nursing Board, as well as authorization from the nurses in charge of the respective units.

The observed professionals were clarified regarding the research objective, data collection strategies and were guaranteed anonymity and confidentiality for the data obtained through the observations. The participants were then invited to participate in the study, and after agreement they were asked to sign the Clear and Informed Consent Form.

## RESULTS

Twenty-eight (28) data collection periods were performed in each studied unit, totaling 112 moments in 224 hours of observation, identifying 356 pharmaceutical disposals in the four units, of which 125 (35.1%) occurred in the clinical unit, 113 (31.8%) in the ICU, 85 (23.8%) in the surgical unit and 33 (9.3%) in the infectious diseases unit.

The results concerning the most disposed pharmacological classes are presented in Table 1.

The category 'Others' was comprised of the following pharmacological classes: immunosuppressive, hepatoprotective, antacids, antianginal, antiepileptic, systemic antifungal,

h1 antihistamines, vitamins, anticoagulants, antiemetics, hypnotics, phosphodiesterase inhibitors and laxatives.

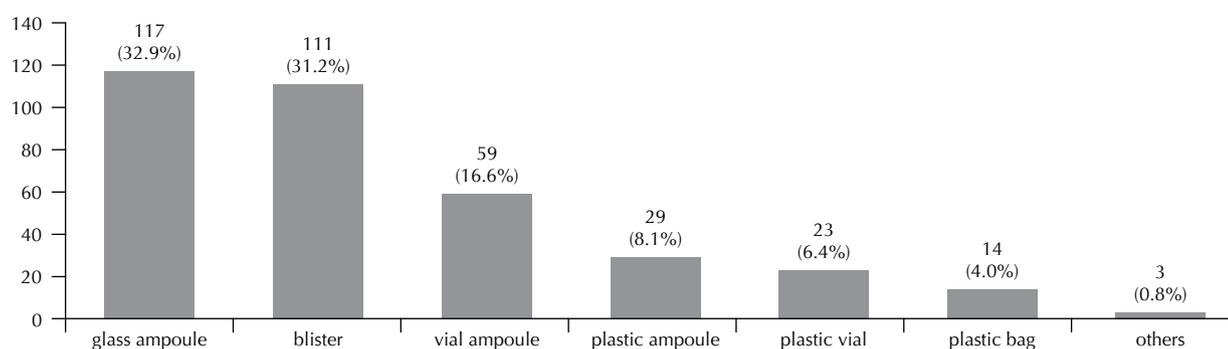
Regarding the commercially available physical form of all the study pharmaceuticals, it is possible to verify that 188 (52.8%) were liquids, 111 (31.2%) were tablets and 57 (16.0%) were powder/lyophilized powder. It is worth noting that no drug disposal was observed in the forms of paste, oil, cream, dragée/sugar-coated tablet, gel or capsule during the data collection period.

Figure 1 shows the main types of primary packaging identified. Drug disposal with tube packaging was not observed.

**Table 1** – Pharmacological class of the pharmaceuticals disposed of, according to the hospital unit – São Paulo, SP, Brazil, 2012.

Pharmacological Class	Type of unit								Total	
	Surgical unit (n = 85)		Clinical (n = 125)		ICU (n = 113)		Infectious Diseases (n = 33)		(n = 356)	
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)
Antimicrobial	32	37.6	18	14.4	22	19.5	9	27.3	81	22.8
Electrolyte, Thinner	5	5.9	19	15.2	22	19.5	7	21.2	53	14.9
Painkiller	18	21.2	14	11.2	14	12.4	6	18.2	52	14.6
Diuretic	–	–	22	17.6	10	8.8	2	6.1	34	9.5
Antiulcer	10	11.8	5	4	9	8	–	–	24	6.7
Anticonvulsant	6	7.1	6	4.8	7	6.2	1	3	20	5.6
Anti-inflammatory	5	5.9	2	1.6	6	5.3	4	12.1	17	4.8
Anti-hypertensive	1	1.2	13	10.4	2	1.8	–	–	16	4.5
Anti-anemic	3	3.5	8	6.4	–	–	–	–	11	3.1
Muscle Relaxant	–	–	8	6.4	–	–	–	–	8	2.2
Anxiolytic	3	3.5	1	0.8	3	2.6	–	–	7	2
Antidepressant	–	–	–	–	6	5.3	–	–	6	1.7
Others	2	2.3	9	7.2	12	10.6	4	12.1	27	7.6

Legend: ICU – Intensive Care Unit.



**Figure 1** – Primary packaging type of disposed drugs – São Paulo, SP, Brazil, 2012.

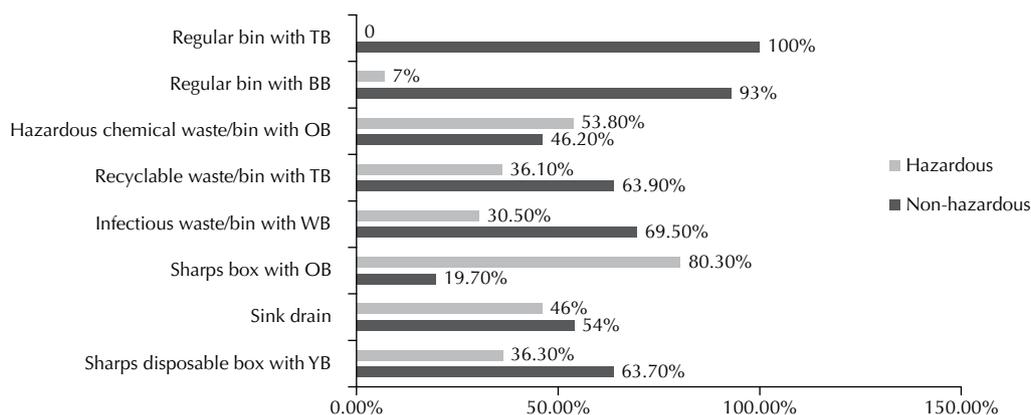
Regarding the physical form of the drug when it was disposed, 51.7% was disposed in its original physical form and the remaining (48.3%) in solution after handling/manipulation. Regarding the place of drug disposal, it was possible to observe that the entire amount (100.0%) was discarded at the place of preparation and always after handling/manipulation. No disposal was found after drug administration.

Results regarding the means used for disposal after preparation are presented in Table 2. This is followed by Figure 2, in which samples were classified into hazardous or non-hazardous substances according to the disposal means, in accordance with the RDC resolution number 306/2004<sup>(3)</sup> and CONAMA number 358/2005<sup>(2)</sup>.

**Table 2** – Disposal means of pharmaceutical/medication, according to the hospitalization unit – São Paulo, BB, Brazil, 2012.

Disposal means	Type of Unit								Total	
	ICU (n = 113)		Surgical (n = 85)		Infectious Diseases (n = 33)		Clinical (n = 125)		(n = 356)	
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)
Sharps disposable box with YB	37	32.8	15	17.7	23	69.7	35	28	110	30.9
Sink drain	39	34.5	4	4.7	2	6.1	58	46.4	103	28.9
Sharps box with OB	–	–	51	60	–	–	–	–	51	14.3
Infectious waste/bin with WB	4	3.5	2	2.3	8	24.2	22	17.6	36	10.1
Recyclable waste/bin with TB	33	29.2	–	–	–	–	–	–	33	9.2
Hazardous chemicals waste/bin with OB	–	–	13	15.3	–	–	–	–	13	3.6
Regular bin with BB	–	–	–	–	–	–	7	5.6	7	2
Regular bin with TB	–	–	–	–	–	–	3	2.4	3	1

Legend: ICU – Intensive Care Unit; YB (yellow bag); OB (orange bag); WB (white bag); TB (transparent bag); BB (black bag).

**Figure 2** – Environmental hazard classification according to disposal means – São Paulo, SP, Brazil, 2012.

## DISCUSSION

In the present investigation, pharmaceutical disposal in four different pediatric hospitalization units was verified. The number of beds, type of care provided to the patients, characteristics of drug therapy and the complexity of the children differed from one unit to another, therefore waste disposal generation was different among the units. According to the CONAMA Resolution number 358/2005<sup>(2)</sup>, the instant when the waste is generated is the mandatory moment to perform its correct separation in relation to its characteristics, in order to reduce the disposal volume and in order to guarantee health and environment protection, in addition to promoting cost reduction<sup>(3)</sup>. About 70% to 80% of the amount of waste generated in health services that are not considered hazardous waste can become potentially contaminating when this step is not performed correctly<sup>(11)</sup>.

According to current legislation, pharmaceutical waste belongs to group B – Chemicals<sup>(2-3,12)</sup>. Of the variables belonging to this group, pharmaceuticals that pose a risk to health or the environment when not submitted to the '3R's' process (reduce, reuse or recycle) must be disposed of according to their hazard characteristics, and forwarded for treatment in specific landfills for hazardous waste (Class I), or if they do not present any characteristic which poses a degree of danger, they can be sent to licensed landfills<sup>(2-3)</sup>.

Chemical waste in a liquid state must be subjected to specific treatment in accordance with the contaminating substance, and final disposal in landfills is prohibited. If the waste does not present hazardous characteristics, it can be released into the sewage network, provided that the guidelines established by the competent environmental agencies, water managers and sanitation are obeyed<sup>(2)</sup>. Thus, there is a need for information about which substances are allowed, since doubts can lead to errors in separating these materials, leading to disposing substances that pose a risk to the population and the environment<sup>(13)</sup>.

In all available legislation on healthcare waste, there are gaps in the disposal of pharmaceuticals used in hospital institutions, making it difficult for managers and even professionals who are in direct care.

In evaluating the pharmaceuticals analyzed in the present study in relation to the means chosen for disposal, we observed non-compliance with the recommendations backed by legislation<sup>(2-4)</sup>. There is a lack of proper disposal sites for these drugs, with no availability of proper containers with identification of the associated risk symbols suitable for each type of substance according to its physicochemical characteristics<sup>(4)</sup>.

According to CVS 21/08<sup>(4)</sup>, a considerable quantity of the waste, including hazardous waste is inadequately disposed, leading to environmental contamination and resulting in risks

to the population. This resolution emphasizes that a mixture of pharmaceutical waste with infectious waste is considered to be serious, since these are sent to treatment by incineration which can lead to a release of toxic gases and vapors, thereby not contributing to reducing their chemical risk<sup>(4)</sup>. Still, 36 disposals were performed by this means, with 30.5% being composed of substances classified as hazardous<sup>(2-3)</sup>.

Regarding all drugs disposed of in the sharps disposable boxes with a yellow bag, 36.3% presented a risk to the environment and to human health<sup>(2-3)</sup>. Availability of such boxes at the drug preparation sites was common in all the units observed and where pharmaceutical disposal occurred, especially those packaged in glass ampoules as primary packaging. Sharps disposable boxes belong to group E in waste classification, and its destination is similar to infectious waste since the institution advises the box must be closed and wrapped in a white bag suitable for infectious waste after reaching 2/3 capacity<sup>(14)</sup>, with mixture occurring between these wastes being considered incorrect<sup>(2-3)</sup>.

In relation to pharmaceuticals disposed of in the sharps box with orange bag only available in the Surgical unit, 80.3% of the drugs were considered hazardous<sup>(2-3)</sup>. The orange bag in this means is a process adaptation for this material proposed by the studied institution. Considering the total number of pharmaceuticals disposed in hazardous chemicals waste/bins with an orange bag, 53.8% consisted of drugs that needed special care in handling.

Orange bags are destined for hazardous chemical waste disposal in solid form, being the best means for disposing of this type of waste<sup>(4)</sup>. The orange bag was also available in the hazardous-chemical bin, and only available in the surgical unit.

We should also highlight pharmaceutical disposal down the sink drain. Approximately 46% of the pharmaceuticals disposed of in this way presented a risk factor, requiring a specific means; among them was tacrolimus, an immunosuppressant class classified as RPM type I<sup>(4)</sup>. In relation to the rest of the pharmaceuticals disposed of down the sink drain, there is no consideration in the current legislation that indicates danger to the environment, and no contraindication of this means for final disposal provided there is a sewage treatment network to treat this effluent<sup>(2)</sup>. Studies point to the presence of several drugs in surface water, which are not removed by sewage treatment plants (STPs)<sup>(15-22)</sup>.

The presence of drugs in common waste, although in less quantity than other means, also needs attention. This waste is sent to landfills where they can come into contact with the population working at these sites, as well as contaminate the soil<sup>(11)</sup>.

The recyclable waste bin with a transparent bag is intended for disposing of waste that can be recycled, such as paper, cardboard, and secondary packaging of medicines, provided that they have not been in contact with them<sup>(11)</sup>. The use of this means for disposing of drugs is not recommended<sup>(23)</sup>. Even so, this means was used for this purpose in 36.1% of pharmaceuticals that offered risk to the population and the environment. All these disposals occurred in the ICU.

A study conducted to diagnose healthcare waste management in Rio Grande do Sul found that those belonging to Group B had not undergone the necessary care during their disposal, as only 57% of the studied hospitals promoted separation/sorting of this waste. The main reason mentioned in the study was insufficient employee knowledge in the establishments about environmental aspects and associated possible risks, justifying the importance of health team training and orientation<sup>(23)</sup>.

In addition to the changes that are necessary, there must also be awareness, "(...) a political will by those who are managing services to enforce health standards and recommendations, helping those who are already aware of the importance of adopting this behavior and promoting understanding in those who still do not know"<sup>(24)</sup>.

## CONCLUSION

The results allowed for verifying that the characteristics of drug therapy and the complexity of the children differed from one place to the other, consequently directly reflecting waste disposal production.

Regarding the drug disposal site, the most frequently adopted was the sharps disposable box with a yellow garbage bag, however a relevant finding was identifying that 28.9% of the disposals were performed via sink drain, demonstrating an important factor regarding the environmental impact of healthcare waste, as 48.2% of the total primary sample corresponded to medicines that pose a risk to human health and the environment.

In all the national legislations available on healthcare waste, there are gaps in means of pharmaceutical disposal used in hospital institutions, making it difficult for managers and even those in direct care.

It is necessary to discuss measures that contribute to reducing pharmaceutical disposal volume, such as instituting individualized dosing and health team training relating to managing healthcare waste, with the intention to engage in reflexive action on waste generation and its adequate disposal and with a consequent impact on nursing practice and environmental health.

## RESUMO

**Objetivo:** Verificar o descarte dos resíduos de medicamentos realizado em unidades pediátricas. **Método:** Estudo descritivo e observacional, realizado em um hospital universitário. A amostra de conveniência foi constituída pelos medicamentos descartados durante o período de estudo. Observaram-se a manipulação e o descarte durante o preparo e a administração. A coleta dos dados ocorreu em horários preestabelecidos e realizada por meio de instrumento pré-validado. **Resultados:** Identificaram-se 356 descartes de medicamentos (35,1% na clínica, 31,8% na unidade de cuidados intensivos, 23,8% na cirúrgica e 9,3% na infectologia). As classes farmacológicas mais descartadas foram: 22,7% antimicrobianos, 14,8% eletrólitos, 14,6% analgésicos, 9,5% diuréticos e 6,7% antiulcerosos. Vias mais utilizadas: caixa descartável para perfurocortante com saco amarelo (30,8%), ralo da pia (28,9%), caixa de perfurocortante

com saco laranja (14,3%) e lixeira infectante com saco branco (10,1%). Não foi identificado descarte após a administração dos fármacos. **Conclusão:** Faz-se necessária a discussão de medidas que contribuam para a redução do volume de resíduos, com o intuito de engajar a atuação reflexiva da equipe e o descarte adequado.

## DESCRITORES

Resíduos de Serviços de Saúde; Preparações Farmacêuticas; Enfermagem Pediátrica.

## RESUMEN

**Objetivo:** Verificar el descarte de los residuos de fármacos realizado en unidades pediátricas. **Método:** Estudio descriptivo y observacional, realizado en un hospital universitario. La muestra de conveniencia estuvo constituida de los fármacos descartados durante el período de estudio. Se observaron la manipulación y el descarte durante la preparación y la administración. La recolección de datos ocurrió en horarios preestablecidos y fue llevada a cabo mediante instrumento pre validado. **Resultados:** Se identificaron 356 descartes de fármacos (el 35,1% en la clínica, el 31,8% en la unidad de cuidados intensivos, el 23,8% en la quirúrgica y el 9,3% en la infectología). Las clases farmacológicas más descartadas fueron: el 22,7% de antimicrobianos, el 14,8% de electrolitos, el 14,6% de analgésicos, el 9,5% de diuréticos y el 6,7% de antiulcerosos. Medios más utilizados: caja desechable para punzocortante con bolsa amarilla (30,8%), rebosadero del lavabo (28,9%), caja de punzocortante con bolsa naranja (14,3%) y basurero infectante con bolsa blanca (10,1%). No se identificó descarte tras la administración de los medicamentos. **Conclusión:** Se hace necesaria la discusión de medidas que contribuyan a la reducción del volumen de residuos a fin de involucrar la actuación reflexiva del equipo y el descarte adecuado.

## DESCRIPTORES

Residuos Sanitarios; Preparaciones Farmacéuticas; Enfermería Pediátrica.

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