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# Nursing workers' perceptions regarding the handling of hazardous chemical waste\*

A PERCEPÇÃO DOS TRABALHADORES DE ENFERMAGEM SOBRE O MANEJO DOS RESÍDUOS QUÍMICOS PERIGOSOS

PERCEPCIÓN DE LOS TRABAJADORES DE ENFERMERÍA SOBRE EL MANEJO DE RESIDUOS QUÍMICOS PELIGROSOS

Taiza Florêncio Costa<sup>1</sup>, Vanda Elisa Andres Felli<sup>2</sup>, Patrícia Campos Pavan Baptista<sup>3</sup>

## ABSTRACT

The objectives of this study were to identify the perceptions of nursing workers regarding the handling of hazardous chemical waste at the University of São Paulo University Hospital (HU-USP), and develop a proposal to improve safety measures. This study used a qualitative approach and a convenience sample consisting of eighteen nursing workers. Data collection was performed through focal groups. Thematic analysis revealed four categories that gave evidence of training deficiencies in terms of the stages of handling waste. Difficulties that emerged included a lack of knowledge regarding exposure and its impact, the utilization of personal protective equipment versus collective protection, and suggestions regarding measures to be taken by the institution and workers for the safe handling of hazardous chemical waste. The present data allowed for recommending proposals regarding the safe management of hazardous chemical waste by the nursing staff.

## DESCRIPTORS

Nursing  
Hospitals teaching  
Chemical waste  
Waste management  
Occupational health

## RESUMO

Este estudo objetivou identificar a percepção dos trabalhadores de enfermagem sobre o manejo dos resíduos químicos perigosos no Hospital Universitário da Universidade de São Paulo e elaborar uma proposta para o manejo desses resíduos. Trata-se de pesquisa de abordagem qualitativa, cuja amostra foi intencional, composta por dezoito trabalhadores de enfermagem. A coleta de dados foi realizada pela técnica de grupo focal. Com a análise temática foram identificadas quatro categorias que evidenciaram a deficiência de treinamento nas etapas do manejo, como a primeira dificuldade expressa, tendo aparecido ainda o desconhecimento da exposição e impactos, assim como o uso dos equipamentos de proteção individual em detrimento da proteção coletiva, seguidos das sugestões quanto às medidas de competência institucional e dos trabalhadores para o manejo seguro dos resíduos químicos perigosos. Esses dados permitiram recomendar propostas para o manejo adequado dos resíduos químicos perigosos pela enfermagem.

## DESCRIPTORES

Enfermagem  
Hospitais de ensino  
Resíduos químicos  
Gerenciamento de resíduos  
Saúde do trabalhador

## RESUMEN

Se objetivó identificar la percepción de trabajadores de enfermería sobre el manejo de residuos químicos peligrosos en el Hospital Universitario de la Universidad de São Paulo y elaborar una propuesta para manejar dichos residuos. Investigación cualitativa, muestra intencional, constituida por 18 trabajadores de enfermería. Datos recolectados por técnica de grupo focal. En el análisis temático se identificaron cuatro categorías que evidenciaron la deficiencia de capacitación en las etapas del manejo, como la primera dificultad expresada, habiendo aparecido incluso el desconocimiento sobre la exposición y sus impactos, así como el uso de equipamientos de protección individual en detrimento de la protección colectiva, seguidos de sugerencias respecto de las medidas de competencia institucional y de los trabajadores para el manejo seguro de residuos químicos peligrosos. Dichos datos permitirán recomendar propuestas para el manejo adecuado de residuos químicos peligrosos para la enfermería.

## DESCRIPTORES

Enfermería  
Hospitales escuelas  
Residuos químicos  
Administración de residuos  
Salud laboral

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## INTRODUCTION

Among the current goals of health institutions concerning the handling of hazardous chemical waste and its derivatives is the establishment of converging economic and environmental interests toward a sustainable development, as the referred entities stand out as a focal point for the use and dissemination of health-based technologies.

As part of the productive chain in the healthcare area, nursing professionals are critically exposed to various types of health threats resulting from work overload, scarcity of human resources, exposure to biological materials and handling of chemical waste, among others<sup>(1)</sup>.

In order to characterize the products which generate hazardous chemical waste, hospitals should make use of the criteria established by Resolution 306<sup>(2)</sup> of the National Health Surveillance Agency (ANVISA), dated the 7<sup>th</sup> December 2004, as well as the provisions set forth by the Environmental Sanitation Technology Company (CETESB)<sup>(3)</sup> through the Technical Norm P4.262/2007 and the legal provision of the Health Surveillance Center (CVS) of the State of São Paulo, represented by Decree CVS 21, dated the 10<sup>th</sup> October 2008<sup>(4)</sup>.

Additionally, the generators of hazardous chemical waste are also held to the standards of the Brazilian Technical Standards Association (ABNT)<sup>(5)</sup> under the title "Chemical Products – Information on Safety, Health and Environment", dated September of 2009. These norms comply with the Globally Harmonized System's (GHS) safety information regarding hazardous chemical waste, which deals with information on the safety, health and environmentally-related aspects of chemical products. These products were divided into four categories by the Brazilian Regulatory Norm (NBR): NBR 14.725-1 - Terminology; NBR 14.725-2 – Hazard Classification System; NBR 14.725-3 - Labeling; and NBR 14.725-4 – Safety Information Form (FISPQ). These recently approved documents represent the most important legal provisions for the classification of Hazardous Chemical Waste.

The Brazilian Regulatory Norm NBR 10004<sup>(6)</sup> grounding these legal provisions sets out that in order for a product to be considered as a hazardous chemical waste, it must present at least one of the following properties, being: flammable, corrosive, reactive and toxic. This norm provides a basis for Resolution 358/2005 of the National Council for the Environment (CONAMA)<sup>(7)</sup>, which governs the treatment and disposal of healthcare-related waste.

Dated in 2005, Resolution 358 of the CONAMA<sup>(7)</sup> classifies healthcare-related waste into five groups: A, B, C, D, and E. Group B contains chemical waste products that may present public health or environmental risks, depending upon their hazardous characteristics, and includes the following list of products: hormones, antimicrobials, cytostatic materials, antineoplastics, immunosuppressives, digitalis, immunomodulatory agents, antiretrovirals, medications controlled by Decree MS 344/98 of the Ministry of Health, sanitizing waste, disinfectants, waste containing heavy metals, lab reagents (including the glassware or plasticware contaminated by them), effluents from imaging processing (developers and fixers), effluents from automatic equipment used in clinic analyses, and all other products considered by ABNT's NBR 10.004<sup>(6)</sup> to be hazardous waste (toxic, corrosive, flammable and/or reactive).

When not reused, recovered or recycled, all chemical waste belonging to Group B that presents hazardous features must be treated and forwarded to undergo specific final disposal processes<sup>(3-4)</sup>.

**The management of Hazardous Chemical Waste (HCW) generated in the course of the provision of healthcare services must be a priority, as improperly handled waste can bring about critical problems affecting the health of the staff, the public and the environment.**

It should be highlighted that the facility originating Hazardous Chemical Waste (HCW) products must be held accountable for the management of the residue in all handling phases, beginning with the separation of the material up until its final disposal<sup>(2)</sup>.

The hazardous chemical waste generated throughout the healthcare process must be adequately managed, in order to comply with in-force legislations and also to prevent the emergence of problems affecting health workers, the general public and the environment.

The management of Hazardous Chemical Waste (HCW) generated in the course of the provision of healthcare services must be a priority, as improperly handled waste can bring about critical problems affecting the health of the staff, the public and the environment. The situation may become even more urgent due to the lack of studies regarding this matter, above all those that can propose specific interventions. The issue of HCW is always addressed by specific studies in a very general way. This fact favors a superficial understanding of the problem, causing institutional managers to make decisions without prioritizing the proper management processes of hospitals' hazardous chemical waste<sup>(1-2,8)</sup>.

Within this context, and taking into account the complexity involved in the management of the phases of hazardous chemical waste handled by nurses in hospitals, the present study sought to identify the perception of the staff regarding the HCW issue, as well as to elaborate a management proposal for this type of waste.

## METHOD

This descriptive, qualitative-based research was carried out at the University of São Paulo's University Hospital (USP-UH). Subjects were selected from a convenience sample and totaled 18 workers (nurses and nursing technicians). The data collection process made use of the focal group technique; this phase was carried out following the formation of two focal groups comprised of nine participants each<sup>(9)</sup>. The groups were named A and B. The one-hour meetings took place between the 18<sup>th</sup> and 20<sup>th</sup> of August 2008 in the institution's amphitheater.

The study was approved by the Research Ethics Committee of the USP-UH under protocol number 785/07. Before carrying out the first focal group, subjects were instructed on the goals of the project and signed the Free and Informed Consent Form (FICF). The statements were recorded, transcribed and categorized according to their thematic analysis<sup>(10)</sup>. Participating subjects were identified with the letter W (standing for Worker), followed by numbers 1 through 18, according to the number of participants.

## RESULTS

Four categories emerged from the statements: Knowledge of the Hazardous Chemical Waste Management (HCWM) process, generating issues regarding *training* and *HCWM phases*; Awareness of the exposure and impacts, generating issues on *nursing*, *patients* and the *multidisciplinary team*; Preventive measures, generating issues on *Personal Protective Equipment* (PPE); and Suggestions for HCWM, generating issues regarding the *institution* and *staff*.

The category *Knowledge of the Hazardous Chemical Waste Management process*, from which the *training* and *HCWM phases* issues emerged, can be observed in the following statements:

(...) I've been working at the UH for over twenty years now and *training* for me is not an issue of someone coming to you one day and saying that from now on you have to replace one activity with another; in my view, that's only information (...) W1.

(...) *Training* for me has to be a formal procedure, explaining what and why it is important to do something (...) W1.

(...) as for the *HCWM*, I think endoscopy is the procedure that uses the most *glutaraldehyde*, because we have bio-safety cabinet where water is mixed in the containers. We use approximately 70 liters and remove 40 liters. So, on average, we observe a certain amount of loss, because some water is inserted into the endoscopic tubes and the remainder goes to a container assigned to the nursing area (...) W2.

(...) the Obstetrics Center (OC) uses 60 liters of *formaldehyde* per month; around 50 liters of the waste used to be drained; now it's rebottled (...) In the Operating Room, we receive 20 liters of formaldehyde weekly and we usually do not use all of it (...) W1.

(...) I have a 100 ml bottle of *acetic acid* at the OC; it lasts up until the product's expiration date. If the product expires, I drain it into the sewage system (...) W1.

(...) I also have *trichloroacetic acid* at the OC and the procedure is the same as with the acetic acid (...) W1.

(...) a long time ago, the *ganciclovir* and the *cyclophosphamide* were prepared in the medication room; when this preparation was carried out by nursing technicians, they did not wear anything except for a pair of gloves at the very most. Then, we received a memo saying that the nurse should now mix the preparation. As soon as the nurse began to mix the preparation in the medication room, the process was improved. As for the effects of the procedure, no immediate effect was reported, except for the venous access, which presents an overflow related to the patient's access (...) and the waste is not even separated (...) W6.

(...) the *sevoflurane*, the *isoflurane*, the *halothane* and the *benzocaine* do not produce leftovers. The bottle must be discharged in the box for sharps; as for the halothane, a box must be designated to collect the bottles at the end of each day (...) W5.

(...) we use just a small amount of *potassium hydroxide* in order to check for rupture of the amniotic membrane. The small glass vial with the leftover goes to a rigid box (...) W5.

(...) we use *hypochlorite* a lot and the waste is drained into the sewage system (...) W9.

(...) the *peracetic acid* is drained into the sewage system and the container is thrown out in the common garbage (...) W17.

(...) we use *benzene* for cleaning purposes, such as removing dust from cabinets and tables; when the content is gone, the bottle is thrown away in a plastic bag without any special identification; we just put it there, it's not an ordinary plastic bag. When the expiration date is reached, we ask the cleaning personnel to remove it. We notify the cleaning staff and they just come and take it. If the product spills, we just use a damp cloth and it's gone (...) W10.

(...) *alcohol* is one of the most commonly used materials; when 100 ml and 1000 ml bottles are empty, both are discharged in the infectious waste bin (...) W11.

(...) we have already thrown away little bottles of expired *benzoin* in the common garbage (...) W12.

(...) We use *acetone* for ordinary activities, such as to remove nail polish prior to endoscopic procedures... the remainder is thrown away in the garbage (...) W14.

(...) in general, mineral oil or *Vaseline* leftovers are thrown away in the infectious garbage (...) W16.

(...) the nitric oxide is used based on demand and there are not usually any leftovers because the cylinder is turned on and when the product is gone it is just replaced; it's possible, though, that it leaks into the environment. When the staff started using it, I think they were not instructed on proper use and they closed it improperly; sometimes, the gas kept leaking into the environment and people complained of eye irritation, headache; more sensitive people even had nausea. Now the product does not leak that much anymore; sometimes we notice small amounts of leakage (...) W18.

(...) We receive pill-shaped *permanganate* in order to make the dilution. The diluted permanganate is drained into the sewage system and the expired pills are thrown out in the common garbage (...) W15.

(...) we use *hydrogen peroxide* to carry out blood tests on fecal samples. When it expires, we throw it away in the common garbage and the waste is drained into the sewage system (...) W13.

(...) ether is used in the outpatient department; when we have to remove botflies, we ask a small amount to the lab, so there are no leftovers (...) W1.

(...) there was a time when the Operating Room used xylol and the facility's pipelines were connected to the Surgery Room. It smelled terribly (...) then the xylol waste was drained into the sewage system (...) W1.

The statements in the *Knowledge of the Hazardous Chemical Waste Management* category show that the training regarding HCWM and the management phases that subsidize the Hazardous Chemical Waste Management Plan (HCWMP) are intended to be part of the Healthcare Service Waste Management Plan (HCSWMP); additionally, the research recorded reference to 23 other chemical products generating HCW in the studied institution.

Moreover, the existence of references regarding glutaraldehyde and formaldehyde concerning the amount of generated Hazardous Chemical Waste was also observed. The statements also pointed out the lack of separation between Hazardous Chemical Waste and/or packaging and by-products of ganciclovir and cyclophosphamide.

The statements also disclosed information related to the HCW's management phases, such as separation, packaging, identification and internal transport, which subsidize the Hazardous Chemical Waste Management Plan, an integral part of the Healthcare Service Waste Management Plan.

The *Awareness of the exposure and impacts* category generated the *nursing, patients and multidisciplinary team* issues, as can be seen in the following statements:

(...) I do believe that the formaldehyde waste may harm those in contact with it. I presume that it may cause damage, although I can't say what this damage might be. I think it's quite irritating, quite toxic. I think that it may harm those who handle it (...) W7.

(...) In the past, people used to apply formaldehyde in the Operating Room and then close it. We had to run away from that smell, it was terrible. I probably have been affected, because I've been here for over 20 years now and I do not notice the intensity of the smell anymore (...) W1.

(...) the waste originating from the sevoflurane, isoflurane and halothane is harmful, indeed; we know that when these gases are inhaled, they may eventually cause hepatitis (...) W5.

(...) The xylol is used in the Operating Room in order to preserve body parts to be sent for biopsy and the waste is there (...) There was a time in the past when the xylol used in the Operating Room was connected to the facility's pipelines; it smelled terribly. On the days the xylol waste was spread throughout the system, patients had headaches, so did we. A terrible smell. Sometimes, when we arrived to work, we opened the doors and said 'well, today's the day' (...) W1.

(...) Many Operating Room workers who were pregnant lost their babies, and, you know... they were young, healthy people working there (...) W4.

(...) The risks generated by ganciclovir and cyclophosphamide are enormous. One day, while attending a lecture, effects such as abortion and even genetic alterations were addressed. There is a tremendous lack of information on the danger of the waste. Many people are also misinformed, or to put it in a better way, poorly trained (...) W6.

(...) the waste originating from the acetic trichloroacetic acid exposes us to health risks. Therefore, the doctor is much more exposed, because he is the one who mostly deals with this products (...) W17.

(...) the peracetic acid waste causes headaches, stomach ache (...) W9.

The statements in the *Awareness of exposure and impacts* rank ten chemical products generating HCW as the ones that put the health of the institution's staff in the most jeopardy, including nursing professionals. The listed products are: formaldehyde, sevoflurane, isoflurane, halothane, xylol, ganciclovir, cyclophosphamide, acetic acid, trichloroacetic acid, and peracetic acid. Statements related to the vulnerability of patients as a result of the discharge of xylol into the sewage system in past times were also highlighted.

The *Preventive measures* category highlighted issues regarding *Personal Protective Equipment*, as can be seen in the following statements:

(...) In terms of PPEs, you can write this down: here, as in any other hospital, we wear gloves, first of all; then, the masks, and if it is necessary, the gown. And this apparel is designed for all kinds of work here, including medications, disinfecting, sterilizing, acid, (...) W1.

(...) in order to handle the formaldehyde, I wear a gown and gloves, but my concern is focused on the use of the mask. Sometimes I even wear two of them, as the smell of the formaldehyde is very strong (...) W7.



(...) the ganciclovir is eventually used and the employee that handles it must wear the whole outfit. The box is kept in a steam device. Then, the cleaning personnel just come and pick it up. We wear the whole outfit, gown, mask and gloves (...) W6.

(...) in the Pediatrics area, the ganciclovir is only rarely used. It can be found at the Pharmacy and it is already prepared for use (...) W6.

(...) there is this doctor who is even trying to couple a tube to the anesthetic equipment, so that it can leave the anesthetic room, but he has been found out. This doctor has hepatitis, so does his wife, and so do the majority of anesthesiologists and other professionals working in the SR and OC. If exams are performed, the results will show the damaging effects of those gases. So, we've been working here for such a long time now that I'm sure that we will have future problems. It can be felt in the air. However, no one approaches a pregnant employee and says 'you are not allowed to walk around here anymore because you are pregnant and your baby may be born with malformations' (...) W3.

The statements in the *Preventive measures* category point to an emphasis on personal protection measures, exemplified by the use of Personal Protective Equipment (PPE), such as gloves, mask and gowns.

One of the statements even shows the improvisation of the use of two masks while handling formaldehyde.

The statements also present the issue of PPEs for all types of work, especially the ones related to the use of formaldehyde and ganciclovir.

Another statement clearly emphasizes a possible collective protection measure concerning the staff's exposure to anesthetic products.

In the *Suggestions for Hazardous Chemical Waste Management* category, the issues *institution* and *staff* have emerged, as can be observed in the following statements:

(...) One day, while attending a lecture, effects such as abortion and even genetic alterations were addressed. There is a tremendous lack of information, especially here. People are not aware of how dangerous the waste products are and how much they can affect us. There is much misinformation, or to put it a better way, lack of training (...) W6.

(...) In my opinion, this is very far from being a training program. I'm still not sure. There are many important things to be known about hazardous chemical wastes (...) W1.

(...) I heard of a nursing technician that got sick and they had to choose between him and the peracetic acid. The person that worked with the materials was not able to handle that product anymore, as it provoked severe physical reactions. In the end, the employee had to be removed (...) W9.

(...) I don't know how the personnel feel, I don't know what's going on, but the alcohol causes several problems. I have been coughing because of the smell, I have even complained about it. We are provided with a complaint form, so I complained about the alcohol. I think that it's a different brand. Depending on the brand, it can be quite toxic and irritating to the respiratory tract. And this can be applied to every type of alcohol waste, whenever waste is present (...) W11.

(...) the hypochlorite is corrosive. Although everybody has already been oriented a thousand times, what usually happens is that prior to discarding the aspiration bottle, the nursing personnel make use of the hypochlorite. They prefer the smell of the hypochlorite, no matter how much you tell them that secretions do not have any effect, it's useless (...) W9.

(...) I noticed that the hypochlorite has been used a lot by the cleaning personnel to wash the bathroom, clean the floors and windows. The smell is unbearable (...) W9.

(...) Ganciclovir for the medical clinic, surgical clinic and Emergency Room. We wouldn't be able to tell you about the amount of waste because it depends a lot on the time (...) W6.

(...) We use ganciclovir in the Nursery, although it's rare, because it requires a medical prescription (...) nearly 24 ml/day and the treatment can last as long as 14 days (...) W18.

(...) The cyclophosphamide is occasionally used in the adult ICU and the medical clinic. So, we are not able to measure the amount of waste (...) W6.

(...) In order to handle the formaldehyde, I wear a gown and gloves, but my major concern is the mask; sometimes I even wear two of them, as the smell of the formaldehyde is very strong (...) W7.

(...) a doctor (...) is trying to couple a tube to the anesthetic equipment, so that it can exit the anesthetic room, but he has been found out (...) W3.

The contents of the statements clearly connect the suggestions to the following issues: training, the effects of overexposure to HCW, change of the product's trade mark or brand, misinformation regarding the type and quality of PPEs, and collective protection measures.

## DISCUSSION

The following issues are taken from the *first category*, identified as *Knowledge of Hazardous Chemical Waste Management*: Training and Phases regarding the handling of HCWM.

The study subjects' statements raise the issue regarding the lack of information on specific training programs for the management of hazardous chemical waste, as well as the insufficiency or inadequacy of information concerning the phases involved in handling HCW.

Data unveil the controversial view of the staff regarding training programs that only convey information through the establishment of norms and routines, meeting the needs of the moment and based on the organization of the work. The mere transference of information does not necessarily equate to knowledge<sup>(11)</sup>.

Dealing with waste training processes - and more specifically HCW - is a complex task. The statements point out the type of training that is carried out, revealing that the staff is explicitly dissatisfied with the education thus far received from the institution. More intense dissatisfaction is found among participants who have been working for more than ten years in the institution. This can be justified by the advancement of the discussions regarding Healthcare Service Waste in the last two decades.

The implementation of managerial strategies that can cross the borders of knowledge and promote deep reflection regarding the workers' actions are capable of effectively leading professionals to a change in behavior. The achievement of knowledge and awareness is only part of the solution. Professionals must be instructed as to the reasons why the adoption of attitudes supporting healthcare promotion, public healthcare and environmental preservation<sup>(11-12)</sup> are important steps to be taken.

In the *Knowledge of Hazardous Chemical Waste Management* category, the issue regarding the *Phases of HCWM* sought to capture the understanding of professionals on the handling phases of HCW within and outside the institution, from waste generation up to its final disposal process.

Statements shed light on the striking lack of knowledge regarding most of the detected hazardous chemical waste products. Professionals have an inadequate comprehension of the separation phase. Knowledge of the phases of packaging, identification, internal transport, temporary storage, treatment, external storage, external collection/transport and final disposal are utterly fragmented, showing that nursing professionals are totally unaware of how to handle the above-mentioned HCW.

The chemical waste's packaging must carefully identify the name of the product, physical and chemical properties and volume and packaging date, in addition to the hazard symbol that specifies the chemical product's flammable, corrosive, reactive and toxic properties<sup>(12-13)</sup>.

The *second category* is related to the awareness of exposure and the impact of exposure. This category produced the following issues: Nursing, Patients, and Multi-disciplinary Team.

Following the presentation of data regarding the training program and the phases of Hazardous Chemical Waste Management, this study sought to understand the perception of the subjects regarding their knowledge of the effects and impact of occupational exposure to waste.

Statements show that the perceptions of subjects are predominantly focused on finding out which healthcare team member - besides themselves - could be affected by the hazardous chemical waste. These perceptions are sometimes based on scientific facts; at other times, perceptions are strongly influenced by shared experiences or facts regarding exposure to the product and/or its waste.

The statements concerning *formaldehyde* point to a possible knowledge gap concerning how staff (nursing professionals, doctors and other staff members) are exposed whenever they make contact with the product and its HCW. The statements also reveal a period of time when this waste was drained into the sewage system. The situation indicates an exposure level that goes far beyond the institution's internal affairs. However, the study eventually determined that this product is usually separated.

When handling the substance and/or its HCW, workers are exposed to the various forms of the matter; for instance, the product's toxic liquid and vapor, which may cause mucosal irritation, dermatitis, asthma, bronchitis and pulmonary edema, in addition to mutagenic and carcinogenic effects<sup>(14)</sup>.

The perception of occupational risks to which the staff is exposed influences their behavior, as well as exposure to the handling of products generating hazardous chemical waste<sup>(15)</sup>.

The *third category* refers to the preventive measures, including PPEs and others. The statements of this category show an expressed emphasis on the use of PPEs as the most important element in protecting the staff against the presence of hazardous chemical waste.

The use of gloves, masks and gowns is indicated by the study's subjects as the main resource for protection of the staff when handling chemical waste, thus preventing either acute or chronic problems.

PPEs are always referred to by the staff as indispensable tools that allow them to be able to safely handle detected hazardous chemical waste. However, workers do not mention the use of safety goggles or caps, and only occasionally mention the use of aprons, as the gloves and masks are their major focus. Subjects make casual references to difficulties related to the use of masks against the exposure risks of handled HCW. Prevention is directly connected to use of PPEs. However, the use of masks is effective only when the nursing staff takes on a monitoring role in their own work environment.

PPE does not eliminate the action of the aggressive agent. Instead, it acts as an important barrier to minimize the intensity of the damaging effect, especially in accident prevention processes. PPEs must be compulsory and their use must be included into the HCSWMP<sup>(16-17)</sup>.

PPEs are indispensable during all handling phases, beginning with separation and up to and including final dis-

posal. The study references the use of PPEs only while the waste is being handled in the participants' own working area. This is a direct result of the fragmented knowledge of professionals regarding the product's handling phases. In addition, the staff does not mention whether or not PPEs are adequate protection while handling HCW.

The *fourth category* relates to the suggestions provided by the study participants regarding HCWM. The following issues emerged: institutional competence and professional competence.

The analysis of the perceptions of the nursing staff regarding their knowledge of HCWM, in addition to their awareness of exposure/impacts and preventive measures, allows us to compose a series of pertinent institutional and individual measures or suggestions, aimed at the adequate management of HCW by nursing professionals.

The study's subjects were given the opportunity to contribute their suggestions regarding HCWM based on their field experiences. Several conversations carried out among the study subjects allowed us to build an experience exchange platform that permitted a series of reflections regarding possible alternatives, which emphasized the implementation of training programs, the development of new products, teaching strategies for the handling of HCW, use of PPEs and collective protection measures.

The statements clearly show that the feasibility of both the individual and collective measures to promote the adequate management of HCW will not only depend on the nursing staff and/or doctors, among others, but also on isolated actions and endeavors geared towards solving the problem. The answer to this equation lays in the joint efforts of back-up sectors, such as the pharmacy, the continuing education department, the cleaning personnel, the Hospital Infection Control Commission (HICC), the Specialized Service in Safety Engineering and Labor Medicine (SSSELM), and the administrative and technical board of directors, among others.

The more frequently the staff is exposed to increasing amounts of hazardous chemical substances, especially when labor conditions are inadequate, the more the adverse effects provoked by the product's generated waste will cause adverse effects. Examples of this fact may be shown by poor training programs, absence of PPEs and inadequate collective protection measures. Collective protection measures depend, above all, on the institution and involve the following practices: replacement of toxic or harmful products, changes/alterations in processes, discontinuance or seclusion of a given harmful process, separation of the process, general dilution and local exhaust ventilation systems, and adequate maintenance<sup>(18-19)</sup>.

The scientific literature highlights that the labor conditions of nursing professionals in South American countries are worse than the labor conditions experienced by North Americans and Europeans, including the threats to health

resulting from the mishandling of chemical substances and generated waste<sup>(20)</sup>.

This present study supports the idea that the emergence of collective protection measures becomes more effective when they are created in close association and cooperation with the staff. Good examples would be the medical-sanitary surveillance carried out by the Medical Control Program in Occupational Health (MCPOH) and the Environmental Risk Prevention Program.

Nursing's current lack of knowledge, or fragmented knowledge, concerning HCWM in caring for patients has motivated the elaboration of a proposal for the adequate handling of HCW.

### **PROPOSAL FOR THE PROPER HANDLING OF HAZARDOUS CHEMICAL WASTE GENERATED IN THE USP-UH**

Taking the fourth category - *Suggestions for HCWM* - into account and based on ANVISA's legal provisions set forth by the Resolution of the Collegiate Board of Directors (RCBD) (RCBD number 306/04 - Technical Regulation for the Healthcare Service Waste Management); Decree CVS 21/08 (Technical Norm on the Management of Healthcare Service Medication Hazardous Waste); CETESB P4.262/07 (Management of Chemical Waste Originating in Healthcare Service Facilities); NR 32/05<sup>(21)</sup> (Safety and Health in Healthcare Labor); and ABNT's NBR 14725/09 (Chemical Products - Information on Safety, Health and Environment), a proposal was elaborated toward the management of hazardous chemical waste handled by nursing professionals in the USP-UH.

The proposal recommended the employment of an instrument called Information Form on Hospital Hazardous Chemical Waste (FIGERQP-HOSP)<sup>(8)</sup> as a management tool for the handling of chemical waste and as a training strategy for the professional nursing team.

After identification of the chemical products, the FIGERQP-HOSP must assess the following characteristics: stability, corrosivity, reactivity, toxicity, environmental information, active ingredients, classification, indications for CW separation, packaging indications, identification indications, indications for internal transport, indications for temporary storage, treatment indications for accidental exposure, indications for external storage, indications for collection and external transport, and indications for final disposal<sup>(19)</sup>, as follows:

*Identification and classification of HCW* - In accordance with the products' hazardous characteristics (flammable, corrosive, reactive and/or toxic product), the institution shall characterize its generated HCW (related or not to medications) according to RDC 306/04 and based on safety principles.



**Separation** – This process shall take place at the time the chemical waste is generated, according to its classification.

**Packaging** – The HCW shall be packaged properly, according to its physical status, so that potential leakage is prevented.

**Identification** – The identification of risks shall be present on all HCW packaging and containers, at the entrance of storage facilities (waste rooms and shelters, discharge and reception areas), on vehicles or containers used for internal transport, as well as on external transport collection vehicles.

**Internal transport** – During the transport phase, internal collection of HCW shall meet the demands of the generating facility concerning frequency and time schedules.

**General aspects of internal and external storage** – The HCW shelter shall be designed, built and operated in accordance with the following prerequisites: masonry-based, sealed construction equipped with screened windows that allow for adequate ventilation. When products are stored on shelves, the installation of tray-like spill concentration systems endowed with drains for eventual collection, or other appropriate collection system is recommended. The location of the facility shall provide users with easy access and internal/external collection operations.

**Collection and external transport** – HCW transport shall be carried out by vehicles that have received the Certification of Road Transport Training Program for Fractioned Hazardous Products. It shall also comply with Norms NBR 7.500, NBR 7.503 and NBR 9.735. HCW collection and external transport shall comply with the Approval Certification for Industrial Waste Destination (CADRI), issued by CETESB. The generating facility shall be held accountable for meeting collection companies to present a Declaration of Responsibility for Waste Collection (DRCR), which shall be attached to the HCSWMP of the hazardous chemical waste generating facility. HCW collection systems shall comply with in-force legislation regarding the transport of hazardous loads, as well as with the requirements of the Institute of Measures and Weights (IPEM).

**Treatment and final disposal** – The HCWMP shall specify the adequate treatment for each type of waste (external treatment for recovery, treatment for discharge or incineration). The final destination of hazardous chemical waste shall depend on CETESB's mandates and approval. In addition to the intended destination, the requirement shall also provide qualitative characterization information

and annual estimates for the generation of each type of waste, as well as the consent letter of the final destination and other documents related to the process. Treatment or final disposal facilities are subject to environmental licensing and registration with the State Sanitary Surveillance System (SEVISA). Treatment and final disposal of HCW shall comply with the Approval Certification for Industrial Waste Destination (CADRI) issued by CETESB, and/or a complimentary document that may be eventually requested, whenever the loads must be transported out of the state.

**Guidelines for Non-Hazardous Chemical Waste** – After being separated, non-hazardous solid or semi-solid chemical waste (lacking flammable, corrosive, reactive, and toxic properties) shall be packaged in plastic bags (NBR 9.191) in order to be discarded as a common waste in CETESB's properly licensed systems. Non-hazardous chemical waste that cannot be recycled in its liquid state shall be discarded, in isolation or conjointly, in sewage collection networks connected to treatment plants, given that they comply with the guidelines established by competent environmental authorities and water/sanitation resource managers.

The application of the FIGERQP-HOSP in the studied field institution, as well as in other hospital facilities in which nursing staff must handle hazardous chemical waste, will provide the professionals with the necessary knowledge to safely handle waste, as well as guidelines for the elaboration of a Hazardous Chemical Waste Management Plan generated in the hospital environment.

## CONCLUSION

This study showed that the management of hazardous chemical waste represents a problem for the nursing staff due to the lack of knowledge of the danger of the hazardous chemical wastes that they are exposed to. Moreover, it pointed out the lack of knowledge regarding the handling phases of such waste, the fragmentation of information on exposure and impacts on health and also the aspects related to applicable preventive measures.

The study, therefore, established a proposal toward the use of the Information Form on Hospital Hazardous Chemical Waste on all hazardous chemical waste generated in the studied institution. The instrument is potentially ready to comply with legal requirements and respond to the staff's need for information and suggestions.

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