



## Occupational hazards for nursing professionals related to the reuse and single use of the dialyzer\*

Riscos ocupacionais para profissionais de enfermagem relacionados ao reúso e uso único do dialisador

Riesgos ocupacionales para profesionales enfermeros relacionados con el reúso y el uso único del dializador

Olvani Martins da Silva<sup>1</sup>, Maria Conceição da Costa Proença<sup>2</sup>, Alessandra Rosa Vicari<sup>2</sup>, Karen Patrícia Macedo Fengler<sup>2</sup>, Cristina Karohl<sup>3</sup>, Eneida Rejane Rabelo-Silva<sup>4</sup>

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<sup>1</sup> Universidade do Estado de Santa Catarina, Departamento de Enfermagem, Chapecó, SC, Brazil.

<sup>2</sup> Hospital de Clínicas de Porto Alegre, Serviço de Nefrologia, Porto Alegre, RS, Brazil.

<sup>3</sup> Universidade Federal do Rio Grande do Sul, Faculdade de Medicina, Porto Alegre, RS, Brazil.

<sup>4</sup> Universidade Federal do Rio Grande do Sul, Programa de Pós Graduação, Porto Alegre, RS, Brazil.

### ABSTRACT

**Objective:** To compare the reports of occupational events recorded by nursing professionals during the periods of reuse and single use of the dialyzer. **Method:** Retrospective longitudinal study with electronic medical records from nursing technicians of a hemodialysis service. Data were analyzed descriptively and Rate ratio. **Results:** During the reuse of the dialyzer, there were seven events from five professionals reporting musculoskeletal disorders, ocular allergies and dermatosis. During single use, two professionals reported low back pain. The rate ratio of medication use was 6.7 days for every 1000 professionals during the reuse period and 1.52 days in the single use period (RR=4.4; 95% CI 2.182-9.805). Anti-inflammatory drugs were the most prescribed, and sick leaves were similar in both periods. **Conclusion:** Dialyzer reuse was associated with musculoskeletal disorders, ocular irritation, dermatosis and increased use of medications by professionals. Sick leaves were similar on the periods of dialyzer reuse and single use.

### DESCRIPTORS

Nursing, Team; Renal Dialysis; Equipment Reuse; Occupational Risks; Occupational Health.

### Corresponding author:

Olvani Martins da Silva  
Rua Sete de Setembro, 91D  
CEP 89801-140 – Chapecó, SC, Brazil  
[olvani.silva@udesc.br](mailto:olvani.silva@udesc.br)

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## INTRODUCTION

The evolution of the dialyzers over time, up to the current models, is undeniable. It is possible to point to the improvement of the membranes, the better biocompatibility and efficiency of solute clearance, and the recent introduction of nanotechnology<sup>(1)</sup>.

However, the uncertainties and speculations around the dialyzer refer to elucidating its best use: whether reuse or single use. In the chronological course of its evolution, many sterilants and germicides have been tested, and even today, the most used method for the dialyzer processing is peracetic acid<sup>(2)</sup>.

Seeing that there is no conclusive opinion on the best use of the dialyzer, its reuse still occurs in many countries<sup>(3)</sup>. If, on the one hand, speculation regarding cost containment seems to be what supports its reuse<sup>(4)</sup>, on the other, proponents of the single use rely on evidence related to greater security and better survival of patients<sup>(2)</sup>.

Most of the studies on the subject<sup>(4-5)</sup> focus on comparing the reuse and single use of the dialyzer and their repercussion on solute removal, dialysis efficiency and economic costs. Little attention has been given to the risks and injuries to the health of the nursing professional who carries out the reuse of the dialyzer. Activities routinely performed in many dialysis centers expose professionals to the risk of accidental contact with biological material and chemicals used in the cleaning and disinfection process<sup>(6)</sup>.

Reports found in the literature suggest that health risks arise from the manipulation of toxic substances, such as peracetic acid (Proxitane<sup>®</sup> and Renalin<sup>®</sup>), used to sterilize the dialysis system and disinfect the machines. This substance can cause injuries, such as allergies, burns and can even induce cancer<sup>(6)</sup>.

Direct contact with this product is harmful to the skin and causes irritation to the mucous membranes of the eyes and to the respiratory tract, with symptoms such as discomfort and pharyngeal irritation. Exposure to aerosols generated from diluted substances was associated with lacrimation<sup>(7)</sup>, which can be intensified in small, poorly designed locations with little air circulation<sup>(6)</sup>.

In addition to the risk of allergic processes, the risks of musculoskeletal disorders in the reuse room can also be highlighted. Data from a recent study that examined the health problems of workers of a hemodialysis service demonstrated that the back pain and lower limb pain reported by these workers were considered severe. In addition, physical damage was associated with medical treatment leave<sup>(8)</sup>.

Data from a hemodialysis service reinforced these findings by indicating that the professionals' leaves were related to musculoskeletal system disorders, with predominance of pain in the spine and upper limbs<sup>(9)</sup>.

Thus, the risks to the health of professionals associated to the use of germicides refer to exposure of the respiratory mucosa, skin and eyes to possible lesions<sup>(7)</sup>. Added to these risks are the musculoskeletal disorders, caused by the use of physical force, which leads to fatigue, pain and sick leaves<sup>(6)</sup>. The studies available in the literature addressing the health of the professional in the hemodialysis service<sup>(8,9)</sup> and the reuse of the dialyzer<sup>(10)</sup> are incipient and do not compare the longitudinal effect of dialyzer reuse and single use on the health of professionals who carry out this practice.

Similarly, government agencies have also weighted the risks posed to the nursing team that practices reuse on their decision regarding the suspension or consolidation of this practice. It was in this scenario of uncertainties regarding the best practices in hemodialysis<sup>(11)</sup> that the present study was conducted, with the objective of evaluating the process of change from the reuse technique to the single use and its repercussion for the health of the professionals. This study is relevant because it provides important information about the effect of these two methods and their implications for the health of professionals. In view of the above, the objective was to compare the reports of occupational illnesses recorded by nursing professionals during the periods of reuse and single use of the dialyzer.

## METHOD

### TYPE OF STUDY

Longitudinal study, with retrospective data collection.

### SCENARIO

The study was conducted in the Hemodialysis Service of a public teaching hospital in the Southern region of Brazil. The manual reuse of the capillary dialyzer at the institution occurred since the implementation of that modality of hemodialysis, on June 1975, until February 2013, totaling 37 years. The unit had two dialyzer-processing rooms, one for hepatitis C patients, and one for non-carriers. The rooms were equipped with specific cleaning benches, treated water, and deep tubs. In the same place, sterilizing solutions and dialyzers were stored in order to avoid contamination.

During the period of reuse of the dialyzers, the professionals carried out the activity, on average, twice a week, with an approximate time of 4 hours, during which they performed nine reuses per shift of the chronic patients in dialysis programs, in addition to the acute patients, according to the demand. The reuse routine occurred by the manual reuse technique, with a maximum number of 11 reuses of the same dialyzer (12 uses), according to the Resolution of the Collegiate Board, RDC 154, of 2004, in force in that period. The germicidal solution used was Proxitane<sup>®</sup> (peracetic acid at 0.2% concentration). In March 2013, the institution started to implement the single use dialyzer, which remains to this day. Since 2014, the unit adhered to the new guidelines published on Resolution RDC 11, of March 2013, which establishes good practices for the functioning of the dialysis services<sup>(11)</sup>.

### POPULATION

The unit's Nursing team consisted of 30 professionals, 10 nurses and 20 Nursing technicians, who had a workload of 36 hours per week, distributed in the morning, afternoon and evening shifts. This staff remained stable, and the unit did not change the number of points for dialysis during the study.

The period of analysis of medical records was from March 2012 to March 2014, accounting for 1 year of analysis during reuse and 1 year during single use.

The electronic records referring to all the nursing technicians who worked in the hemodialysis unit during this

period, which were available at the Occupational Medicine Service of the Hospital de Clínicas of Porto Alegre, were included in the study. Nursing technicians who worked in only one of the periods (reuse or single use) and nurses, who did not carry out the reuse technique, were excluded.

Outcomes of interest were Work-Related Musculoskeletal Disorders (WRMD): muscular, tendon, joint, nerve and ligament disorders, often associated with tissue alteration characterized by pain, paresthesia, sensation of weight and fatigue in the upper limbs and scapular region related to the executed work<sup>(12)</sup>. The term musculoskeletal disorder was chosen instead of musculoskeletal disease because it is a term used as a descriptor in other studies.

Ocular and skin allergies of the nursing team associated with contact with chemical substances, such as peracetic acid, used for the disinfection and sterilization of the dialyzers<sup>(13)</sup>, had the following characteristics: ocular irritation: foreign-body sensation, lacrimation and hyperemia<sup>(14)</sup>; dermatosis: inflammatory disorder of the skin, manifested by erythema and vesiculation in the acute phase, dryness and cracking of the skin in the chronic phase, usually present on hands and face due to exposure to irritating substances, such as chemicals<sup>(15)</sup>; use of medications: medications used to treat musculoskeletal disorders or allergies were considered; sick leaves caused by repetitive movements in the reuse room<sup>(13)</sup> or by allergies.

## DATA COLLECTION

For the data collection, there was an initial face-to-face meeting with all the nursing technicians and the head of the unit, with the purpose of presenting the objectives of the study and collecting the signatures of the Informed Consent Term (TCLE). The data used to characterize the sample were taken from the medical records through a structured instrument including socio-demographic variables, such as gender, level of education, marital status, time of work in hemodialysis, work shift, time of exposure to the reuse room, work journey and variables related to the events reported (notification period, type of occurrence, signs and symptoms reported, nature of the notification, site affected, use of medication and number of days, work sick leave and number of days).

## DATA ANALYSIS AND TREATMENT

Data analysis was performed with the Statistical Package for Social Sciences (SPSS), version 18.0. Categorical variables were described with relative frequencies and percentages. For the continuous variables, the Kolmogorov-Smirnov test was used to verify the normality, and, when the normal distribution was verified, their means and standard deviation were expressed. For the other variables, the median and the interquartile range were used.

The notifications of the professionals regarding sick leaves and use of medications were analyzed through descriptive statistics. For the calculation of use of medication among professionals, the Rate ratio (RR) was calculated as the effect measure.

## ETHICAL ASPECTS

The project complied with the guidelines of Resolution n. 466/2012, of the National Health Council, which determines the

regulatory norms for research involving human beings. The study was submitted to the Research Ethics Committee of the institution and approved on 12/16/2014, under protocol no. 924.238.

## RESULTS

Of the 20 medical records of nursing technicians who worked in the hemodialysis sector during data collection, two were excluded: one because the professional was not working during the reuse phase and another because the professional was on leave due to chronic disease.

Eighteen medical records of nursing technicians were included in the two phases of the study. The mean age was  $38 \pm 5$  years (minimum 30, maximum 47 years) and female workers were predominant. The mean time of work in the hemodialysis service was  $12 \pm 7$  years. The number of employees per shift was proportional in both periods, as well as the number of chronic kidney patients attended by these professionals. Only two professionals had a double bond employment relationship.

## NOTIFICATIONS OF OCCURRENCES IN THE MEDICAL RECORDS OF NURSING TECHNICIANS

During the period of reuse of the dialyzer, seven notifications were registered in the medical records of five nursing technicians. The records reported work-related musculoskeletal disorders (WRMD), namely wrist and elbow tendinitis and scapular pain; ocular allergies manifested by irritation or redness of the eyes; and dermatosis, with presence of friction abrasions on the face due to the use of the coal mask. Pain was described in five (71%) reports, corresponding to 28% of professionals.

In the single-use period, there were no reports of musculoskeletal disorders in the upper limbs. Likewise, no occurrence of ocular or cutaneous allergy was reported. In this period, two professionals reported low back pain. Data presented in Table 1.

**Table 1** – Notifications of events among nursing technicians professionals working in the hemodialysis service during the reuse and single-use of the dialyzer – Porto Alegre, RS, Brazil, 2016.

Variables	Reuse (n=18)		Single use (n=18)
	1 <sup>st</sup> Notification	2 <sup>nd</sup> Notification	1 <sup>st</sup> Notification
<b>Event and/or injury</b>			
Yes	5 (28%)	2 (11%)	2 (11%)
<b>Classification of the notification</b>			
Musculoskeletal Disorder	3 (17%)	1 (6%)	---
Ocular Allergy	1 (6%)	1 (6%)	---
Skin Allergy	1 (6%)		---
<b>Definition of the notification</b>			
Eye irritation and redness	1 (6%)	1 (6%)	---
Friction abrasion	1 (6%)	--	---
Scapular pain	1 (6%)	---	---
Elbow and wrist tendinitis	2 (11%)	1 (6%)	---
Low back pain	---	---	2 (11%)
<b>Presence of pain (notifications)</b>			
Yes	4 (57%)	1 (14%)	2 (100%)

Note: Musculoskeletal disorders (elbow and wrist tendinitis and scapular pain).  
Note: Values expressed in n (%).

## USE OF MEDICATION AFTER NOTIFICATION OF OCCURRENCES AND WORK SICK LEAVES

After reporting the occurrences, the professionals used medication for 44 days during the reuse period. During the single use of the dialyzer, the use of medication was for 10 days. The rate of medication use was 6.7 days for every 1,000 professionals during the reuse dialyzer period, and 1.52 days for every 1,000 professionals in the single-use period, an RR=4.4; CI 95%: 2,182-9,805. The most prescribed group of drugs was anti-inflammatory drugs on both periods. The sick leaves were similar in both periods, according to Table 2.

**Table 2** – Use of medications after notifications of occurrences and sick leaves among nursing professionals during the reuse and single use of the dialyzer – Porto Alegre, RS, Brazil, 2016.

Variables	Reuse (n=18)		Single-use (n=18)
	1 <sup>st</sup> notification	2 <sup>nd</sup> notification	1 <sup>st</sup> Notification
<b>Use of medications after the notification</b>			
Yes	4 (22%)	2 (11%)	2 (11%)
<b>Group of medications</b>			
Corticoid and antibiotic	1 (6%)	1 (6%)	--
Anti-inflammatory	3 (16%)	1 (6%)	2 (11%)
<b>Needed work sick leave</b>			
Yes	1 (6%)	1 (6%)	2 (11%)
Days of absence	3 days	2 days	4 days

Note: Values expressed in n (%).

## DISCUSSION

This study provides unprecedented information regarding the effects of the reuse and the single use of the capillary dialyzer on the health of the nursing professional who carries out this procedure. The results indicated a greater occurrence of occupational illnesses among professionals during the period of reuse of the capillary dialyzer. Among the professionals studied, musculoskeletal disorders related to the upper limbs and greater use of medications were the predominant health implications during the reuse period. The sick leaves were similar in the two periods.

In the hemodialysis service, professionals perform many activities, including dialysis reprocessing, a procedure that begins with its removal after hemodialysis, followed by cleaning, verification of integrity and measurement of internal fiber volume, sterilization, labeling and storage of the dialyzer<sup>(11)</sup>. However, the cleaning step sometimes requires striking maneuvers to effectively detach blood clots. The use of strokes on the lines of the dialyzers is carried out with the aid of metal tweezers or metal and resin hammers, in order to facilitate the internal cleaning of the system. This practice is not recommended for the dialyzer and is only used in some hemodialysis services<sup>(10)</sup>. The repetition of monotonous and fast-paced movements during this activity may have contributed to pain complaints related to the upper limbs of the professionals surveyed. There are no studies that investigated it in the literature, which makes it difficult to compare these findings.

However, a prospective cohort investigated the physical and psychosocial demands related to the work of nursing technicians and assistants and evidenced a high exposure to repetitive hand movements. The results indicated that the use of muscular force on the arms and hands is common in the execution of work. The prevalence of WRMD in a segment of the body was 83.4%, with 33.8% prevalence in the shoulders. In general, 57.1% of the professionals had the highest prevalence in the neck, shoulder or upper back and 32.8% in the extremities of the upper limbs, such as elbow, forearm, wrist and hand<sup>(16)</sup>. These findings were demonstrated in a public hospital; however, they confirm that the work performed by nursing technicians may lead to the development of upper limb injuries. When thinking about the dialyzer's reuse room, this probability is increased, since, in addition to the force used, the shortage of time, the excessive activity and the repetition of movements are also issues.

Another study used a risk map and observations of the postures of the professionals in a hemodialysis service in the South of Brazil and discovered that the tasks performed by the workers were repetitive. Most interviewees reported some kind of work-related problem. Pain was the most reported symptom, followed by fatigue and loss of muscle strength. The most compromised parts of the body were the neck, shoulders and arms<sup>(17)</sup>.

In addition to the risks of musculoskeletal disorders, the segment of the upper limbs, especially the hands, are at risk of developing skin allergies by exposure to chemicals. However, in this study, skin dermatitis found during the reuse period was located in the facial region, due to the friction caused by the use of mask.

The facial region had the highest number of reports of allergic processes during the reuse of the dialyzer, in particular by ocular irritation. The occurrence of allergies among nursing professionals in hemodialysis services may be related to exposure to chemical substances used during the reuse of dialyzers<sup>(13)</sup>. These assumptions are reinforced by a study that identified the occupational hazards to which hemodialysis professionals are exposed. The results indicate that the chemical risks were associated with toxic products handled in the reuse room, such as Renalin<sup>®</sup> and Proxitane<sup>®</sup> (peracetic acid mixture), which may cause allergies when not properly diluted<sup>(6)</sup>.

This finding was corroborated by a recent literature review that analyzed the toxicity data for peracetic acid deriving from occupational exposure limits and found that it was extremely irritating to the upper respiratory tract and caused itching in the face, extreme discomfort of mucous membranes, redness and eye tearing, all depending on the concentration of the product<sup>(18)</sup>.

Exposure to chemical agents progressively and slowly compromises the health of the professional, who does not perceive the damage suffered over time in the work environment until the first cumulative effects appear which may be mild or severe. A study conducted in a dialysis unit addressed the concern about long-term effects by verifying the professionals' perception of the risk exposure in the unit, indicating concern about respiratory, integumentary and ocular damage that may occur in the future<sup>(19)</sup>.

The analysis of data on the single use of the dialyzer in this study found reports of low back pain, a frequent symptom in

nursing work. This was only found in the single use period; however, it does not indicate that the professionals were immune to low back pain during the reuse period. Instead, it is possible that, during this period, pain in the upper limbs due to repetitive and constant movements in the reuse room overshadowed symptoms in other anatomical segments.

Long working hours, inadequate posture during the venipuncture procedure, inadequate transportation of patients, poorly designed physical structure of the units, physical effort and repetition of tasks are aspects that contribute to pain and overload of the spine<sup>(6)</sup>.

In this study, the occurrence of musculoskeletal and allergic disorders led professionals to use medications and, sometimes, work sick leaves. The most common drug class was non-steroidal anti-inflammatory drugs (NSAIDs). The use of NSAIDs is associated with risks of bleeding and cardiovascular diseases, as demonstrated by a meta-analysis, which included 31 randomized clinical trials evaluating seven different NSAIDs and found that ibuprofen was associated with an increased risk of stroke, followed by diclofenac. The latter was also associated with an increased risk of death from cardiovascular disease<sup>(20)</sup>.

There are recommendations of caution with the use of NSAIDs for the treatment of musculoskeletal pain and prescribers and patients are aware of their risk and benefit<sup>(20)</sup>. However, in this study, it was the most common drug of choice for treatment. Untreated pain reduces efficiency, generates suffering and leads to work sick leaves, bringing negative consequences for the organization of the work, as it interferes with patient care, causes work overload<sup>(21)</sup> and generates additional costs for the replacement of missing personnel.

Sick leaves due to musculoskeletal disorders and skin lesions, in this study, lasted five days during reuse, compared to four days in single use. This aspect does not allow comparisons with other studies available in the literature due to

lack of investigations that address the reuse and single use of the dialyzer and its implications for the health of professionals. A study in the context of hemodialysis addressing the workers' sick leave investigated indicators of pleasure and suffering related to work characteristics. However, their purpose was not to investigate the cause of the leave<sup>(22)</sup>.

Finally, the data presented in this study indicate that nursing professionals are at greater risk of occupational illnesses with detrimental effects on their health during the dialyzer reuse technique.

Despite the fact that this study was conducted in a single center, which currently has already adhered to the single use method, the results presented here suggest there are damages to the health of the professionals who are exposed to the reuse practice. Additionally, these results may help competent bodies to see the risks of reuse not only regarding patients, but also on professionals.

It is important to point to the fact that this study only considered the professionals' leave described in the medical records concerning WRMD and allergies. This data was obtained in an electronic medical record and, therefore, is subject to bias of retrospective data recording. Sample size and follow-up period may also be increased in future studies, in order to strengthen these findings.

## CONCLUSION

The comparison between occupational occurrences during the periods of reuse and single use of the dialyzer revealed more musculoskeletal disorders, ocular irritation and dermatosis among the professionals during the reuse period. There was also a significant difference regarding medication use, with the single use characterized with a lower rate of notifications and use of medications. Sick leaves were similar in the two periods.

## RESUMO

**Objetivo:** Comparar as ocorrências ocupacionais registradas pelos profissionais de Enfermagem durante a utilização do dialisador reutilizado e de uso único. **Método:** Estudo longitudinal, retrospectivo, realizado com prontuários de técnicos de Enfermagem de um serviço de hemodiálise. Os dados foram analisados descritivamente e calculados pela Razão de Densidade de Incidência. **Resultados:** Durante a reutilização do dialisador, foram registradas sete notificações de cinco profissionais relacionadas a distúrbios osteomusculares, alergias oculares e à dermatose. Durante o uso único, dois profissionais registraram dor lombar. A taxa de exposição ao uso de medicamentos foi de 6,7 dias para cada 1.000 profissionais no período de reutilização do dialisador e de 1,52 dias no período de uso único (RDI=4,4; IC 95%: 2.182-9.805). Os anti-inflamatórios foram os mais prescritos, e os afastamentos do trabalho foram semelhantes nos dois períodos. **Conclusão:** O reúso do dialisador esteve associado a distúrbios osteomusculares, irritação ocular, dermatoses e maior uso de medicamentos pelos profissionais. Os afastamentos do trabalho foram semelhantes durante o uso do dialisador reutilizado e de uso único.

## DESCRIPTORES

Equipe de Enfermagem; Diálise Renal; Reutilização de Equipamento; Riscos Ocupacionais; Saúde do Trabalhador.

## RESUMEN

**Objetivo:** Comparar las ocurrencias ocupacionales registradas por los profesionales enfermeros durante la utilización del dializador reutilizado y de uso único. **Método:** Estudio longitudinal, retrospectivo, realizado con fichas de técnicos de Enfermería de un servicio de hemodiálisis. Los datos fueron analizados descriptivamente y calculados por la Razón de Densidades de Incidencia. **Resultados:** Durante la reutilización del dializador, fueron registradas siete notificaciones de cinco profesionales relacionadas con distúrbios osteomusculares, alergias oculares y dermatosis. Durante el uso único, dos profesionales registraron dolor lumbar. La tasa de exposición al uso de fármacos fue de 6,7 días para cada 1.000 profesionales en el período de reutilización del dializador y de 1,52 días en el período de uso único (RDI=4,4; IC 95%: 2.182-9.805). Los antiinflamatorios fueron los más prescritos, y las bajas laborales fueron semejantes en ambos períodos. **Conclusión:** El reúso del dializador estuvo asociado con distúrbios osteomusculares, irritación ocular, dermatosis y mayor uso de fármacos por los profesionales. Las bajas laborales fueron semejantes durante el uso del dializador reutilizado y de uso único.

## DESCRIPTORES

Grupo de Enfermería; Diálisis Renal; Equipo Reutilizado; Riesgos Laborales; Salud Laboral.

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