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RESEARCH

The nurse's work on identification of occupational risks in hyperbaric medicine

O enfermeiro do trabalho na identificação dos riscos ocupacionais em medicina hiperbárica

La enfermera del trabajo en la identificación de riesgos laborales en medicina hiperbárica

Gabryella Vencionek Barboza ¹, Elaine Antunes Cortez ², Geilsa Soraia Cavalcanti Valente ³

ABSTRACT

Objective: to elaborate the risk map; identify the occupational risks to workers in a clinical of hyperbaric medicine, to describe actions / preventive measures for the nurse's work to reduce the risks. **Method:** This is a descriptive and an exploratory study, with a qualitative approach. The risk map was developed using the Adobe Illustrator CS3, after authorization. **Results:** the work of professionals in clinical of Hyperbaric Medicine is enveloped in several occupational risk factors, highlighting the probability of fire or explosion that can cause harm to workers' health and even death. The nurse's work could act guiding / educating workers about the importance of using strategies to remove / keep away from all sources of ignition in the presence of oxygen. **Conclusion:** The preparation of the risk map is of paramount importance for the diagnosis of occupational risks and, therefore, the planning of preventive measures aimed at promoting the health of workers in this area. **Descriptors:** Hyperbaric medicine, Nursing, Occupational risks, Risk map.

RESUMO

Objetivo: elaborar o mapa de risco; identificar os riscos ocupacionais ao trabalhador da clínica de medicina hiperbárica; descrever ações/ medidas preventivas do enfermeiro do trabalho para minimizar os riscos existentes. **Método:** estudo descritivo e exploratório com abordagem qualitativa. O mapa de riscos foi elaborado utilizando-se o programa Adobe Illustrator CS3, após autorização. **Resultados:** o trabalho dos profissionais nas clínicas de Medicina Hiperbárica está envolto em vários fatores de risco ocupacional, destacando-se a probabilidade de incêndio ou explosão que podem ocasionar danos à saúde dos trabalhadores e até mesmo a morte. O enfermeiro do trabalho pode atuar orientando/educando os trabalhadores quanto à importância de utilização de estratégias para eliminar/manter afastadas todas as fontes de ignição na presença de oxigênio. **Conclusão:** a elaboração do mapa de riscos é de primordial importância para o diagnóstico dos riscos ocupacionais e conseqüentemente para o planejamento de medidas preventivas, visando à promoção da saúde dos trabalhadores. **Descritores:** Medicina hiperbárica, Enfermagem, Riscos ocupacionais, Mapa de risco.

RESUMEN

Objetivo: elaborar el mapa de riesgos; identificar los riesgos laborales a los trabajadores en una clínica de Medicina Hiperbárica; describir las acciones y medidas preventivas para el trabajo de la enfermera para reducir los riesgos. **Método:** estudio descriptivo y exploratorio con un enfoque cualitativo. El mapa de riesgo fue desarrollado usando el Adobe Illustrator CS3, con previa autorización. **Resultados:** el trabajo de los profesionales en las clínicas de Medicina Hiperbárica está envuelto en varios factores de riesgo laboral, destacando la probabilidad de incendio o explosión que puede causar daño a la salud de los trabajadores e incluso la muerte. La enfermera debe educar a los trabajadores sobre la importancia de la utilización de estrategias para eliminar toda fuente de ignición en presencia de oxígeno. **Conclusión:** La preparación del mapa de riesgos es de suma importancia para el diagnóstico de riesgos laborales y por lo tanto la planificación de medidas preventivas encaminadas a la promoción de la salud de los trabajadores. **Descriptor:** Medicina hiperbárica, Enfermería, Riesgos laborales, Mapa de riesgos.

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INTRODUCTION

The work can be seen as a set of actions and operations of the person who performs, involves the use of human energy in several respects, involving the dimensions of physical, psychological, emotional and social, therefore, plays a key role in the integration of individuals in world, contributing to the formation of identity, subjectivity construction, allowing them to participate in social life, being essential to health. However, the conditions in which work is organized and run, translate into much risk and its impact on the health and life of the worker, which may result in adverse effects, including illness and death.¹

The impacts and effects on human health and the environment as a result of work activities and work processes have always aroused interest and concern of the whole society. Bernardino Ramazzini was in 1700, in his famous work *De Morbis Artificum* demarcated the work process as a risk factor for the development of various diseases.²

Given this scenario, the company returns to discuss and seek measures and actions to minimize, prevent and control factors inherent to the work process, responsible for illness, disability and death of workers.³ It should be noted that occupational diseases are a major public health problem worldwide, but historically health professionals were not considered high risk category for accidents.⁴

In the context of the Clinical Hyperbaric Medicine, the conditions under which work is performed, holds itself, by its very nature, an element of risk that is peculiar, abnormal work pressures, causing the dissociation of gases within the body human. Among them, the gases that come off of its conjugated form to the free form, such as hydrogen, nitrogen and oxygen, in this state, cause diseases or hyperbaric barotrauma, decompression illness, as well as intoxication and narcosis.⁵

Brazilian law through Decree 3214/78 of the Ministry of Labor and Employment - MTE sets the Norm - NR15, recommendations and specific criteria for the protection of workers under hyperbaric conditions and accident prevention. Clinics of Hyperbaric Medicine offer hyperbaric oxygen therapy (HBOT), the main method of treatment prescribed by specialists in this branch of medicine, which covers the prophylaxis and treatment of complications resulting from human exposure to hyperbaric environments and several other pathological conditions, such as injuries chronic ulcerated.⁶

The Clinics of Hyperbaric Medicine usually owns a multiplace camera, offering advantages such as cost X productivity also allows direct monitoring of the patient through an internal guide (doctor, nurse or nursing technician) which is inside the chamber during treatment hyperbaric with easier identification of problems and early intervention, better emotional support and also childcare therefore presents disadvantages as the exposure of staff, large number of professionals, physical space and professionals involved.⁷

Treatment by HBOT is still very limited availability in Brazil, but it is a specialty that is growing every day and the breadth of his statements indicates its importance to health. However, it is appropriate to emphasize the current trend in the training of nursing staff to work in hyperbaric chambers located in hospitals or clinics. Education and job training are strategies to be explored with a view to implementation of quality standards and accident prevention, considering the types of cameras or single seat multiplace profile and severity of clients assisted, since the training and qualification of professionals nursing to work in hyperbaric chambers are not part of the programs of undergraduate, graduate and nursing.⁸

In this perspective, it is possible to observe several factors that may contribute to the occurrence of accidents, together with the issue of the presence of occupational hazards, and directly influence the working process of the teams entered in clinical hyperbaric medicine. For the safety of the patient environment and worker, preventive measures should be taken in hyperbaric medicine service, and must take into account, among others, the reactive nature of oxygen at high temperatures and in the presence of metals, their own health conditions aggravated the work situation and the presence of several risk factors in places where they perform their activities.⁹

In the case of curative and ensuring rehabilitation of population health, the role of the nursing staff, as well as other health workers, can not dispense with respect to job satisfaction and maintaining a comfortable environment without risks health and safety at work.¹⁰

In this context, have as **object**: the role of the nurse work against occupational hazards in a clinical of hyperbaric medicine. This time, the research **objectives** were: Mapping the occupational risks of the clinical in research; Identify occupational hazards to workers; Describe actions / preventive measures of nurse's work to minimize the risks in a clinical of hyperbaric medicine, based on the map risks.

METHODOLOGY

This is a qualitative, exploratory and descriptive research¹¹. The methodological approach was qualitative.^{12:116}

We conducted a survey of occupational hazards through the construction of a Risk Map in a Clinical Hyperbaric Medicine (Specialized Wound Care Diseases and Decompression), located in the municipality of Cabo Frio-RJ, after written authorization by the general direction the service. This scenario was chosen because one of the researchers performing work activities at that location.

The working population of Clinical Hyperbaric Medicine is comprised of a team covering 4 hyperbaric doctors, 1 nurse, 3 nursing technicians, one administrator, one receptionist, one general assistant, 1 maintenance technician, totaling 12 professionals. This team works according to the clinical criteria and protocols for the use of hyperbaric oxygen therapy (HBOT), which are directly linked to the quality of the treatment program

regards the specialized medical management, control, and periodic monitoring of the injury, skilled nursing for assessment and curative indication, physiotherapy, dietary advice, surgical debridement and hyperbaric oxygen therapy.

Taking into account the working process of the team Clinical Hyperbaric Medicine in question, the risk map was developed from the recognition of each compartment that comprises the clinical and hand-drawn on A4 for further computerization using the program Adobe Illustrator CS3.

The identification of occupational hazards was made through a theoretical analysis and recognition of these risks using the parameters of Regulatory Standard NR 9 which deals with environmental risks, and subsequently located geographically in the plant clinic as the identification and characterization of potential risks to site workers.

As risks have been identified, suggestions were made based on NR6 - Personal Protective Equipment in NR15 - Unhealthy Activities and Operations in NR17 - NR32 and Ergonomics - Health and Safety in Health Services These suggestions aim to propose ways to minimize or neutralize these risks with a view to health and quality of life of the worker.

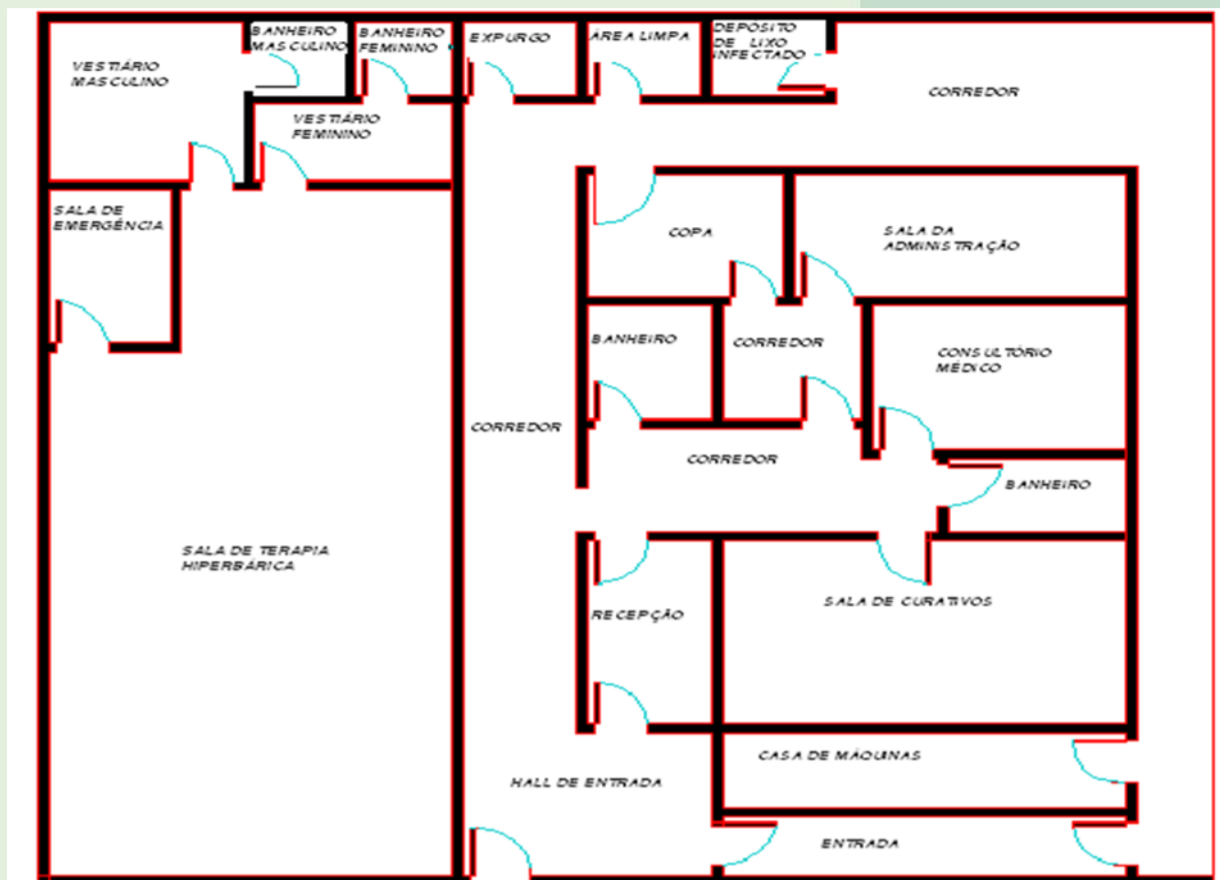
RESULTS AND DISCUSSION

Mapping of environmental risks is a technique employed to collect as many information as possible about the risks present in the workplace.¹³ It is a graphical representation of a set of factors present in the workplace capable of causing harm to the health of workers. Created by Italian workers as an instrument of knowledge and action on health issues in the workplace, has been adopted and adapted to the Brazilian context. This allows making a diagnosis of the health and safety of work in companies for the purpose of establishing preventive measures.¹⁴

Such risk factors arise in the various elements of the work process (materials, equipment, facilities, supplies, and work spaces, where the changes occur) and the form of organization of work (physical arrangement, responsibility, control mechanisms the pace of work, the operative mode, monotony, repetitiveness, work method, hierarchy, shift work, working posture, training, etc.).

The risks were divided into five groups sorted by colors that match a specific agent type: red, chemical risk, green, physical risk; brown, biohazard, yellow, and blue ergonomic risk, risk of accidents.

Thus, in Figure 1, there is the risk map of Clinical Medicine Hyperbaric searched:



CAPTION:

- ◆ PHYSICAL RISK
- ★ CHEMICAL RISK
- BIOHAZARD
- ERGONOMIC RISK
- ▲ RISK OF ACCIDENTS

- Presentation of recommendations for improving the environment of the risks identified

After making the risk map and recognition of the presence of occupational hazards to which the worker is exposed in the workplace, it is possible to operate with preventative measures to eliminate or minimize those risks with the goal of providing the health worker with the dissemination and implementation of the risk map in the workplace.

It is important to highlight the need to understand how problems occur within the work processes, and through what mechanisms affect workers, which can be achieved by analyzing the relationships of these technical and organizational processes, and with the participation of workers in construction risk map, providing socialization of collective knowledge and seeking solutions to improve working conditions,¹⁵ in order to control occupational hazards, otherwise generate occupational diseases and accidents at work.¹⁶

Regulatory norm nº 6 (NR6) - Personal Protective Equipment - PPE, states that the company is required to provide to employees, free, personal protective equipment appropriate to the risk and in perfect condition and operation, where the measures of

general do not provide complete protection against the risks of accidents and injury to health of employees.¹⁷

Regulatory norm n. 15 (NR15) - Activities and Operations Unhealthy - are described activities, operations and unhealthy agents, including their tolerance limits, thereby defining the situations when experienced in the workplace by workers have inspired the characterization exercise unhealthy, and also the means to protect workers from such exposures are harmful to your health.

Regulatory norm n. 17 (NR17) - Ergonomics - aims to establish parameters for the adaptation of working conditions psychophysiological conditions of workers in order to provide maximum comfort, safety and efficient performance.¹⁷

As for Norm from n. 32 (NR32) - Safety and Health at Work in Health Services - is to establish the basic guidelines for the implementation of measures to protect the safety and health of workers in establishments of health care, as well as those who exercise promotion activities and health care in general. For the purpose of this NR is meant by appropriate health care, any building for the provision of health care to the population at any level of complexity in inpatients or not.¹⁷

Thus, in Figure 2 shows the identification of the physical risks with their generating sources and recommendations:

Figure 2 - Classification of physical risks identified (group 1: green), and its main source generating recommendations.

PHYSICAL RISKS	GENERATING SOURCE	RECOMMENDATIONS
Unstable temperature and poor air circulation	The dressing rooms, doctor's Office, directors have little air circulation and influence on room temperature. There is no air-conditioning system in these compartments.	Improve air circulation system and maintain stable temperature. Review the possibility of acquiring/install air conditioning.
Level of noise nuisance and annoying	Presence at the clinic of noisy equipment such as hyperbaric chamber in activity of HBOT (hyperbaric environment) and the compressor used to compress it with compressed air.	Put wall acoustic coating. Every 12 months, and whenever it deems it necessary, request additional examination of Audiometry.
Abnormal pressures	The interior of the hyperbaric chamber in activity of HBOT.	Assess clinically the worker who will be under hyperbaric condition, by the nurse and doctor in charge. Every six months to request periodic examination for workers' control in diving activity.

The temperature, environment uncomfortable and annoying noises can cause irritability in workers and difficulty concentrating, factors that can cause human error and accidents.¹⁸ A hyperbaric chamber is a device that holds itself Agent noise and abnormal pressures on activity that occurs in hyperbaric oxygen hyperbaric environment (ambient pressure greater than atmospheric), being necessary according to standards NR15 entrance exam for selection psychophysical of candidates for diving activity. Thus, the qualified physician will determine whether the candidate is suitable or not to work under hyperbaric conditions. For workers' control, the audit should be performed periodically every six months and exams every 12 months or when deemed necessary.¹⁷

With regard to thermal conditions of the workplace should provide comfort to workers with temperature maintained between 24 and 26 ° C, stable and equal in all compartments, preventing displacement of excess air and keeping the relative humidity levels of 40 to 60% .¹⁹

Another risk identified in the Clinical Hyperbaric Medicine was the chemist, which was organized within three (3) the sources and the proposed recommendations.

Figure 3 - Classification of chemical risks identified (group 2: red color), its main source and generating recommendations.

CHEMICAL RISKS	GENERATING SOURCE	RECOMMENDATIONS
Gases (O ₂ , N ₂ and others)	<p>Realization of dressings</p> <p>Preparation and use of solutions for sterilization of thermosensitive materials.</p> <p>O₂ cylinders and compressed air outside the clinic.</p> <p>Presence of O₂ and N₂ inside the hyperbaric chamber in activity of HBOT.</p>	<p>Use personal protective equipment against chemical agents in the procedures.</p> <p>Promote ventilation and exhaust from the point of operation and reducing the exposure time.</p> <p>Keep the area isolated, signalled and with restricted access to workers properly trained.</p> <p>Delete/keep away from all sources of ignition</p> <p>Remove objects from metals, watches, cell phones and the like (any source of ignition in the presence of oxygen)</p> <p>Implement a rigorous routine of indoor environmental monitoring of the Chamber.</p> <p>Meet the treatment table properly</p> <p>Assess clinically the worker after work under hyperbaric condition, by the nurse and doctor in charge.</p> <p>Submit the worker be hyperbaric condition once every 12:0 am.</p> <p>Every six months require periodic examination and complementary examinations annually for workers' control in diving activity.</p>

With respect to internal risk agents at work, there is the chemical agent as follows: Are the agents found in solid, liquid and gas, whose action can cause both chronic injury as acute. Such agents may act according to different states and conditions i.e. in bulk (liquid and solid), diluted in air (gases and vapors) from airborne solid (dusts and fumes) and the liquid (mist and fog). Agents diluted and suspended in the air are called aerosols.²⁰

In Clinical Hyperbaric Medicine chemicals are used for various purposes such as the execution of dressing and sterilization of heat-sensitive materials. It should be noted that the chemical agents are capable of producing various types of cell injury and its effects can manifest itself immediately or in the long term.²¹

In order to protect the worker NR 6 in 6.1, is a consideration of the need for use of personal protective equipment by workers exposed to occupational hazards: 6.1 - For the purposes of application of this Norm, it is considered equipment individual protection - EPI, every device or product used for individual use by the employee, for the protection of risks likely to threaten the safety and health at work.¹⁷

With regard to worker exposure to gases O₂, N₂ and others in the hyperbaric where it undergoes a pressure variation that simulates the environment change to normobaric an

underwater environment, it is evident that during the pressurization with compressed air is increased the surface tension of the bubbles of gas (O₂, N₂ and others), the decrease in size of these bubbles of gas facilitates the dissolution and absorption. The gas bubbles gradually compressed travel through the lung to the blood followed until they reach the tissues.⁷

During the course of decompression becomes bubbles towards the lung tissue, returning to its normal size and then be eliminated from the body. The big problem is an inadequate decompression with non-compliance with protocols may lead to a supersaturation of N₂ increasing the risk of what we call decompression sickness (DDC). The decompression illness mostly affects natural cavities and joints of the human body, but that risk exists only when you inhale air, the DDC is no problem when you inhale O₂⁷

As for other risks, follow-up within five (5) biological risks identified in the Clinic of Hyperbaric Medicine:

Figure 5 - Classification of biological hazards identified (group 3: brown color), its main source and generating recommendations.

BIOLOGICAL RISKS	GENERATING SOURCE	RECOMMENDATIONS
Contact with bodily fluid	Sneezing secretions during procedures	Perform permanent education discussing NR 6 and 32.
	Professional contact with patients contaminated with pathogens	Increase attention during procedures.
	Professional contact with clothing and contaminated materials	Use PPE (eyeglasses, masks, protective gloves for their hands).
		Perform the vaccination of workers with serological testing
		Request periodical inspections to workers
		Increase the frequency of cleaning.
Frequency in cleaning and hygiene of toilets	Odor, dirt	

Biological hazards are own activities or processing organic material nature affecting the health of the worker, through direct or indirect contact with biological agents. Biological agents include: bacteria, viruses, protozoa, fungi, as well as all vectors, including man himself. In health care, especially in nursing workers are faced with a dense microbial population, cross-infection, contact with blood, body fluids, contact with samples, failures in disinfection, sterilization and disinfection. Note that the activities in which biological agents are present as a risk factor for occupational health is necessary rigorous use of personal protective equipment specified, such as gloves, gowns, masks, caps, aprons, etc.²²

The occurrence of needle-stick accidents reveal the behavior of professionals not to adopt the use of standard precautions and maintain practices risk of accidents involving exposure to biological material such as; disposal of unsuitable material in containers on the type and capacity, do not use gloves, needles escape active transport or handling needles unprotected.²³

Workers exposed to biological agents, especially those who work in direct assistance to the health of people, should undergo periodic health examinations and measurements of immuno-prophylaxis appropriate in accordance with Ordinance nº. 1602, of 17 July 2006

establishing throughout the national territory, the calendars of Vaccination.²² The mandatory immunization for health professionals is ensured by law by Norm 32 (NR 32), the item 32.2.4.18.6, emphasized that the employer must

provide all vaccines recorded in the country that can, criteria of risk exposure, be given to the worker.

In this context, it is important that the biosecurity can also be understood as an educational action, ie, must be understood not only as a process of acquiring skills and content that aim to preserve the environment and human health, but should take into account the idea that education goes beyond the notion of knowledge transfer and training; education involves sharing actions, consider whether the arrangements, and habitus of agents, especially in designing agents really like learning subjects, involving individuals in their whole, considering their differences and singularities.²⁴

Besides the biological risks were also found in the environment of Clinical Hyperbaric Medicine ergonomic risks that are described below under six (6).

Figure 6 - Classification of ergonomic hazards identified (group 4: yellow), its main source and generating recommendations.

ERGONOMIC RISKS	GENERATING SOURCE	RECOMMENDATIONS
Poor posture	Some procedures require poor posture of workers, for example, transportation and handling of weight	Proper handling of patients and handling of loads (NR 17)
Boredom and repetitiveness	Some procedures are repeated like the control panel of the hyperbaric chamber	Check the possibility of acquisition of ergonomic chairs
Occupational stress	Demand for attention in the Control Panel, with the patients inside hyperbaric chamber in activity of HBOT in house machine equipment.	Perform breaks during the activities, from a session to another
	Responsibility for the life and well-being of other people	Provide comfort and improvements of working conditions
	Problems of physical environment, such as noise and hyperbaric environment bit pleasurable	Better distribution of tasks and organization of the work process
		Assess the worker's psychological state with the use of questionnaires and measurements of physiological parameters of stress
		Promote prevention programs with the goal of performing stretching exercises and relaxation

Ergonomics is based on the set of studies aimed at the methodical organization of work according to the proposed order and the relations between man and machine. It is through the ergonomic analysis that identifies risks or ergonomics ergonomic agents causing potential damage to the health of workers considering the physical, psychological and social, as well as the structure of the organization and the work environment itself.²² The risks of physical ergonomic, unlike the physical environmental risks, these are in work conditions or the nature of activities that can cause damage, injury, wear the worker, which may lead to temporary or permanent disabilities, such as the osteo-articular diseases related to work (MSDs), repetitive strain injuries (RSI), decreased visual acuity. And there are also many other diseases such as stomach ulcers, high blood pressure and heart problems resulting from occupational stress.¹⁷

It was also possible to observe the presence of risks of accidents on the Clinical Hyperbaric Medicine that can harm worker safety, and these will be displayed in the table below seven (7).

Figure 7 - Classification of accident risks identified (group 5: blue), its main source and generating recommendations.

RISK OF ACCIDENTS	GENERATING SOURCE	RECOMMENDATIONS
Irregular ground, wet and slippery	Inadequate physical plant	Level the ground and placing of antiskid floors
Likelihood of fire or explosion	Cleaning the environment of the clinic	Flag during cleaning Do not use slippery on the floor Cleaning in smaller time team movement
	O ₂ cylinders, compressed air.	Keep the area isolated, signalled and with restricted access to workers properly trained.
	Engine room	Delete/keep away from all sources of ignition
	Presence of O ₂ in hyperbaric environment	Remove objects from metals, watches, cell phones and the like (any source of ignition in the presence of oxygen) prior to the hyperbaric treatment Strictly follow the standards of monitoring/security laid down in the manual of the hyperbaric chamber.

The risk of accidents and environmental risk factor can lead to work accident itself, with serious consequences for the worker, the company, for the whole society and the environment.

With respect to internal risk agents at work, there is the agent of accidents as follows: Are the agents whose source has action on specific points of the environment. Its action is independent of the person and be exerting its activity depends on direct contact with the source. Generally cause acute injuries. As an example, from electric shock, or falls on slippery roads, among others.^{20:73}

Many studies have sought to clarify the major causes of accidents. However, it is understood that accidents are often associated with the following aspects: non compliance with legal requirements by employers, working conditions and physical arrangement of equipment and machinery, the adoption precarious or absence of preventive measures, and behaviors and worker attitudes in the face of risk situations.

CONCLUSION

The work of professionals in Clinical Hyperbaric Medicine is wrapped in several occupational risk factors that can cause damage to the health of workers and, therefore, interfere with the quality of care provided to patients.

The elaboration of the risk map was of paramount importance for the diagnosis of occupational hazards and therefore for planning preventive measures aimed at promoting the health of workers in this area. Before the emergence of new clinical hyperbaric medicine and consequently the increase of number of professionals who will work in this field of work and the rich diversity of occupational factors that will be exposed, it is considered that further studies addressing the aforementioned object of research should be encouraged in order to contribute to the acquisition of knowledge that can support improvements in working conditions and for the development of educational strategies directed at workers, in order to identify occupational hazards to which they are exposed and security measures that should be adopted.

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