



CHEMICAL AND MICROBIOLOGICAL RISKS IDENTIFIED IN OPERATING ROOMS OF SANTANDER HEALTH INSTITUTIONS AND THEIR PREVENTION STRATEGIES

Riesgos químicos y microbiológicos identificados en quirófanos de instituciones de salud de Santander y sus estrategias de prevención

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KEYWORDS

Chemical risk
Surgery's room
Biological risk
Microbiological
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Dangers

ABSTRACT

Medical personnel run the risk of contracting infectious diseases caused by physical, microbiological and chemical agents because they are directly exposed to risk factors such as the presence of pathogens in the environment; For this reason, this article derives from research carried out in four hospital centers in the department of Santander (Colombia) that seeks to identify the most common fungal microorganisms, bacterial microorganisms that can transmit diseases through the enteral, respiratory, dermal and blood routes, the microorganisms that can cause lung infections, wound contamination (abscesses), folliculitis, cellulitis and otitis, among others, in operating room workers, as well as determining the most appropriate disinfection protocols and possible control strategies, determining the measures aimed at monitoring, containment and elimination of these sources of contamination.

PALABRAS CLAVE

Riesgo químico
Salas de cirugía
Riesgo biológico
Microbiológico
Bacterias
Peligros

RESUMEN

El personal médico corre el riesgo de contraer enfermedades infecciosas causadas por agentes físicos, microbiológicos y químicos por hallarse expuesto directamente a los factores de riesgo como la presencia de patógenos en el medio ambiente; por tal razón, el presente artículo deriva de la investigación realizada en cuatro centros hospitalarios del departamento de Santander (Colombia) que busca identificar los microorganismos fúngicos más comunes, los microorganismos bacterianos que pueden transmitir enfermedades por vía enteral, respiratoria, dérmica y sanguínea, los microorganismos que pueden causar infecciones pulmonares, contaminación de heridas (abscesos), foliculitis, celulitis y otitis, entre otras, en los trabajadores de los quirófanos, así como determinar los protocolos de desinfección más apropiados y las posibles estrategias para su control, determinando las medidas encaminadas al monitoreo, contención y eliminación de estas fuentes de contaminación.

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1. Introduction

In Colombia in recent years it has been evident that patients who have undergone medical treatments and surgical interventions in different hospital institutions mainly in the operating rooms of hospital centers have been affected by dangerous bacteria. These health conditions in patients and in medical, paramedical and general service personnel, are normally caused by physical, microbiological and chemical agents, which negatively impact, causing diseases that affect not only the patient but also all personnel who are constantly directly exposed to risk factors, being present in the environment, causing the occurrence of threats of natural origin, which extend beyond their private spaces and the individual, in which the activities of people that due to their magnitude, speed and contingency require a management process and better and greater control to mitigate the effect caused (Velarde, 2013).

To generate greater risk control, it is necessary to create good practices and security management with actions that strengthen the processes adopted as improvement plans. Therefore, it is necessary that the recommendations that are given at the level of the improvement plans in the hospital centers can generate greater effectiveness in the activities that are carried out within the surgical procedures, that allows to improve not only physical health, but also mental and social health in all health workers, generating efficiency in the execution of processes (González & Herrera, 2019).

Over the years in the practices of this type of institution, asepsis and antisepsis play an important role in the control of chemical and microbiological risk to maintain the health of people who have access to operating rooms in good condition, for which the institutions apply biosafety protocols, with the aim of reducing the levels of chemical, microbiological and endotoxin contamination of liquids, microbiological control of water and microbiological control of air in operating rooms and immunosuppressed units according to the type of operating room (Vargas, 2019).

According with Álvarez (2020) and Meza (2021), the information generated by the World Health Organization -WHO- the definition of Infections Associated with Health Care (IAAS) will replace other definitions previously used in other subsystems, such as infectious nosococci, which have to do with nosocomial or intrahospital infection that is contracted by patients admitted to a health care facility, or Health Care Associated Infections (IACS) (Paredes *et al.*, 2022). Chemical substances are used daily in health institutions, some consciously and others without prior knowledge of their handling, which most of the time cause irritation, organ damage or other health effects in accordance with the exposure time, amount or concentration of the chemical to which it is intended or exposed. However, despite the care and precautions that are being implemented, it is common for some effects to occur in people with some frequency, caused by the lack of prevention. For this reason, the General Directorate of Safety and Health at Work of the European Commission has published a report on the application of the directive for the prevention of these infections, as well as the Technical Directorate of Occupational Risks of the Ministry of Labor and Social Security of Colombia.

When talking about occupational health at work, the WHO in 2014 defines it as a multidisciplinary activity that promotes and protects the health of workers, where it seeks to control accidents and diseases by reducing risk conditions (González & Cataño, 2019).

With reference to the above, to promote and protect the health of workers, the activity to which they are engaged and the risk conditions in which they find themselves must be recognized. Accidents at work constitute an important public health problem in the world due to the significant increase in them, since according to the International Labor Organization (ILO), millions of work accidents and occupational diseases are reported annually, of which we can find accidents due to biological risks (37.8%), due to mechanical risk (37.5) and due to physical risk (24.5%), which occur more frequently in areas such as: hospitalization (33%), outpatient services (18%), surgical clinical processes (15%), and the remaining percentage in the different administrative processes. For this reason, NIOSH (National Institute of Occupational Safety and Health) has classified hospitals as high-risk workplaces.

Colombia is no stranger to the increase in work accidents, which can be evidenced in the statistics of the Colombian Federation of Professional Risk Insurers (Fasecolda), which indicate that in the year 2000 approximately 159,241 work accidents were reported and for the year 2011, 546,358 were registered; Of these, 7.2% correspond to the social and health services sector (Duran *et al.*, 2018).

The work environment and safety conditions in health institutions are characterized by having a large number of risk factors that are potentiated and affect the health and physical integrity of workers, which also have an impact on the gross domestic product due to the loss of work capacity, be it temporary, permanent, due to disability or even the death of the worker, thus bringing about a reduction in income, the worker's lack of self-esteem and family stability; on the other hand, the institution decreases the provision of the service for not having the necessary resources, adaptation and maintenance of the structures and technological advance.

These factors or risks currently have a scarce bibliography, making it difficult to take measures and improvement plans by the entities involved in the protection and reduction of risks. This shortcoming is reflected in the actions and methodologies in the prevention of accidents and in this way ensure longevity of each one of the workers or

personnel involved in these health areas, such as operating rooms due to low compliance or quality of the security conditions foreseen and necessary in these areas.

Given the situation raised, all institutions that provide health services to the population must implement and guarantee the correct functioning of the minimum security conditions existing in Colombia, in order to control, minimize and/or eliminate risk factors seeking well-being physical and mental of the workers.

Consequently, the discussion arises about the measures used in health institutions and their real effectiveness, since they are not fortuitous circumstances or isolated events without any relation that lead to these situations. For this reason, the design of strategies for the prevention and control of chemical and microbiological risk in the operating rooms of Santander health institutions is more important than ever, since no measure will apparently be sufficient while it lacks constant review, adaptation, and planning adequate.

2. Methodological design

The methodology followed in this research is descriptive of cross-section based on quantitative technique. The population is the surgical rooms of health institutions in the Department of Santander, 14 samples were collected from surgery rooms of four health institutions in Santander. The research aims to design strategies for the prevention and control of chemical and microbiological risks identified in surgery rooms of health care institutions in Santander.

Techniques:

1. Selective and non-selective culture media (Fungi and Bacteria)
2. Measurement of anesthetic gases
3. Risk assessment (adaptation Matrix GTC 45)

Procedure:

1. Request for permission to participate in the study
2. The schedule, date, and locations of sampling were agreed according to the needs of each institution and the schedule of surgery
3. Samples were taken from the institutions which were taken to the laboratory, where the isolation and characterization of the micro-organisms present in the application of microbiological tests were carried out using selective and non-selective culture media and identification reagents such as, platform Crystal valuation of risk (adaptation Matrix GTC 45)
4. A database was built in the Excel program where all the information was included; institution, room number, sampled surface, identified micro-organisms, frequency and characterization thereof
5. The hazard was finally assessed according to the pathogenicity of each micro-organism.

3. Referential framework

The investigation focuses on the environment of the operating room and the provisions of the Ministry of Labor and Social Security of Colombia in the year 1979 in Resolution 2400, Articles 155 -156 that all necessary measures must be adopted to control effectively harmful agents and preferably from their origin, being able to carry out substitution of substances, change or modification of the process, enclosure or isolation of processes, exhaustive local ventilation and maintenance. Likewise, complementary methods are recommended, such as limiting the exposure time to chemical agents and personal protection, when the former are insufficient or, likewise, can be combined.

The ministerial resolution recommends that the evaluation of atmospheric pollutants should be carried out by means of precision or measurement equipment or devices that determine the concentrations of dust, gases, vapors, smoke, etc. in work environments, which express their concentration in parts per million or in milligrams per cubic meter, and which are used to periodically control dangerous levels that are above the permissible limit values expressed in the "concentrations allowable limits table" for chemical substances.

Oliveira in 2009 conducted a review of some studies that document effects related to occupational exposure to some residues of anesthetic gases, identifying a 50% increase in the risk of liver damage, a 30% increase in the risk of kidney damage and neurological alterations in 3%.

There is also information taken from other studies such as Castro *et al.*, (2016), "Detection of contamination in the anesthesia equipment in the operating room of a hospital in Mexico", as well as that of Villalobos *et al.* (2014) "Surveillance of infections associated with health care, bacterial resistance and antibiotic consumption in high complexity hospitals, Colombia", in which the most frequently affected personnel were nursing staff and doctors and the most frequent mechanisms of biological accidents injuries were mainly needles (up to 90%), cuts (many times by glass) and splashes on the mucosa with biological material.

Decree 097 of 1996, which partially regulates Law 6 of 1991 in Colombia, on the medical specialty of

Anesthesiology, mentions the proper management and exercise of this specialty in a multidisciplinary way in the integral management of health.

The research is framed within norms that regulate the health sector specifically in surgical areas such as Decree 4725 of December 26, 2005, which regulates the regime of sanitary registries, marketing authorization and sanitary surveillance of medical devices for human use.

In the same way, studies carried out by Rodríguez *et al.* (2010) are taken into account, researchers who carried out a study entitled "Educational intervention on biosafety in health workers", in which the rationale is that biosafety represents a vital component of the system quality assurance, constituted in a doctrine aimed at achieving attitudes and behaviors that reduce the worker's risk of acquiring infections in the workplace.

In Circular 000076 of November 21, 2005, mentions the profile of surgical instrumentation through the application of scientific, technical and technological knowledge in invasive and non-invasive interventions, sterilization procedures, as mentioned by Gutiérrez *et al.* (2023). Likewise, the study "Occupational Risks of Health Workers" from Galindez & Rodríguez (2007) is also taken into account.

The exercise of professional surgical instrumentation in application of Law 784 of 2002 determines its nature, object and fields of application and determines that an appropriate university degree is required, based on scientific, technical and humanistic training as stated by Gutiérrez & López (2019).

In accordance with Resolution 02183 of July 9, 2004 that approves the Manual of Good Sterilization Practices for Health Service Providers, it obliges to establish procedures and activities in sterilization plants to ensure compliance with all sterilization processes.

The provisions of Decree 351 of 2014 provide for the generation, identification, separation of containers, collection, transportation and storage of waste generated in health care, since its purpose is to regulate the environmental and sanitary comprehensive management of generated waste. in health care and other activities.

Courault *et al.*, (2017), carried out an evaluation of airborne enteric viruses emitted by wastewater reused in agriculture, a study that was taken into account. The purposes of the research were 1) to characterize the human enteric viruses found in wastewater bioaerosols 2) to propose a numerical model to assess the health risk of populations close to irrigated areas, with special attention to norovirus, which is responsible for most viral gastroenteritis. Water and air samples were collected at various irrigation sites in France near Clermont-Ferrand, at the WWTP inlet and after treatment, in the air above activated sludge basins and above irrigated fields with WW. Various enteric viruses were found in water samples collected both before and after treatment. Norovirus was the most abundant with $>10^4$ genome copies/ μl (GC/L) before treatment and $\sim 10^3$ GC/L after treatment. Low amounts ($<10^3$ GC/ m^3) were detected in the air above the activated sludge pools and irrigated plots. Hepatitis E virus was detected in all sampled compartments.

In Quito, Freire (2014) carried out an investigation whose purpose was to analyze the exposure to pathogenic microorganisms faced by the personnel who work in the sewerage area of the Metropolitan Public Company of Drinking Water and Sanitation of Quito, during maintenance and repair of the infrastructure that captures, conducts, and deposits residual discharges for industrial and domestic use that are produced in the city of Quito to their final destination.

In Mexico, Contreras (2017), carried out a study where they applied surveys to the population of the Mezquital Valley that use sewage for irrigation and communities that use drinking water, this in order to compare the prevalence of self-reported diarrheal diseases in children under five years. Samples of wastewater, drinking water, household environmental samples, and fecal samples were collected and analyzed. Communities exposed to sewage had a 1-week prevalence of diarrhea (10%), compared to unexposed communities (5%). This association held in an adjusted modified Poisson regression model (PR = 2.31, 95% CI 1.00, 5.31), but not when limited to agricultural households.

4. Results

Common fungal microorganisms were identified in the operating rooms of four health institutions such as *Aspergillus* spp, *Aspergillus niger* spp, *Penicillium* spp, *Cladosporium* spp, *Cladophialopora* spp, *acromonium* spp, *Fusarium* spp, *Mucor* spp, and *Rhizopus* spp:

- Common bacterial microorganisms were identified in the surgery rooms of four health institutions such as *Pseudomona aeruginosa*, *Flavimonas oryzihabitans*, *Micrococcus luteus*, *Staphylococcus aureus*, *Staphylococcus epidermis*, *Aerococcus urinae*.
- Microorganisms identified in the surgery rooms of four health institutions can transmit diseases through the enteral, respiratory, dermal and blood pathways in workers in surgery rooms
- Microorganisms identified in surgery rooms can cause lung infections, wound contamination (abscesses), folliculitis, cellulitis, otitis, among others.
- Disinfection, Handwashing, Asepsis and Tissue Therapy Protocols and Universal Precautions of the Atlanta CDC Strengthened.

5. Conclusions and recommendations

Microbiological contamination from hospital-type procedures is an important factor in terms of environmental health, given that a considerable number of micro-organisms have the capacity to disperse to the environment as a result of bio aerosol generation or inadequate waste management, for this reason, measures aimed at monitoring, containment and proper elimination of these sources of contamination must be strictly adopted and monitored in hospital institutions.

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CHEMICAL AND MICROBIOLOGICAL RISKS IDENTIFIED IN OPERATING ROOMS OF SANTANDER HEALTH INSTITUTIONS AND THEIR PREVENTION STRATEGIES

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