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How to Deal with Biohazard Risks in Modern Medicine? The Right Approach Always Works

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Abstract
Hospitals and healthcare facilities have unique occupational health and safety risks. These factors can affect the health and performance of healthcare professionals as well as the health of people. It is important to control, remove, or reduce these risks to improve the healthcare system through patient care. Engineering measures, administrative policies and personal protective equipment can help in this regard. Both hospital outpatient routine and infectious disease research can potentially present serious public health risks. Protecting the health and safety of individuals and the community requires commitment from institutions and employees, each with a high sense of responsibility. The biohazard management system establishes principles to help laboratories, clinics and health care facilities achieve biosafety and bioprotection goals. It also outlines the essential components to be integrated into the governance, strategy, planning, and culture of a public, private, or home health care setting. Overall, it describes a comprehensive process for managing and reducing biological risk and provides guidance on its implementation (Fig 3).

Keywords: Public Health, Occupational Health, Containment of Biohazards, Outpatients, Hospitals, Patient Care, Home Care Services, Personal Protective Equipment, Communicable Diseases

Introduction
Infectious hazards and biological risks are present but can be mitigated. They can be managed through an occupational health and safety program [1]. In this regard, three macroareas of interest can be identified: biological risk problems in health and nonhealth facilities, i.e., at home; trends in health management with respect to biological risk; and risks to the environment, health and safety in the workplace. Healthcare personnel are generally trained on the issue of biohazard, and this preparation is supported by cultural training and experience. On the other hand, monitoring the effective application of biorisk guidelines is still necessary. Currently, the different work activities in the health sector are well known and categorized. It is a common belief that the staff of the health area is appropriately trained in the issues of biological risk. In fact, the cultural training required to carry out healthcare activities and work experience support this view. Healthcare professionals face potentially dangerous conditions such as patient management, medication administration, and monitoring patients' vital signs worldwide. Hence, he is at risk of injury, for example, from needlesticks, and is at risk of contracting infectious diseases [2]. The number of home health care workers is growing. This implies a great impact on the safety and health of home caregivers [3]. In this context, containing environmental microbiological contamination will help maintain healthy environments and keep both workers and users of health care facilities or home patients healthy. Ultimately, we must aim for continuous improvement, guarantee training and recognize the progress achieved. In addition, a biohazard management program in itself implements compliance with legal requirements.

Methods and Results
Any biological factor that changes the environment can contaminate places where people live and work. The dedicated collection of data from specialist clinical, outpatient, and home activities is essential for assessing hazards. Notably, it is advisable to use checklists and data collection cards for data collection. Consider, for example, the risks faced by home health care providers. Risks include physical hazards such as tripping, slipping, lifting, biological hazards, and environmental

issues such as poor air quality and allergens. The results of these studies highlight the need for broader training to help operators identify and address these hazards [3]. Additionally, the responsibility for health and safety in research work must be clearly defined. Since it was discovered that certain microorganisms can be agents of disease, researchers have studied microbial diseases and developed countermeasures, but working with infectious agents can lead to danger [4]. Institutions must implement biosecurity practices to protect workers and public health [5]. On the other hand, healthcare workers face many occupational health and safety risks, such as physical, biological, chemical, ergonomic and psychosocial hazards. According to the topic of the paper, Table 1 shows several transmission pathways of biological pollutants in clinical settings [6]. Those who work in hospitals and healthcare facilities are more exposed than those who work in other sectors [7]. For example, any biological laboratory is dedicated to the handling and storage of microorganisms and their derivatives. In addition, outpatient activities involve exposure to infectious materials, and biological hazards arise mainly from patients, blood and body fluids, contaminated instruments, and aerosols. Medical waste and contaminated surfaces also pose hazards. In addition, nurses and surgeons risk injuries from blood splatters or cuts. A biological laboratory is an example of a risk to the environment, health and safety in the workplace [8]. Safety in laboratories is critical for all educational institutions as well as in university clinics. It is important to identify, assess and control hazards through risk management to reduce risks to students and staff, with a focus on chemical, biological, and environmental risks [9]. Any laboratory appropriately manages any hazardous pathogens it may have to handle. They responsibly adopt safety threat management by implementing biohazard management systems to improve their safety. An example of this is the management of COVID-19. Post-COVID-19 is a complex disease that has affected many people around the world. According to a meta-analysis, it is important to identify risk factors to understand who may develop this condition to offer timely clinical support [10]. Risk factors included previous intensive care unit admission, vaccination, age, sex, body mass index, smoking status, and comorbidities such as anxiety, depression, and diabetes. The meta-analysis revealed that being female, having a high body mass index, and smoking increase the risk, whereas patients vaccinated with two doses have a lower risk. Be that as it may, we need to prioritize these discussions, as it seems clear that key factors in implementing a biohazard management system include management's commitment to providing resources, setting expectations, and preventing accidents [11].

Table 1: Significant transmission routes of biological pollutants in clinical settings

	TRANSMISSION MODE			
	DIRECT CONTACT	INDIRECT CONTACT	INHALATION	PERCUTANEOUS ROUTE
PATHWAY OF TRANSMISSION	Spread during medical procedures involving contact with skin and mucous membranes.	Dissemination through vehicles such as clinic items or work surfaces.	Spread by inhalation of contaminated aerosols or by close contact with the airways.	Spread during procedures involving skin cuts, injections or bandages.
PATHOGENS INVOLVED	*Epidermophyton floccosum* *Human rotavirus* *Herpes simplex virus Types 1 and 2* *Klebsiella spp* *Cytomegalovirus* *Actinobacillus* *Actinomycetemcomitans* *Actinomyces spp.*	*Staphylococcus aureus* *Actinomyces spp.* *Adenovirus Types 1 to 5 and 7*	*Actinomyces spp.* *Staphylococcus aureus* *Influenza virus* *Human papillomavirus* *Mycobacterium tubercolosis*	HBV HCV HDV HIV

Discussion

Currently, despite the good levels of safety achieved, research aims to inform health policymakers and operators about these risks. In addition, health risks are better identified, and strategies to address them are suggested [7]. In this context, experts develop and provide recommendations to reduce them. Biosafety guidelines are necessary to address these risks and reduce human error, for example, in the laboratory or in the doctor's office. Agreement among authorities, the public and scientists is important to ensure trust and progress in the management of biohazards [8]. For example, during the coronavirus pandemic in 2019 and 2020, programs were implemented according to the ISO 35001:2019 standard to address specific situations. This approach allowed for effective management even in unforeseen circumstances, integrating risk management into daily operations and increasing biohazard awareness among users and stakeholders [9]. In this context, the ISO 35001:2019 standard deserves in-depth study. It is a recommendation that is based on a systemic approach, allowing biosecurity risks to be identified, assessed and controlled. It aims to define appropriate requirements for each organization and promotes continuous improvement through the plan-do-check-act (PDCA) cycle. This model helps achieve continuous improvements in processes and products that are applicable to every element of the biohazard management system [11]. Notably, the phases of the PDCA include planning objectives and processes; doing so; implementing what has been planned; verifying, monitoring and measuring results; and taking action to continuously improve performance (Fig 1).

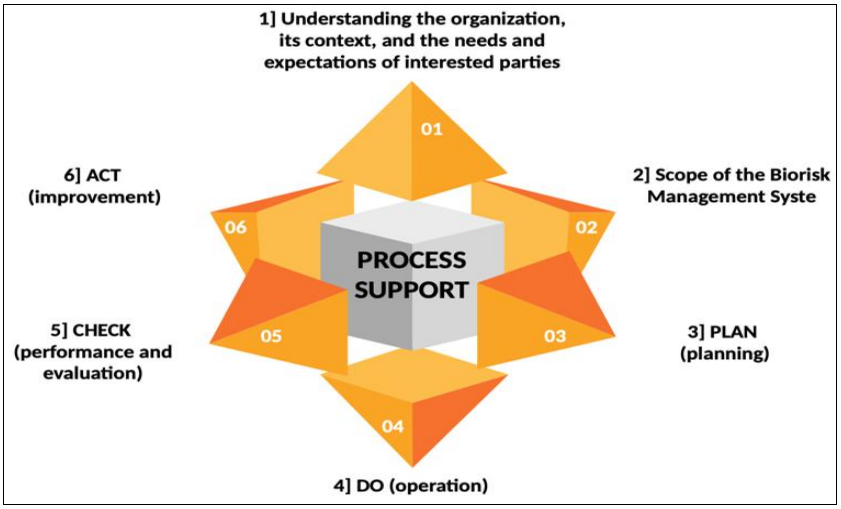

Fig 1: Graph drawn up based on the original Plan-Do-Check-Act cycle from ISO/DIS 35001(en). Project template from PresentationGO.com

Improvement requires attention to the causes of nonconformities and accidents. Crucially, think of the continuous training of the staff in charge. Inattention and intense work rhythms can cause accidents [12]. In addition, some patients may be healthy carriers [13]. Prevention is also implemented with an effective training system. For example, training involving interactive virtual simulation for remote healthcare professionals can be just as effective as traditional paper or face-to-face training [14]. Finally, in daily practice, implementing the actions of hand hygiene, the use of PPE (personal protective equipment), the systematic replacement of gowns and/or work clothes, the management of biohazard emergencies, the sanitization of environments and objects, sterilization practices, and the storage and disposal of medical waste should not be excessive.

General Reccomendations

To take the discussion a step further, it is worth taking a look at the prevention of nosocomial infections in outpatient settings. This is achieved by enhancing safety in the outpatient setting through the involvement of healthcare professionals, academic institutions and patient associations. Decision-making processes to ensure safety in medical and hospital outpatient clinics are quite complex. In this context, the basics of infection prevention include the following basic practices: hand hygiene, respiratory hygiene, patient handling, and the use of personal protective equipment (PPE). Healthcare personnel must be aware of the risks of exposure to bloodborne pathogens. In addition, they must receive training upon entry into service and be vaccinated. Good practices to prevent transmission of bloodborne pathogens, and thus infections from needle sticks and sharps, as well as from work devices, must be implemented. As part of antimicrobial prevention, cleaning, disinfection, and sterilization play important roles. Given that the building requirements of health care facilities are met, health surveillance includes a water, pest and sanitary waste stream management program. Practitioners must be familiar with the concepts of cleaning, decontamination and sterilization to be applied as appropriate. Proper procedures generally make use of checklists to evaluate the efforts of the clinical management program. In this regard, quality control by the antimicrobial stewardship officer can ensure process compliance. In addition, joint training between healthcare staff and patients, in synergy with local authorities, can help improve the level of safety. Fig 2 shows the hierarchy of disinfection and sterilization levels.

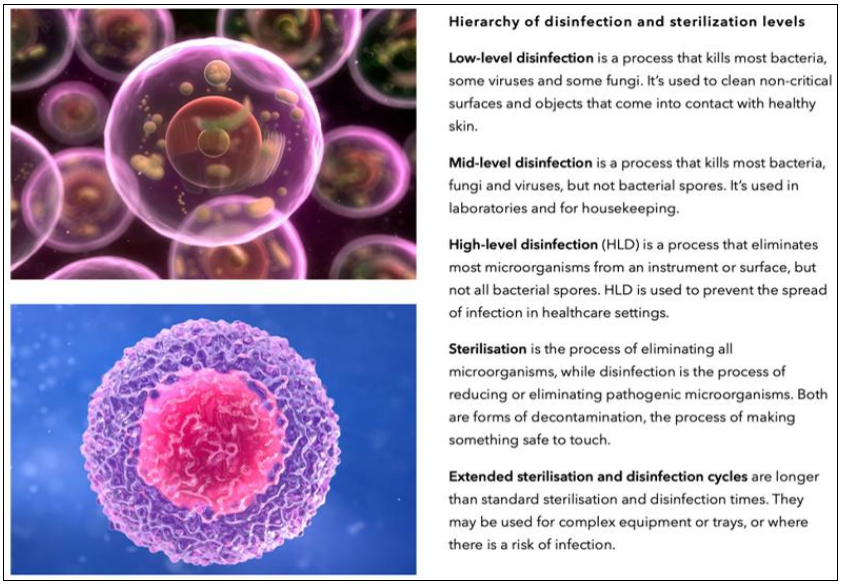

Fig 2: Hierarchy of disinfection and sterilization levels. Project template from Pages, Apple Inc.

Conclusion

It is important to pay attention to risks and prevention practices in healthcare facilities. Hospitals and indoor and outdoor healthcare facilities present risks to the health and safety of healthcare workers, affecting their well-being and performance. Monitoring, eliminating or reducing these risks is essential to improve patient care and the healthcare system, which involves the use of engineering measures, administrative policies and protective equipment. In this context, institutions must implement adequate supervision and take measures to reduce these risks. Finally, as an example and as a starting point for future work, a questionnaire administered periodically to staff and users could help assess the level of safety awareness in health care.

Ethics approval and consent to participate

Studies are conducted in accordance with the ethical standards of national research institutions or committees.

Consent for publication

Studies have been approved by ethics committees.

Availability of data and materials

Data in support of the results of this study are available from the authors of the articles in the references and with their permission on reasonable request.

Competing interests

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Acknowledgements, Authors' contributions

De Giorgio Roberto conceived, designed the work, analyzed, interpreted the literature data, and was instrumental in writing the manuscript.
Bencivenga Caterina performed the literature search, analyzed, interpreted the literature data, and selected the consistent works.
De Giorgio Daniela checked the writing in English also considering each phrase, clause, sentence, and paragraph for grammatical correctness and stylistic excellence.

Statement

All authors read and approved the final manuscript.

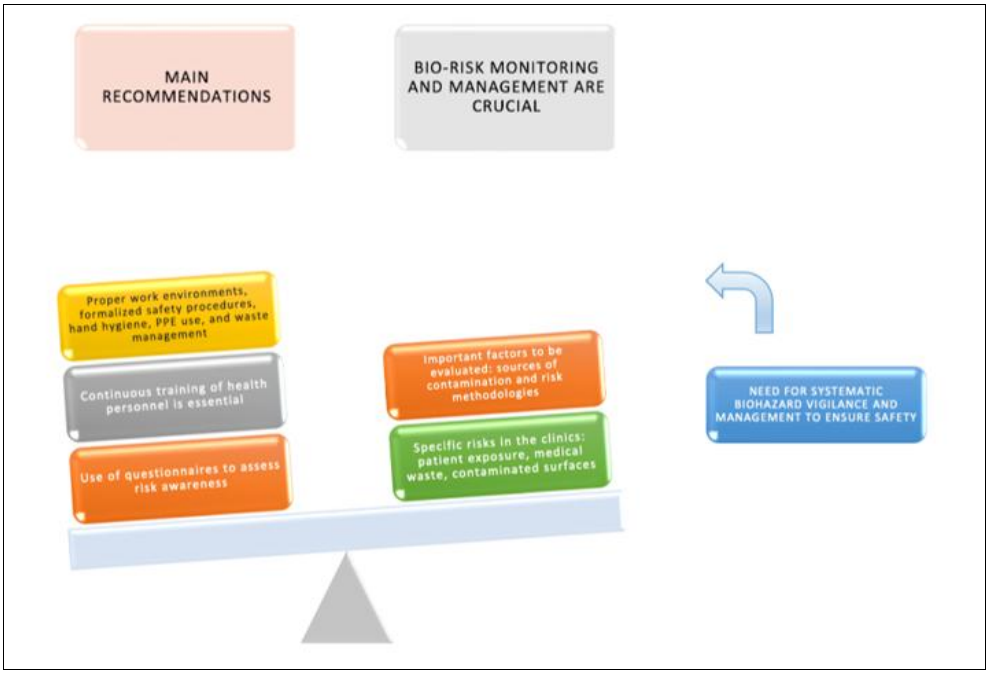

Fig 3: Abstract graphics

Highlights

Biological and environmental risks in health and non-health facilities; Biohazard healthcare trends;
Current increase in home health workers; Monitoring of the implementation of the guidelines; Prevention governance and training.

What is known about the subject?

Biohazard management is defined as the identification, evaluation and management of risks from biological agents (e.g. bacteria, viruses, toxins). The management of biological agents is predicated on the implementation of prevention and control measures, the primary objective of which is to protect public health.

What does the study performed add to the literature?

A substantial body of research has examined the evaluation and mitigation of biological hazards in the workplace, and this document offers a comprehensive review of procedures for healthcare professionals.

What are the implications of the results obtained?

The area of biohazard management is of significant public health concern; as such, prevention in outpatient clinics is of critical importance in ensuring safety, reducing risk and expense.

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