



**Research Article**

**BIOLOGICAL HAZARDS- A NEW CHALLENGE FOR OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM (OHSMS)**

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**ABSTRACT**

Biological hazards at workplace present the Occupational Health and Safety (OHS) professional with complex challenges due to the large number and variety of potential biological agents and their effects. Many work activities include hazards to workers, and among these biological risk is particularly important, mostly because all workplaces harbor the potential for various forms of biohazard exposure, including person-to-person transmission of infectious disease. While prevention and management of biohazards is often the responsibility of occupational or public health personnel, the generalist OHS professional should have an understanding of biohazards and their mechanisms of action, and the importance of vigilance and standard control measures. It is important to improve the current understanding of the health hazards caused by biological factors at the workplace.

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**INTRODUCTION**

In the recent years, infectious diseases due to biological hazards have been found to be most frequent among occupational diseases. Occupational biohazards are infectious agents or hazardous biological materials that exert harmful effects on workers' health, either directly thorough infection or indirectly through damage to the working environment, and it can also include medical waste or samples of a microorganism, virus, or toxin from a biological source.

Biological hazards are organic substances that pose a threat to the health of humans and other living organisms. Biological hazards include pathogenic micro-organisms, viruses, toxins (from biological sources), spores, fungi and bio-active substances. Biological hazards can also be considered to include biological vectors or transmitters of disease. Worldwide, it is estimated that around 320 000 workers die each year from communicable diseases caused by work related exposures to biological hazards (Driscoll *et al.* 2005; OSHA 2007).

**Risk of biological hazards**

The degree of risk associated with a biological agent or its ability to cause harm to humans is largely established by its classification as a risk group. This classification is made based on the following criteria:

1. its ability to infect healthy humans,
2. its possibility of being transmitted between humans or to the community,

3. the severity of the disease it causes and the availability of drugs or prophylaxis to combat its negative effects.

Biological agents (infectious microorganisms) are classified into four groups according to the degree of risk to humans, animals, plants and the environment. The classification system is based on World Health Organisation guidelines and takes into account the pathogenicity of the agent; the mode and ease of transmission; host range of the agent; and the availability of effective preventive measures and treatment.

According to these criteria, a biological agent can be:

**Group 1 biological agent:** one that is unlikely to cause an infectious disease in man.

**Group 2 biological agent :** one that can cause a mild or moderate infectious disease in man and can pose a danger to workers, being unlikely to spread to the community and generally prophylaxis or effective treatment.

**Group 3 biological agent:** one that can cause serious illness in man and presents a serious danger to workers, with the risk that it will spread to the community and there is generally effective prophylaxis or treatment.

**Group 4 biological agent:** one that can cause serious or very serious illness in man and poses a serious danger to workers, with a high probability of spreading to the community and without generally having effective prophylaxis or treatment.

The biological hazards that workers get exposed in their workplaces were categorized into five broad groups reflecting the source of potential transmission of biological hazards:

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**Human bodily matter;** including blood, tissues, vomit, urine, faeces, saliva and breast milk etc., that may contain viral or bacterial diseases

**Living animals;** including cattle, sheep, poultry, fish and invertebrates, and their urine and faeces

**Animal products:** including raw and cooked meat, offal, skins, blood, milk and eggs

**Laboratory cultures:** including animal and human tissue cultures, bacterial and cell cultures, and

**Biohazard waste, sewerage and Rubbish.**

Biological risk is the possibility that a worker may suffer damage as a consequence of exposure or contact with biological agents during the performance of their work activity. Biological agents are dispersed and transmitted through the air, by bioaerosols; through water or food; by contamination of surfaces, tools or objects (fomites) and through other living things (reservoirs, hosts and / or vectors). Once dispersed in the work environment, the way in which the biological agent penetrates the worker’s organism and by which it becomes pathogenic is known as a route of entry.

**The routes of entry of biological agents are**

**Respiratory or inhalation:** It is the main route of entry for biological agents. Exposure is due to the presence of biological agents in the work environment in the form of bioaerosols, that is, suspended in the air that the worker inhales. Bioaerosols are usually produced by coughing, talking and in powder processes or with pressurized water.

**Dermal or cutaneous:** The entry of the biological agent is through intact skin, slightly damaged skin or through the mucous membranes (eyes, nose). Exposure occurs when in contact with contaminated elements such as tools, surfaces, samples, raw materials, and sick patients or animals; also by projections and splashes to the mucosa.

**Digestive or oral.** The entry of the biological agent is through the intake of contaminated food, water or elements. Exposure in the workplace is mainly caused by poor hygiene practices (lack of personal hygiene before meals, smoking with dirty hands, etc.).

**Parenteral or percutaneous:** The entry of the biological agent is by inoculation of the biological agent into the deep layers of the skin. Exposure in this case occurs as a consequence of an occupational accident, puncture, cut, bite or sting of an animal. This form of exposure is frequent in the health and veterinary sector, in laboratory work and in animal experimentation centers; also in outdoor work due to animal bites and stings.

Description of the types of biological hazards that workers are typically exposed at various Occupations

**Table 1** Category of biological hazards and its associated diseases at various occupations

Occupations	Examples	Diseases
Agriculture	Cultivating and harvesting Breeding and tending animals Forestry Fishing Abattoirs, food packaging plants Storage facilities: grain silos, tobacco and other processing	Rabies, Monkey pox, Rat bite fever, Brucellosis, Influenza, Q fever
Agricultural products	Processing animal hair and leather Textile plants Wood processing: saw mills, paper mills, cork factories	Allergies caused by moulds/yeasts, bacteria, and mites; organic dusts of grain, milk powder, or flour contaminated with biological agents; toxins such as botulinustoxins or aflatoxin
Building cleaning worker, construction worker, dockworker, farmer and rancher, farmworker, heating and air conditioning worker, hunter and trapper, pest control worker, repair worker, wildlife biologist	Raising of dust of excreta from rodents	Arenaviral infection, hantavirus infection, Lassa fever, leptospirosis, lymphocytic choriomeningitis, rat bite fever
Metal-processing industry, wood-processing industry		Skin problems due to bacteria and bronchial asthma due to moulds/yeasts in circulating fluids used in industrial processes such as grinding, fluids used in pulp factories, and metal- and stone-cutting fluids
Working areas with air conditioning systems and high humidity (e.g., textile industry, print industry, and paper production) Laboratory animal care	Caring for animals	Allergies and respiratory disorders due to moulds/yeasts, <i>Legionella</i> Hepatitis A, Hantavirus , Rat bite fever
Health care	Patient care: medical, dental	Several viral and bacterial infections such as HIV, hepatitis, or tuberculosis; needle stick injuries
Biotechnology	Production facilities	Various infections caused by bacteria, viruses, rickettsiae, fungi, and parasites
Sewage and compost facilities		Several bacterial and viral infections such as typhoid fever, salmonella, cholera, diarrhea, Hepatitis and HIV
Industrial waste disposal systems		Various waterborne diseases such as Infectious Hepatitis, salmonellosis, shigellosis, cholera, gastroenteritis and dysentery.

**Biological Hazards and Occupational Health**

Biological hazards pose risks for many workers in a wide variety of ways. Exposure to biological hazards in the work environment can also occur when people are in contact with laboratory cell cultures, soil, clay and plant materials, organic dusts, food, and rubbish, wastewater and sewerage. Exposure to moulds and yeasts is common in some industrial processes, in workplaces with air conditioning systems and high humidity, and in the Construction industry. Workers in health care professions are exposed to biological hazards via contact with human bodily matter, such as blood, tissues, saliva, mucous, urine and faeces, because these substances have a high risk of containing viral or bacterial diseases. Likewise, people who work with live animals or animal products (blood, tissue, milk, eggs) are exposed to animal diseases and infections, some of which (zoonoses) have the potential to infect humans (e.g. Q-fever, avian flu or Hendra virus) or cause serious allergy via sensitization.

The method to evaluate the risk of biological hazards to worker's health is to determine which workers are exposed to biological hazards and the types of biological hazards these workers are exposed to. However, there is very little information available on worker exposure to biological hazards worldwide. In addition, for the majority of biological agents there are still no occupational exposure limits (OEL).

The health effects are highly variable and depend on the biological agent in question, the exposure conditions and the worker's conditions (immune or health status). The main health effects resulted from exposure to biological agents are: infections, allergies and toxic effects or poisonings.

The infection is the result of the contact and multiplication of the biological agent in the worker's organism; for example brucellosis in agricultural activities or tetanus in construction.

Some infectious diseases, mainly those caused by viruses, can become chronic and over time trigger a cancerous process, such as hepatitis B, which can lead to liver cancer.

Allergy is the result of a strong reaction of the immune system induced by certain substances known as allergens or sensitizers. Clinical manifestations can affect the airways such as rhinitis, asthma, or hypersensitivity reactions; or to the skin as itching, inflammation, abrasions, etc.

Toxic effects or intoxications are produced by substances released by certain biological agents, known mainly as toxins (exotoxins, endotoxins, mycotoxins).

### Control of Biological Hazards

As with other hazards the priority for control is elimination of the biological hazard. This may be by eliminating the source of the biohazard (e.g. design of air conditioners to eliminate water as a reservoir for Legionella); eliminating the biohazard agent (e.g. use of pesticides to eliminate pest species); eliminating the vector (e.g. elimination of vector species such as birds who act as vector for psittacosis). Where elimination is not possible then the hierarchy of control with engineering, administrative and PPE controls can be applied. Table 2 provides an example of a hierarchy of control for biohazards

**Table 2** Hierarchy of control as applied to Biohazards (modified from Work Safe Alberta. (2009))

Engineering/Bioengineering controls	<ul style="list-style-type: none"> <li>• Vaccines</li> <li>• Prophylactic anti-viral medications</li> <li>• Ventilation systems</li> <li>• Engineered safe needle devices</li> <li>• Automated equipment</li> <li>• Policies and procedures</li> <li>• Routine practices such as "universal infection control" and the other safe work procedures</li> </ul>
Administrative controls	<ul style="list-style-type: none"> <li>• Immunization programs</li> <li>• Training</li> <li>• Quarantine and isolation procedures</li> <li>• Gloves</li> </ul>
Personal Protective Equipment(PPE)	<ul style="list-style-type: none"> <li>• Protective clothing</li> <li>• Eye protection</li> <li>• Face protection</li> <li>• Respiratory protection</li> </ul>

### General Prevention Measures

The general measures for the prevention and control of biological risk try to avoid the growth, dispersion and contact

of the biological agent with the worker, among them we can mention:

- ✓ cleaning and disinfection of premises, equipment and work tools;
- ✓ the implementation of work procedures and the use of collective protection equipment to prevent the dispersion of the biological agent (avoid generation of dust or bioaerosols, closure of processes, localized extraction);
- ✓ vector control (insects and rodents);
- ✓ proper management of potentially infectious waste and samples;
- ✓ follow-up of adequate hygiene practices (hand washing, personal hygiene, change of clothes, etc.);
- ✓ immediate treatment of any cut, wound or accident with biological risk;
- ✓ specific surveillance of the health and vaccination of the worker; and
- ✓ the use of personal protective equipment.

The proper implementation of these measures requires information, education and training of the worker in the correct monitoring of them. The results of health surveillance must be collected and kept up-to-date in the individual medical history of each worker and by means of their assessment it is possible to:

1. Identify particularly sensitive workers in relation to biological risk,
2. Establish whether the worker's health status may constitute a danger to himself and / or third parties and
3. Plan adequate preventive measures such as: vaccination or prophylaxis programs; additional or special preventive measures in cases of any contaminant of biological origin or when vaccination is rejected; and training and awareness programs.

Based on the above, health surveillance is a fundamental tool to determine the health status and immunization or vaccination of the worker and to assess and detect early damage related to exposure to biological agents.

In relation to vaccination, this constitutes a fundamental preventive measure, since a worker vaccinated or immunized against the biological agent to which he is exposed has a lower risk of becoming infected and, therefore, becoming the focus of infection or what is the same, of passing the infection on to others. This is why when there is a risk from exposure to biological agents for which there are effective vaccines, these should be made available to workers, informing them of its advantages and disadvantages.

### CONCLUSION

At the workplace level, there is an urgent need to protect workers, in all sorts of jobs, from a new risk related to global epidemics. This is all the more so, given the difficulties in finding adequate treatment for some diseases. Organisational, collective measures including workers training to identify at-risk situations and to apply the adequate control measures to both protect themselves and to stop the risks of further spreading are necessary and should be complemented with the necessary personal protective measures. Effort should be made to raise the level of knowledge about biological hazards. This may be partially achieved by considering the need for policy

interventions on biological hazards and their identification and control in the workplace.

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