EHS 101 OCCUPATIONAL HEALTH AND SAFETY

Unit 5

Yavuz Cabbar

BIOLOGICAL RISK FACTORS

One of the most important problems encountered in occupational health and safety is various risk factors that can be encountered in the working environment and that can endanger the health and safety of the employee. In general, these risk factors can cause occupational diseases, incapacity and even death as a result of immediate or continuous exposure to employees.

In this section, the general definition of biological risk factors and biological risk groups, the workers in which they pose a danger and the working environments where they can be seen, the reduction, recognition, contamination, etc. of biological risks in work environments and / or laboratories and also general information about the security measures will be given.

BIOLOGICAL RISK DEFINITION

According to the Regulation on the Prevention of Exposure Risks to Biological Factors, biological factors are defined as cellular or non-cellular microbiological agents that can cause any infection, allergy or poisoning. These microbiological agents consist of microorganisms, cell cultures and human endoparasites, including those that have been genetically modified.

Biological risk factors include viruses, bacteria, fungi and the products they produce as a result of their metabolism, as well as parasites and plants that can settle in the body as internal and external parasites. Also, recently, biotechnological products have been counted as biological risk factors.

According to the Prevention of Risk Exposure to Biological Factors Regulation, biological risk factors can be classified in four groups according to their risk level. A biological factor causing illness in a healthy person depends on; The high ability of the agent to infect (pathogenicity-virulence), the ways of transmission (contact, non-living materials, air and vectors), the sensitivity of the host person, environmental factors (temperature changes, humidity, radiation, air pressure, air flow speed, chemical substances, gases and toxins).

These 4 risk groups are;

Group 1 biological agents: Biological agents that are not likely to cause disease in humans,

Group 2 biological factors: Biological agents that can cause disease in humans, harm employees, but are unlikely to spread to the community, and generally have effective prevention or treatment,

Group 3 biological factors: Biological agents that cause severe diseases in humans, pose a serious danger to workers, may have a risk of spreading to the society, but generally have the opportunity of effective prevention or treatment and

Group 4 biological agents: Biological agents that cause severe diseases in humans, pose a serious danger to employees, have a high risk of spreading to the society, but without effective prevention and treatment methods.

Group	Causes ilness	Harmful for workers	Possible spreading to the sociaty	Effective prevention/ treatment
1	-	-	-	+
2	+	+	-	+
3	+	+	+	+
4	+	+	+	-

Evaluation of biological risk factors according to the risk level of infection, harm to employees and spread to the society and the availability of effective prevention and / or treatment method.

Although Group 1 has a rather wide list compared to other groups, the fact that any biological agent is not classified in Group 2, Group 3 or Group 4 and is not included in the list does not mean that this biological agent is in Group 1.

Biological agents pose a risk not only because they are infectious (infectious) and toxic, but also because they can cause allergic reactions such as allergic rhinitis, asthma and hypersensitivity pneumonia.

These hypersensitivity reactions to biological agents are not related to risk groups. Fungi, bacteria and some parasites are among the factors that cause hypersensitivity. These usually affect the respiratory system and less commonly the skin. In addition, some biological agents may cause carcinogenic (cancer-causing) effects as a result of long-term exposure.

samples of bacteria, viruses, fungi and parasites according to the safety risk classification (classification starts from Group 2 in the regulation)

Group	Bacteria	Viruses	Fungis	Parasiters
2	Bacteroides fragilis Clostridium tetani Corynebacterium diphteriae Staphylococcus aureus	Herpesvirus varicella–zoster İnfluenza virüsleri Tip A, B ve C Hepatitis A virüsü (insan entero virüsü Tip 72) Epstein-Barr virüsü	Aspergillus fumigatus Candida albicans Candida tropicalis	Ascaris, lumbricoides Taenia saginata Toxoplasma gondii Trichuris trichiura
3	Bacillus antrhracis Brucella abortus Mycobacterium tuberculosis Yersinia pestis Salmonella Typhi Shigella dysenteriae (Tip 1)	Hepatit C virüsü Hantaan virüsü Human immunodeficiency virüsleri (HIV) Yellow fever	Blastomyces dermatitidis Paracoccidioides brasiliensis Ajellomyces capsulatus	Echinococcus granulosus Trypanosoma cruzi Taenia solium Leishmania brasiliensis
4	-	Ebola virüsü Crimean-Congo heamorrhagic fever Marburg virüsü Variola virüsü	-	-

Works that can be exposed to biological risks

Although biological agents basically have essential and generally beneficial effects for the continuation of life, in some cases they can threaten human life. Since organisms living on Earth have existed, there are also biological risk factors and they can be found everywhere. While biological risk factors are sometimes a necessity of nature of the work, exposure to them often occurs accidentally. Biological risk factors and associated infections in work areas may arise from the following sources:

Blood and other body fluids

Human corpses, animal carcasses and raw meat

Human or animal waste such as feces and urine

Scattering during coughing or sneezing

Skin contact

In addition to these, molds and mold spores, mites, feathers, animal dander and pollen can cause allergic and toxic reactions. Although scientists, physicians, and laboratory staff are aware of most of these risks, most workers have limited knowledge of these risks. Risk assessment can also be very difficult, as these risks are often not visible.

According to the assessment of the risk of biological risk factors in Turkey; the focus was on healthcare workers, laboratory workers and agricultural workers. Taking into account the data of the European Agency for Occupational Health and Safety (EU-OSHA), the Ministry determined some of the jobs that may be exposed to biological factors as follows:

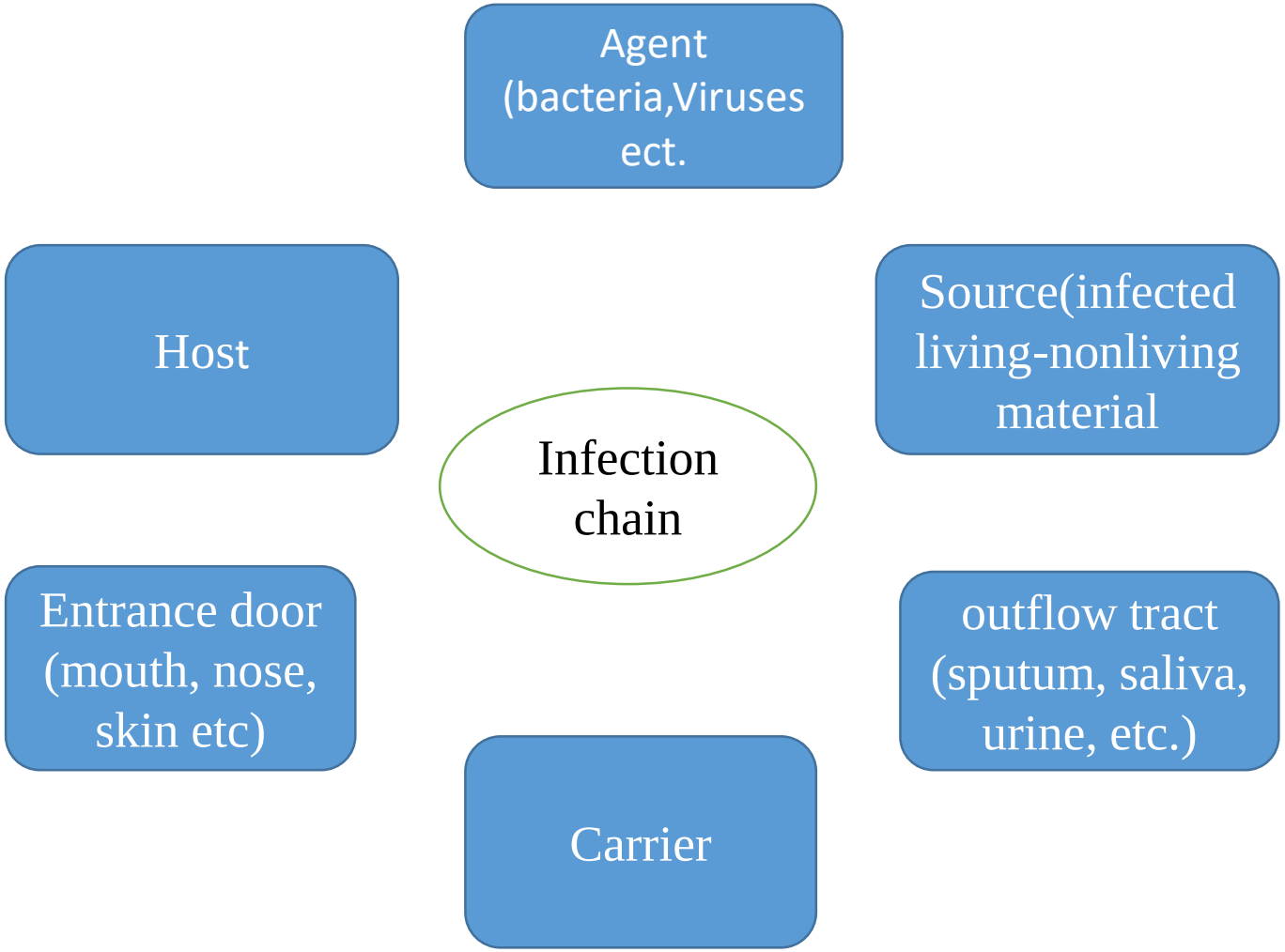
- Working in food producing factories
- Work in agriculture
- Working with animals and / or products of animal origin
- Working in places where healthcare services are provided, including quarantine and morgues
- Work in clinical, veterinary and diagnostic laboratories other than microbiological diagnostic laboratories
- Working in waste processing/recycle factories
- Work in sewage treatment plants

The employer employing workers in any of the areas listed above is obliged to avoid using harmful biological agents according to the nature of the work performed and, in the light of the available information, to replace the biological agents with those that are not dangerous to the health of the employees or less dangerous in accordance with the conditions of use. At the same time, the employer should take the necessary measures to reduce the risk of exposure to biological factors in the workplace.

The biological risks that workers are exposed to have historically been identified in healthcare workers. Over the years, many healthcare professionals have become ill or even lost their lives due to biological factors while conducting research or treatment of diseases.

Common infections, especially in healthcare workers are: bacterial infections such as tuberculosis, meningococcal meningitis, gastrointestinal tract infections, Legionnaires' disease, diphtheria, pertussis; viral infections such as hepatitis-B, measles, rubella, mumps, chickenpox or Varicella Zoster, Herpes infections, Cytomegalovirus infections, Acquired Immune Deficiency Syndrome, and parasitic infections such as Histoplasmosis.

If the agent is located in the person herself, it is mentioned internally (endogenous), if taken from outside, external (exogenous) infection is mentioned. Infection risk is higher than the general population in healthcare workers. Because healthcare workers are constantly involved in a process called the infection chain


Agent (bacteria,Viruses ect.
Host
Source(infected living-nonliving material
Infection chain
Entrance door (mouth, nose, skin etc)
outflow tract (sputum, saliva, urine, etc.)
Carrier

Causative Infection: Microorganisms settled in various parts of our body become a part of the body's basic defense systems. These organisms that have the ability to infect cause the causative infection. The ability of an infectious agent to cause disease, pathogenicity; the ability of this factor to cause a severe or fatal disease picture is defined as virulence.

The presence and density of resistant microorganisms with very high pathogenicity and virulence in healthcare units, especially in certain departments of hospitals, is a well-known phenomenon and has been determined by research. Such nosocomial infections are highly resistant to antibiotic treatment, highly contagious super infections and threaten healthcare workers as well as patients.

Source: It is the living and non-living beings where the infection settles and reproduces, and it is the end point of the chain. Even someone who has had an infection before can be the source of the source.

Exit Gate: It is the leaving of microorganisms from the body. Events such as sinus discharge, stool, ear discharge are called exit doors. This event, which plays a major role in preventing many infections, is effective in breaking the infection chain.

Entrance Door: These are the most common places where the infection can be transmitted. Areas in our body such as mouth, nose, throat, eyes and skin form the entrance door. Agents can enter the body through through the entrance door. Hospitals, diagnostic and research laboratories are suitable environments for all types of transmission of these agents.

Suitable Host: It consists of individuals whose body resistance is weakened or the defense system is not strong enough against microorganisms. It is the last link in the infection chain. Due to the working conditions, the possibility of various microorganisms to be colonized in various parts of the person is high. In addition, unique and non-unique personal defense mechanisms, stress caused by heavy working conditions and some health problems observed to be higher than the normal population, there may also be situations where it cannot function adequately due to the effects of destructive habits.

Environmental factors are effective at every step of the infection chain. Factors such as temperature changes, humidity, radiation, air pressure, air flow velocity, chemicals, gases and toxins affect the occurrence of infection. There are negative effects of these factors in all departments of health institutions such as pathology, microbiology, biochemistry laboratories; radiology and radiotherapy departments; and operating rooms.

Working area	Main biological risk factors
Agriculture, livestock and veterinary services	Allergens (pollen, herbal products and animal urine, feathers and proteins originating from their skin), mites, fungi, (Such as Aspergillus spp, Penicillium spp, dermatophytes) and bacteria (Actinomycetes, Brucella spp, Bacillus anthracis, Coxiella burnetii, Salmonella spp, MRSA, E.coli), and cell wall components of bacteria (endotoxins and zoonotic viruses (such as Rabies and Influenza), parasites and ticks.
Hospitals, health services	Viruses (such as Hepatitis, AIDS, rubella, Rabies and influenza), bacteria (Staphylococcus aureus, Streptococcus pyogenes, Such as Mycobacterium tuberculosis, Legionella and Clostridium), fungi (such as Tinea spp and Aspergillus spp), parasites Infectious agents (such as Giardia lamblia) and pyrons.
Laboratories	Zoonotic agents (Trichophyron spp, Toxoplasma gondii, Rabies), parasites (such as Leismania spp), and pyrons as well as allergens (such as proteins originating from mites, animal urine, feathers and skin).

Working area	Main biological risk factors
Food and beverage production, bakeries	Fungi (mold and yeast fungi), bacteria, and mites Mycotoxins, endotoxins, glucans, plant and animal originated allergens (such as α-amylase, cellulases),
Waste collection, disposal and separation	fungus (Aspergillus fumigatus, and yeast fungi), infectious (such as Salmonella) and non-infectious bacteria (E. Coli, actinomycetes), Endotoxins, glucans and viruses (Hepatitis A, Hepatitis B like)

Measures To Be Taken Against Risks

There are measures that both employers and employees should take against biological risk factors that may be encountered in workplaces. The employer should identify susceptible persons through periodic checkups. Training of all employees should be carried out both when they are starting work and through in-service training programs. It should be ensured that the behaviors to be followed by the workers while working are regulated, determined and notified to the employees with instructions and warning signs.

In addition, the architectural structures of the working environment (hospital, laboratory, animal shelter, slaughterhouse, packaging workshops, clinics, personal care centers, waste treatment workshops, etc.) should be suitable for the works features.

The chain of infection should be prevented by taking appropriate insulation and disinfection measures. Active immunization should be done for employees. For this purpose, employees should be vaccinated according to the characteristics of the workplace.

For example, laboratory workers and / or those dealing with animal husbandry should be vaccinated with vaccines such as Hepatitis B vaccine, plague vaccine (Yersinia pestis), rabies vaccine, anthrax vaccine (Bacillus anthracis), while those working in daycare and nurseries should be vaccinated against measles, mumps, rubella, poliomyelitis, influenza, Hepatitis A and B.

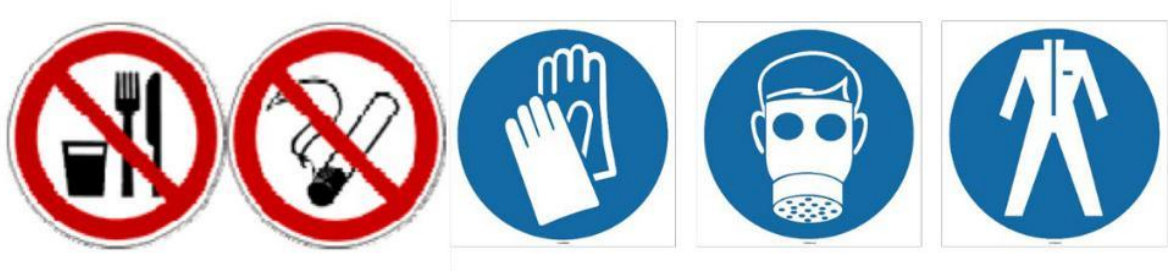
Obligation	What To Do
Substitution	Dangerous Biological risk factor replaces by non-dangerous ones or less dangerous ones
Minimising the risks	Prevents the exposure of employees in the presence of risk. If exposure is unavoidable ,minimizes the exposure level of employees at a level that provide sufficient protection.
Informing the Ministry	Employer notifies the Ministry 30 days before if working with group 2, 3 and 4 biological factors for the first time. The employer shares the risk assessment results, number of workers exposed to the risks and the jobs they work, the measures taken against the risks including workplace safety personnel. Reports accidents such as the spread of biological risk factors or causing an infection. List of employees exposed to post-activity risk and all medical reports records.

Obligation	What To Do
Hygiene and Personal Protection	Prevents Employees' eating and drinking in environments with risk of biological agent contamination and ensures working with suitable protective clothing. Provides Necessary protective devices and equipment (eye wash liquid, skin antiseptic) and its continuity (regeneration, cleaning)
Training and informing the employees	Prevents the exposure of employees in the presence of risk. If exposure is unavoidable ,minimizes the exposure level of employees at a level that provide sufficient protection. Employer trains the employees on protection against exposure, hygiene rules, use of protective equipment and clothing, possible health risks which is the result of biological risk factors exposure, and inform the workers action plan at the time of the incident or Before starting work. Renews the training periodically and as risk factors change

Obligation	What To Do
Informing the employee in special cases	Informs the employees against accidents occur during the work with biological risk factors by creating written instructions. Employees report similar incidents to the employer and other authorities. These accidents, their causes and the afterwards measures taken to correct them notified to the employee / representatives.
List of employees exposed to biological agents	Records the list of employees who are exposed to group 3 and group 4 biological agents with all the details (work done, exposure, accidents, etc.). It keeps these records for at least 15 years after exposure ends (Special records may need to be kept for 40 years).

In terms of occupational health and safety, there are general rules not only for the employer but also for the employees to be protected from biological risk factors.

Examples of safety signs that should be hung by the employer against biological risk factors at workplaces.



Red safety signs indicate dangers and prohibited actions. Blue safety signs show what must be done. some examples of Personal Protective Equipment (PPE) are also shown

General Rules in Laboratories

Especially the laboratories of hospitals or analysis centers are high risk areas in terms of biological factors. For this reason, the rules that should be followed in Laboratories can be generalized as follows.

- Straws should never be used with a mouth, care should be taken to avoid bubbles.
- Syringes or needles should never be used instead of pipettes.
- Opened tube caps and tube mouth should be covered with an alcohol wipe.
- Biological risk operations should be carried out in "Biological Safety Cabinet".

- Centrifuge operations should be done in a room with sufficient ventilation and care should be taken to ensure that the plastic tubes used during these operations are intact.
- As a general rule, a syringe with a locking needle should be used during injection and aspiration. While the needle is separated from the syringe, it must be held with an alcohol wipe.
- Needles and syringes should be thrown into special containers with narrow mouths after use.
- All used and contaminated materials must be sterilized in the autoclave before disposal.

- Contaminated pipettes and glassware should be placed in disinfectant containers before autoclaving.
- It is strictly forbidden not to consume food, drink and cigarette in laboratories, and attention should be paid to this.
- When leaving the laboratory, hands must be washed, and the protective material used during the procedure (glasses, apron, etc.) must be left in the laboratory.
- No food should be kept in the refrigerator where serum or samples are kept.

In addition, employees are required to know the biological risk factors in the workplace and to take all precautions determined by the employer and the regulation for these factors. The presence of a biological risk factor in a workplace is indicated by the international biohazard sign.

Biohazard sign

Matters to be Considered in the Health Surveillance of Employees

Even if necessary measures have been taken to eliminate or minimize risk factors at workplaces, exposure and contamination of employees to biological risk factors may occur, sometimes as a necessity of the work, and sometimes as a result of unexpected accidents or events. In these cases, some applications should be done by the workplace doctor and the employer.

The workplace doctor is responsible for the surveillance of the health of employees exposed to biological factors. In this context, they should know the biological risk factors in the workplace, and follow the health conditions and exposure conditions of the employees. The workplace physician should act in accordance with the practices and principles of workplace medicine and take the following measures while performing the health surveillance of employees:

It should evaluate the personal health status of the employees and keep records regarding their medical and professional backgrounds. It should determine the early and reversible effects of biological factors on Employees and follow their biological analysis. As the workplace physician updates the information about the risk factors that the workplace may encounter during the work and the measures to be taken, it may be decided to conduct further tests on the current subject for each employee.