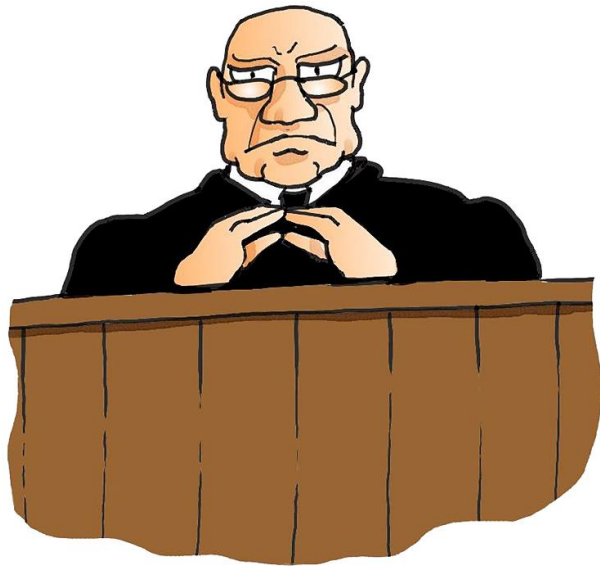


# Biological agents in the workplace - public health view

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Spec. med. microb. with parasit.

# LEGISLATION



- ▶ Directive for workers protection against exposure to biological agents at work (N.N.155 / 2008)
- ▶ Minimum requirements for safety and health of workers and risk for their health and safety and prevention of risk arising from exposure to biological agents at work
- ▶ Law on Occupational Safety (N.N. br. 71/14, 118/14, 94/18, 96/18)
- ▶ Biological Agents Directive 2000/54 / EC

# TERMS

Biological agents - microorganisms, cell cultures and human endoparasites that can cause infection, allergy or poisoning - are classified into 4 groups according to the level of risk of infection:

Group 1 - a biological agent that is unlikely to cause a disease in humans

Group 2 - a biological agent that can cause a disease in humans can be dangerous to workers, is unlikely to spread to the environment, there is effective prophylaxis and treatment

A group of 3 biological agents that can cause serious illness in humans, poses a serious risk to workers, may pose a risk for environmental diffusion, usually there is effective prophylaxis and treatment

A group of 4 biological agents causing severe human illness and posing a serious risk to workers may pose a high risk of spreading to the environment, usually there is no effective prophylaxis or treatment



# Environment and health

- ▶ Development of the economy
- ▶ Environmental Pollution - Impact on Health
- ▶ Health is first on the list of priorities of modern man

# Biological agents

Epidemiological studies - several hundred million people are exposed to BA

Exposure is registered in 22 branches of industry

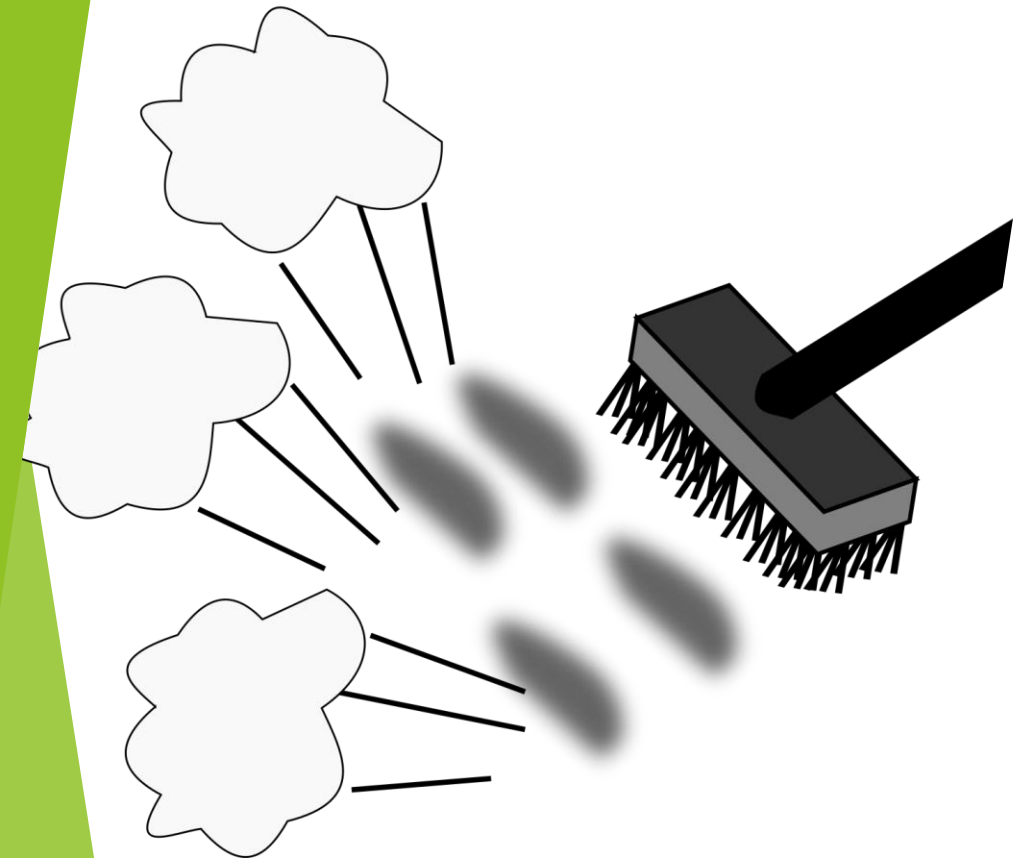
The Challenge for Occupational Health and Public Health

Exposure can lead to the development of various diseases: acute, chronic, life-threatening, diseases that have different socio-economic consequences

- Illnesses caused by parasites, viruses, fungi and bacteria
- Allergies, diseases of the respiratory system caused by exposure to molds or organic dust such as flour, dust of animal excreta, spores
- Poisoning and other toxic effects
- Some viruses, parasites even dust (sawdust) can cause cancer

# Exposure at workplaces

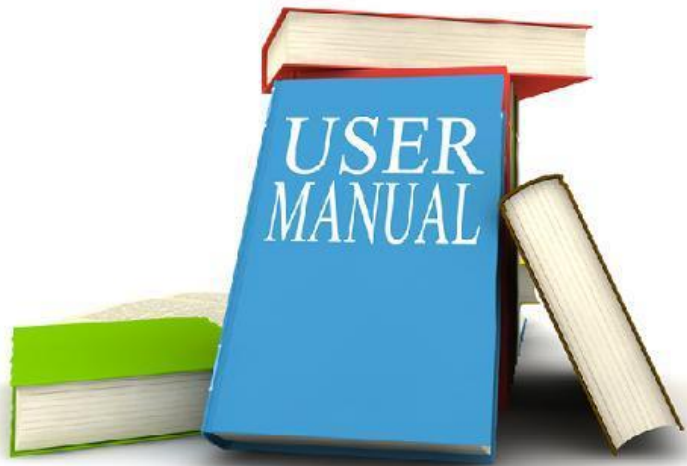
- ▶ Jobs where worker come into contact with land, clay, plants - agriculture
- ▶ Jobs where worker come into contact with animals and / or animal products
- ▶ Working in food production
- ▶ Work in health - contact with blood and human secretions
- ▶ Work in laboratories
- ▶ Waste work
- ▶ Jobs involving "organic" dust (flour, pollen, animal fur)



## Ways of entering the human organism

- ▶ Damaged skin, mucous membranes
- ▶ Inhalation (bioaerosol - airborne dust particles)
- ▶ Ingestion (less frequent in workplace)
- ▶ Animal bite
- ▶ Through uro-genital tract
- ▶ Pricks, scratches and cuts





# Request

- ▶ for general guides
- ▶ standards
- ▶ The eligibility criteria for a correct interpretation of the results from the environment
  - ▶ Chemical and physical risks - the higher the concentration / intensity, the longer the time of exposure - the greater the possibility of damage and illness
  - ▶ Biohazard - no proportionality to answer the question of risk (except for some allergies)



# Lack of standards



- ▶ The relation between the dose and response can hardly be precisely determined
- ▶ It is difficult to identify the microorganisms responsible for the effects on health
- ▶ Individual sensitivity
- ▶ There is a lack of data on the amount of biological agents in workplaces and in the environment
- ▶ Sampling methods are generally not standardized
- ▶ Lack of criteria inhibit the development of analytical methods



# How should standards be made?

- ▶ ENVIRONMENT (AIR - SURFACE)
- ▶ External
- ▶ Interior
  - ▶ Apartment, house
  - ▶ Working place
    - ▶ In the industry
    - ▶ Outside the industry

# Estimation of air pollution by bacteria according to Polish standard (PN-89 / Z-04111/02)

Total number of bacteria	number				Air pollution level
	aktinomicetes	Pseudomonas fluorescens	hemolitical staphylococcus		
			Type of hemolysis		
			α	β	
under 1,0 x1 000	under 1,0 x10	-	-	-	unpolluted
from 1,0 x1 000 to 3.0x 1 000	from 1,0x10 to 1,0 x 100	5,0 x 10 and under	2,5x10 and under	5,0 x 10 and under	moderately polluted
above 3,0 x 1 000	above 1,0 x 100	above 5,0 x 10	above 2,5 x 10	above 5,0 x 10	very contaminated

# Estimation of air pollution by molds according to Polish Standard (PN-89 / Z-04111/03)

<b>Total number of fungi in 1 m<sup>3</sup> atmospheric air</b>	<b>Atmospheric pollution level</b>
to 3,0 x 1 000	Not polluted air
from 3,0 x 1 000 to 5,0 x 1 000	Average pure atmospheric air, especially in the morning period
from 5,0 x 1 000 to 1,0 x 10 000	Contamination that can adversely affect the environment
above 1,0 x 10 000	Dangerous contamination for the human environment

# Reference values for microbial pollutants in air (Portuguese standard)

	<b>Matrix</b>	<b>Unit</b>	<b>Reference values</b>
<b>bacteria</b>	air	CFU / m <sup>3</sup>	The concentration of total airborne bacteria of internal air must be lower than the concentration of external air + 350 CFU / m <sup>3</sup>
<b>Legionella spp.</b>	woter	CFU / l	Concentration below 100 CFU / l, except in the case of a cooling tank where the concentration should be less than 1000 CFU / l. Absence of Legionella pneumophila
<b>molds</b>	air	CFU / m <sup>3</sup>	The mold concentration of internal air should be lower than that of the outside air

# Reference values for molds in the air based on the hazards of different types of molds (Portuguese standard)

Species	Specific conformity conditions	
Species that do not excrete toxins	Cladosporium spp Penicillium spp Aspergillus spp Alternaria spp Eurotium spp Paecilomyces spp Wallemia spp..	The total concentration of all species does not exceed 500 CFU / m <sup>3</sup>
Unusual species	Acremonium spp Chrysonilia spp Tricothecium spp Curvularia spp Nigrospora spp	Single species: concentration below 50 CFU / m <sup>3</sup> Total concentration below 150 CFU / m <sup>3</sup>
Pathogenic species	Chyptococcus neoformans Histoplasma capsulatum Blastomyces dermatitidis Coccidioides immitis	Absence of any species
Toxic species	Stachybotrys chartarum Aspergillus versicolor Aspergillus flavus Aspergillus ochraceus Aspergillus terreus Aspergillus fumigatus Fusarium moniliforme Fusarium culmorum Trichoderma viride	Each species: concentration below 12 CFU / m <sup>3</sup> (several colonies per plate)

# Laboratory for Microbiological Air Analysis - Teaching Institute for Public Health "Dr. Andrija Štampar"

- ▶ Methods for microbiological examination of air
  - ▶ the parameters for determining the total number of bacteria and determining the total number of molds in the air
  - ▶ comparison of indoor and outdoor air of living and working environment
- ▶ HRN EN ISO 16000-1: 2008 Indoor air - Part 1: General aspects of sampling strategy
- ▶ ISO 16000-17: 2008 Detection and counting of mold by impact method - cultivation method
- ▶ ISO 16000-18: 2011 Detection and counting of mold by impact method - sampling
- ▶ HRN EN ISO 16000-19: 2014 Indoor Air - Mold Sampling Strategy
- ▶ EN 13098: 2008 Workplace Atmosphere - Guidelines for the Measurement of Airborne Microorganisms and Endotoxins

# When should microbiological analysis of air be conducted?

- ▶ Complaints about poor air quality
- ▶ Need for determining exposure to certain microbiologically possible harmful factors
- ▶ Testing of the effectiveness of the repaired actions (air-conditioning cleaning, adequate ventilation ...)
- ▶ It is suspected that inadequate air quality has an adverse effect on human health



# Preparation for sampling

Determining the volume of air to be sampled.

- according to the purpose of areas and the estimated contamination of the area.

Location assessment - contamination level

- detailed visual environmental inspection (visible impurities in air-ventilation devices and traces of mold, impurities and traces of molds on walls and other surfaces in the room)
- for assessing the measurement parameters and risk assessment, as well as professional opinion, important data are established during the health eco-survey

# Risk assessment, prevention and control

Risk assessment due to exposure to biological agents

Risk mitigation

- Suspension of working place
- Change of workplace

Information and training of workers

Health surveillance of exposed workers

# Risk management

Expected or continuous exposure to biological agents (cultivation of microorganisms, food production)

- Monitoring of a known agent
- Prevention measures

Occasional or possible exposure to biological agents - consequences of work (agriculture, waste management)

- Risk analysis is more difficult
- For some activities there are information on exposure and the protection measures are prescribed
- Observe general protective measures at the workplace

Type of industry	Major biological agents
Primary agriculture, animal feed production, veterinary service	allergens (eg pollen, plant materials and animal proteins from urine, hair and skin), mites, fungi such as Aspergillus spp., Penicillium spp, dermatophytes) and bacteria (eg Actinomycetes, Brucella spp, Bacillus anthracis, Coxiella burnetii, Salmonella spp, MRSA, E. coli) and endotoxins and glucans, viruses causing zoonoses (eg rabies, flu), parasites and ticks.
Health care, hospitals	Infectious agents including viruses (eg Hepatitis, human immunodeficiency virus, rubella, rabies, influenza), bacteria (eg Staphylococcus aureus, Streptococcus pyogenes, Mycobacterium tuberculosis, Legionella, Clostridium), fungi (eg Tinea spp, Aspergillus spp) parasites (eg Giardia lamblia) and prions.
Laboratories	Infectious agents, including zoonotic agents (eg Trichophyton spp, Toxoplasma gondii, Rabies), parasites (eg Leishmania spp) and prion allergens (eg mushrooms, herbicides and animal proteins from urine, hair and skin).
Production of food and beverages, bakeries	Fungi (molds and yeasts), bacteria and mites. Mycotoxins, endotoxins, glucans, allergens including plant and animal proteins, enzymes (e.g., $\alpha$ -amylases, cellulases),
Forestry	Bacteria (eg Anaplasma phagocytophilum, Borrelia burgdorferi, Coxiella burnetii), viruses (eg Hantavirus, encephalitis viruses), parasites (eg Toxoplasma gondii).
Metal working (where metal fluid fluids are applied)	Bacteria (Pseudomonas spp, Mycobacterium immunogenum), molds / yeasts (eg Fusarium spp), endotoxins.
Wood processing	Bacteria (mainly Gram-negative but also Actinomycetes), fungi (eg Aspergillus spp, Alternaria spp and yeasts), endotoxins
Collection, processing and sorting of waste	Mushrooms (eg Aspergillus fumigatus and yeasts), infectious (eg Salmonella) and noninfective bacteria (eg E. Coli,

# Workplaces connected with the most common biological agents

<b>Collection, processing and sorting of waste</b>	<b>Fungi (eg <i>Aspergillus fumigatus</i> and yeasts), infectious (eg <i>Salmonella</i>) and noninfective bacteria (eg <i>E. Coli</i>, actinomycetes). Endotoxins, glucans and viruses (eg hepatitis A, hepatitis B)</b>
<b>Air-conditioning and high humidity workplaces (eg textile industry, printing industry and paper production)</b>	<b>Fungi (molds and yeasts), bacteria (eg <i>Legionella</i> spp, <i>Pseudomonas</i> spp), endotoxins and allergens</b>
<b>Archives, museums, libraries</b>	<b>Fungi (<i>Aspergillus</i> and yeasts), bacteria, endotoxins</b>
<b>Construction industry (processing of materials, renovation of buildings)</b>	<b>Molds, bacteria, endotoxins</b>

High risk occupations	Dangers / Risks	Preventive measures
Work areas with air conditioning systems and high humidity (eg textile industry, printing industry and paper production)	Allergies and respiratory disorders due to mold / yeast Legionella	Dust and aerosol reduction measures Regular maintenance of ventilation, machines and work surfaces. Limit the number of workers Maintaining high water tap temperature.
Archives, museums, libraries	Mold / yeast and bacteria cause allergies and respiratory disorders	Reduction of dust and aerosols Decontamination Appropriate personal protective equipment (PPE) Workplace equipment maintenance
Metal and wood processing industry	Skin problems due to bacterial and bronchial asthma due to mold / yeast in circulating liquids in industrial processes such as grinding, pulverizing and liquid cutting of metal and stone	Local ventilation. Regular maintenance, filtration and decontamination of liquids and machines Skin protection Appropriate hygiene measures

## Examples of possible hazards caused by biological agents in different occupations and relevant measures that can be used to control / prevent exposure

High risk occupations	Dangers / Risks	Preventive measures
Food industry (cheese, yoghurt, salami) or production of additives, bakers	Mold / yeast, bacteria and mites cause allergies. Organic dust from grain, powdered milk or flour contaminated with biological agents Toxins such as botulinum toxins or aflatoxins	Closed processes Avoid formation of aerosols Separated polluted work area Appropriate hygiene measures