BIOLOGICAL RISK FACTORS AT WORKPLACES:

OVERVIEW & RISK ASSESSMENT

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HAZARDS AT WORKPLACES

BIOLOGICAL

PHYSICAL

ERGONOMICAL

PSYCHOSOCIAL

BIOLOGICAL HAZARDS: DEFINITION

Biological factors/agents or **Biological hazards (Biohazards)**

Include many agents:
microorganisms
with associated
toxins,
cell cultures,
human parasites,

Whole or fragmented as bioaerosols

may cause **morbidity** and/or **mortality** in human through **infection**, **allergy** or **toxication**

BIOLOGICAL HAZARDS: DEFINITION

Biological factor is a broad term.
It includes many agents, such as:

- Bacteria

- Fungi

- Virus

- Bacterial endotoxins and exotoxins

- Mycotoxins

- Peptidoglycans

- β-glucans

- Allergens (high molecular weight)

- Plant fibres

- Animal and plant proteins

- Organic dust

CLASSIFICATION BY PATHOGENIC POTENTIAL

Non-pathogenic

Not known to cause **infection**, but some may be associated with **inflammtory and immuno-toxic reactions**.

They include microorganisms, contituents and metabolites from microorganisms, plant and animal materials.

Ex: *Saccharomyces cereviseae*
Bacillus subtilis
Endotoxins from G⁻ bacteria
Mycotoxins from fungi

Pathogenic

Known to cause diseases through **infections and/ poisoning**.

Pathogenic biological agents include **microorganisms** and **prions**.

Ex: *Bacillus anthracis* that causes Anthrax
Coxiella brunetii that causes Q fever
Clostridium tetanum that causes Tetanus

CLASSIFICATION BY BIOSAFETY LEVELS

BSL IV

Are very serious hazards to workers and public.
Include microorganisms that **cause severe or lethal disease** to healthy adult humans. **No** or limited **prophylaxi**s and **treatment** available. Ex: *Small pox virus, Ebola virus*

BSL III

Are hazards to workers and public.
Include microorganisms that **can cause serious or potentially lethal disease** to healthy adult humans. **Effective prophylaxis** and **treatment** available. Ex: *Yersinia pestis, Mycobacterium tuberculosis, rabies viruses*

BSL II

Moderate potential hazards to worker and public.
Include microorganisms that **can cause mild disease** to healthy adult humans. **Effective prophylaxis** and **treatment available.**
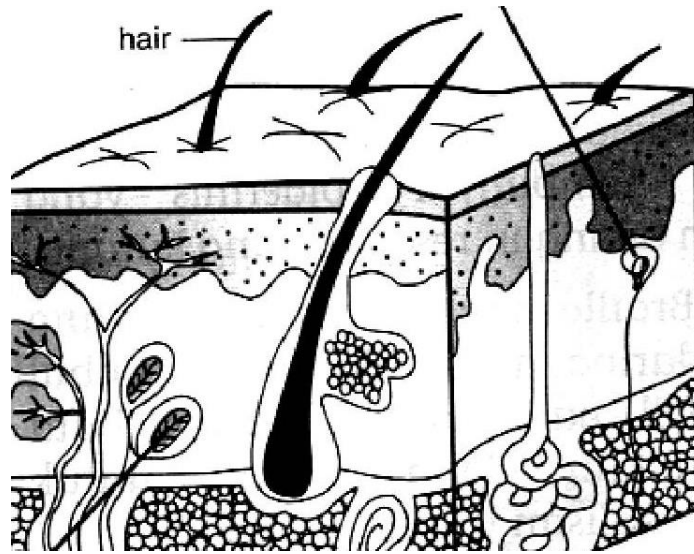Ex: *Aspergillus fumigatus, Streptococus pyogenes, Herpes virus*

BSL I

No or **Minimal hazard** to workers and the public.
Not known to consistently cause disease in healthy adult humans.
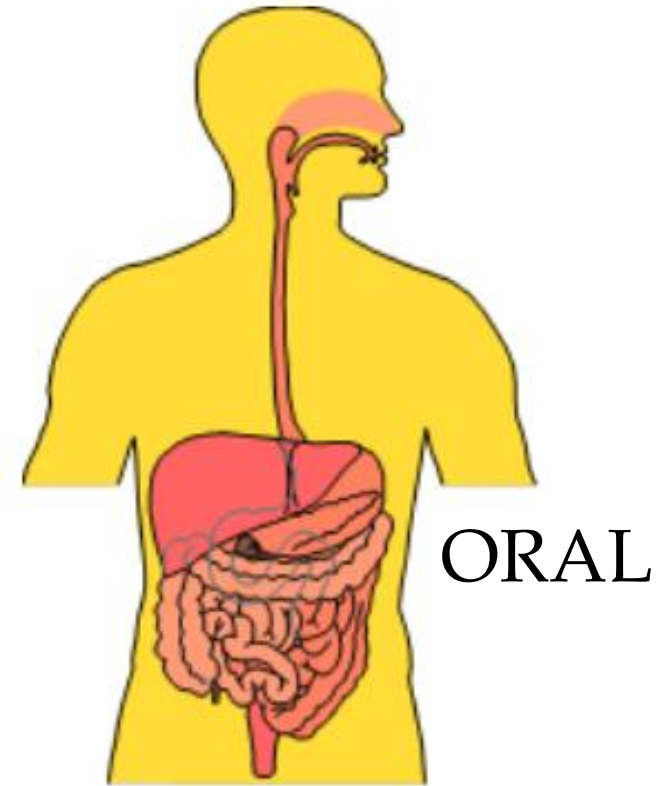Ex: *Saccharomyces cerevisiae*
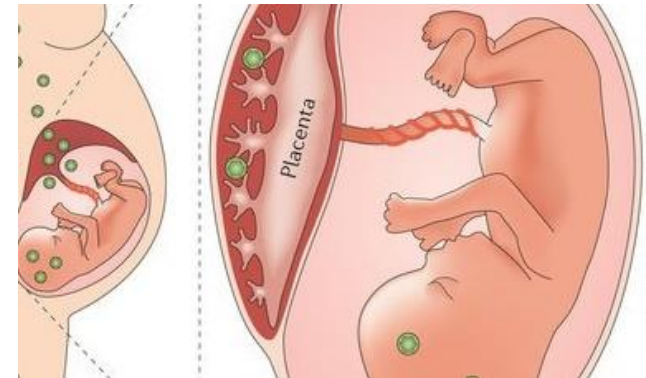
EXPOSURE ROUTES
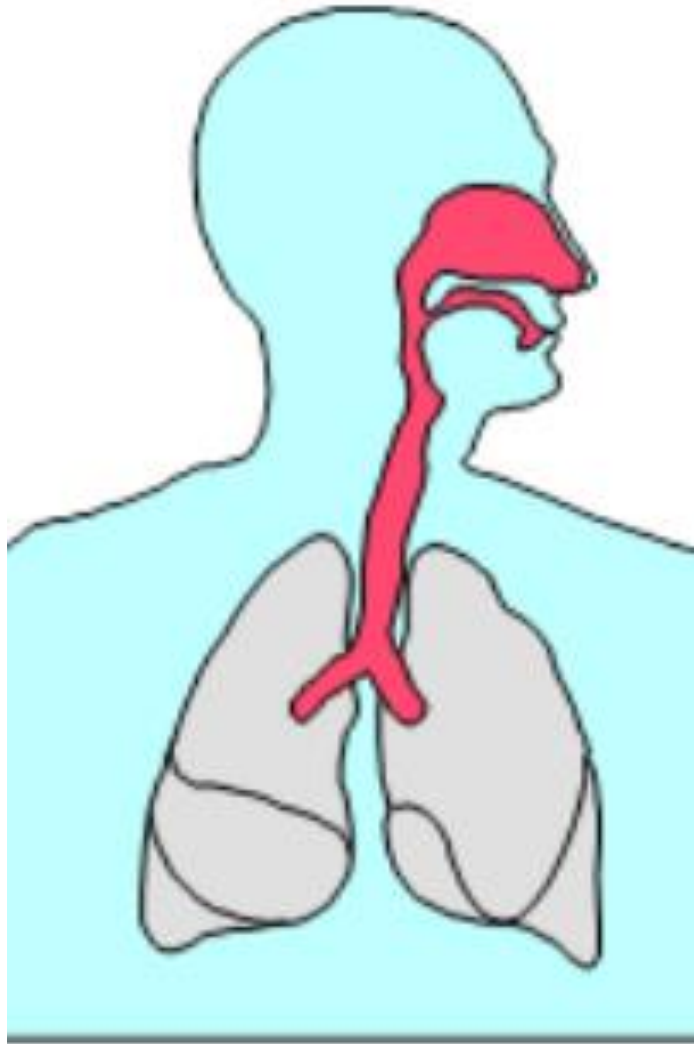
SKIN

ORAL

INHALATION

EYES

PLACENTA

WORK-RELATED DISEASES LINKED TO BIOLOGICAL AGENTS

CANCER

Viruses
(ex: Hepatite B)

Wood dust

Healthcare/Hospitals
Veterinary medicine

https://www.usaid.gov/mala
wi/fact-sheets/malawi-health-
systems-strengthening-fact-
sheet

Laboratories
(Medical, Bioscience, Archeology)

https://www.biograd.co.uk

Wood processing

https://ktpress.rw/2019/07/rwanda-to-launch-an-open-competition-for-wood-dealers/

WORK-RELATED DISEASES LINKED TO BIOLOGICAL AGENTS

INFECTION

Tetanus

AIDS

Leptospirosis

**Bacteria
Viruses
Fungi
Parasites
Prions**

**Healthcare/Hospitals
Veterinary medicine**

Agriculture

Waste management plants

Forestry/ Rangers

WORK-RELATED DISEASES LINKED TO BIOLOGICAL AGENTS

NON-ALLERGIC DISEASES

- COPD
- Farmers lung
- Chronic Alveolotis

**Fungi
Bacteria
Viruses
Parasites**

**Organic dust
Endotoxins
Mycotoxins
Glucans
Allergens
Mites**

Waste Management

https://www.waste.ccacoalition.org/sites/default/files/files/city_assessment_lome_v2.pdf

Food production, processing & packaging

https://www.nytimes.com/2017/10/11/world/australia/vegemite-blend-17.html

Agriculture

https://glm-lic.iza.org/thematic-areas/ta2/111/

Textile industry, Paper production

https://vietnamnews.vn/economy/484005/viet-nam-targets-40-billion-in-exports-from-textile-and-garment-industry.html#DVQhHSgOQsdIvq6G.97

WORK-RELATED DISEASES LINKED TO BIOLOGICAL AGENTS

ALLERGIC DISEASES

Atopic asthma

Hypersensitive pneumonitis

Allergic rhinitis

Fungi
Bacteria
Viruses
Parasites

Organic dust
Endotoxins
Mycotoxins
Glucans
Allergens
Mites

Healthcare/Hospitals Veterinary medicine

https://www.usaid.gov/malawi/fact-sheets/malawi-health-systems-strengthening-fact-sheet

Laboratories

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Food production, processing & packaging

https://www.nytimes.com/2017/10/11/world/australia/vegemite-blend-17.html

Wood processing industry

https://ktpress.rw/2019/07/rwanda-to-launch-an-open-competition-for-wood-dealers/

WORK-RELATED DISEASES LINKED TO BIOLOGICAL AGENTS

SICK BUILDING SYNGROM

Organic dust
Fungi
Bacteria
Endotoxins
Toxins
Glucans
Allergens
Mites

Libraries (Archive), Museums

Textile & Paper production

https://vietnamnews.vn/economy/484005/viet-nam-targets-40-billion-in-exports-from-textile-and-garment-industry.html#DVQhHSgOQsdIvq6G.97

https://fotota.hypotheses.org/4161

EXPOSURE ASSESSMENT OF BIOLOGICAL AGENTS

Volumetric Sampling

Impactors

Filters in cassettes

Impingers

ANDERSON INPACTORS

SAS SAMPLER

IOM
SAMPLER

Inle

SKC
BioSampler

20 mL

Figure 1. SKC BioSampler Components
shown with 20-ml vessel (5-ml vessel a

EXPOSURE ASSESSMENT OF BIOLOGICAL AGENTS

Quantitative detection methods:

Gravimetry

Microscopy

Cultivation

Molecular techniques (qPCR)

Immunoassays

Chemical methods (PLFA, Ergosterol, Glucans)

The exposure assessment of biologi[cal] agents can be quite challenging, however the following steps help monitoring in occupational setting[s]

➢ Idendify the sources

➢ Idendify the tasks determinant fo[r] exposure

➢ Access the exposure intensity an[d] frequency

EXPOSURE ASSESSMENT OF BIOLOGICAL AGENTS

The exposure assessment of biological agents can be quite challenging, however the following steps help monitoring in occupational settings:

➢ Idendify the sources of the biohazards

➢ Idendify the tasks determinant for the exposure

➢ Access the exposure intensity and frequency

EXPOSURE ASSESSMENT OF BIOLOGICAL AGENTS

With the non-pathogenic biological agents that are associated with morbidity, the exposure levels are compared to national or regional establised occupational exposure limit (OEL) .

Examples of OEL:

Endotoxins	$90EUm^{-3}$ (some EU countries)
Fungal spores	10^5 m^{-3} (Nordic countries)
Actinobacteria	10^6 m^{-3} (Nordic countries)
Hard wood dust	$2 mg/m^3$ (EU Today)
Total dust	$15 mg/m^3$ (PEL-OSHA)
Respirable dust	$3 mg/m^3$ (TLV-ACGIH)
Inhalable dust	10 mg/m3 (TLV-ACGIH)

RISK ASSESSMENT OF BIOLOGICAL AGENTS

What are the **hazards?**

Who might be at risk and **how?**

Actions already in place

Further Improvement

Evaluate Record Monitor Review
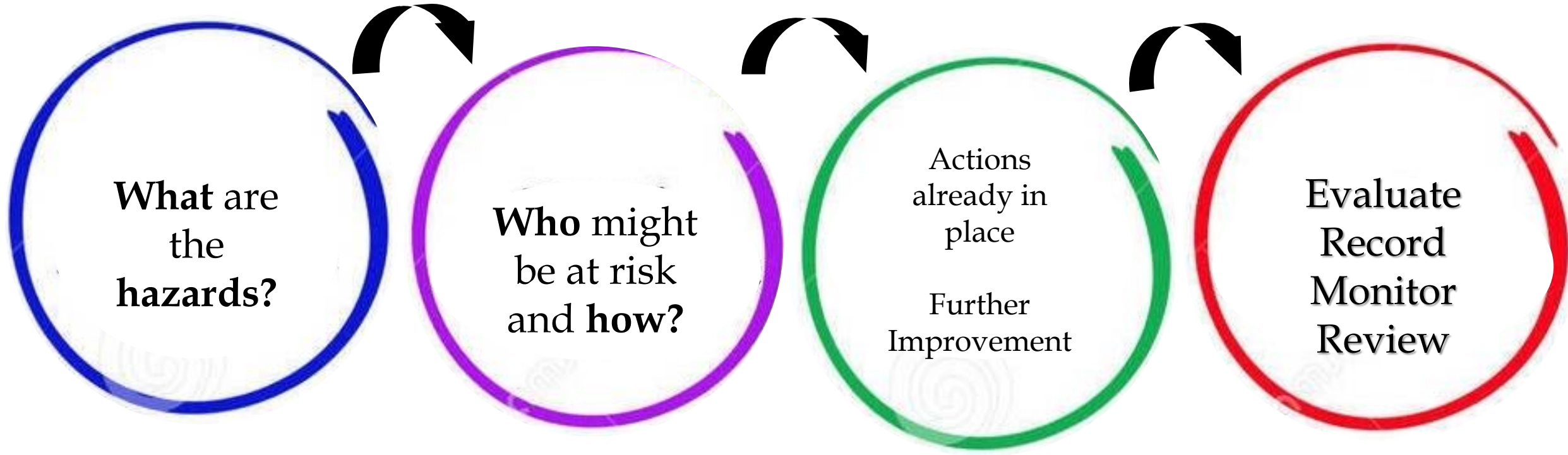
RISK ASSESSMENT OF AGENTS WITH BSL CLASSES

RISK= SEVERITY OF HARM × LIKELIHOOD OF HARM

Severity of the agents (S)

Exposure levels	Biosafety levels	Description	Value
Background levels	BSL1	First aid. No consequence	1
High levels	BSL2	Illness with reversible effects	3
Very High levels	BSL2	Illness with reversible major effects	7
Extremely high levels	BSL3	Illness with Ireversible major effects	15
	BSL4	Death	40

Frequency (F)

Description	Value
< 1 per year	0.5
1 per year	1
1 per mounth	2
< 1 per week	3
Daily	6
Continuously	10

Probabilty of occurrence (P)

Description	Value
Highly unlikely: cannot occur	1
Unlikely: can occur but never occur	3
Likely: occur occasionally	6
Very likely: occur frequently	10

$$R = S \times F \times P$$

R<70: Acceptable risk   **70<R<400: Improvable risk**   **R>400: Undesirable risk**

Source: SONAFI

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RISK ASSESSMENT OF AGENTS

RISK= SEVERITY OF HARM × LIKELIHOOD OF HARM

Severity of harm(S)

Description	Value
Insignificant	1
Minor	2
Moderate	3
Major	4
Fatal	5

Probabilty of occurrence (P)

Description	Value
Highly unlikely: very rare Less than 1 per year	1
Unlikely: can occur but never occur 1 per year	2
Moderate: can occur 1 per month	3
Likely: occur occasionally 1 per week	4
Very likely: occur frequently daily	5

$$R = S \times P$$

R≤5: Acceptable risk

5<R<15: Improvable risk

**R>15: Undesirable risk
Highest priority for action**

BIOLOGICAL AGENT RISK MITIGATION

1. Eliminate the risk to workers by elimination or substitution if possible

2. Reduce the risk by prevention and control

3. Inform and train workers

4. Provide health surveillance as appropriate

BIOLOGICAL AGENT RISK MITIGATION

- Vactination of workers at risk
  - Surveillance of workers
    - Follow up of workers

PPE to reduce exposure to biological agents (Last option)

USEFUL LINKS

OSHWiki: https://oshwiki.eu/wiki/Biological_agents

Bioagent IFA (Germany):
http://gestis.itrust.de/nxt/gateway.dll/bioen/000000.xml?f=templates&fn=default.htm&vid=gestisbioeng:biosdbeng

Occupational health in developing countries:
(https://www.futurelearn.com/courses/occupational-health-developing-countries/8/steps/535095)

TAKE HOME MESSAGES

Biological risk factors prsent in almost every occupation

Biological risk factors can be pathogenic or non pathogenic

Different occupational diseases are linked to exposure to both pathogenic and non-pathogenic biological agents

Risk as Severity of Harm x likelihood of Harm

Information and Awerness of workers are of the greatest importance in the preventing work diseases related to biologicl risk factors

As last option, implementation of protective measures against biological agents are very effective

SOME CASES FOR DISCUSSION

Waste workers
Sloughter/ Butcher

Bakery workers

Mortuary workers

Animal husbandry workers

Risk for lung diseases (eg. Allergy/ infection) by biological agents

Severity of harm(S)		Probabilty of occurrence (P)	
Description	Value	Description	Value
Insignificant	1	Highly unlikely: very rare Less than 1 per year	1
Minor	2	Unlikely: can occur but never occur 1 per year	2
Moderate	3	Moderate: can occur 1 per month	3
Major	4	Likely: occur occasionally 1 per week	4
Fatal	5	Very likely: occur frequently daily	5

R≤5: Acceptable risk

5<R<15: Improvable risk

$$R = S \times P$$

R>15: Undesirable risk
Highest priority for action

Source: ILO 2022

	Health outcomes	Hazards Severity of harm	Likelihood / probability	RISK
Waste sorting workers	Airways irritation	Bacteria and constituents, Fungal spores, fungal fragments, toxins **S=2**	Daily **S=5**	**10**
	Infection	**TETANUS/ Hepatite B** **S=5**	Daily **S=3**	15