

„Prevention is better than cure“

Prevention specialists

Dr. Olaf Riccabona
Industrial medicine

DI Martin Hulak, Dr. Walter Stolz,
Ing. Stefan Mader

Safety engineers



1

Safety in laboratories

Harmful substances

- very poisonous
- poisonous
- Injurious to health (less poisonous)
- caustic
- irritating
- cancerous
- mutating genotype
- sensitising
- endangering reproduction
- fibreing
- radio active
- biologically inert



Easily combustible substances

- incendiary
- highly flammable
- easily flammable
- flammable



Explosive substances



Biological substances

- group 2
- group 3
- group 4



What is the meaning of instructions?

- **Avoidance** of accidents and occupational diseases
- **Information** about possible risks and dangers at the work place
- The employer's **Lawful obligation** (acc. to § 14 of the industrial safety act)



3

When are instructions to be performed? 1

- before the uptake of any activity (initial instruction)
- when changing any scope of work
- when changing or introducing new work devices



4

When are instructions to be performed? 2

- when changing or introducing new work devices
- when changing or introducing new work procedures
- after accidents or near-accidents, in order to prevent the same in future

5

Employees' duties (acc. to § 15 of the industrial safety act)

- Application and acceptance of the offered safety measures
- proper use of work devices
- Employees must not abuse alcohol or drugs, which would harm themselves or others



6

Employees' duties 2 (acc. to § 15 of the industrial safety act)

- Safeguards must not be removed, shifted or readjusted



- All accidents, near-accidents or dangers must be reported to the responsible manager.

7

General safety and hygienics in labs

- Generally, prior to the uptake of any lab activity, an instruction regarding the relevant activity has to be performed by the head of the lab. There should be a documentation to verify that the instruction has been acknowledged.
- All tasks should be planned and set up carefully in order to ensure a safe and smooth work process. Hassle and wrong equipment are one of the main sources of danger

8

General safety and hygienics in labs

- Before starting any activity, make yourself familiar with the location and proper use of safeguards such as first-aid kits, escape routes, telephone, fire alarm, fire-extinguishing agent, emergency- and eye shower, absorbing agents for chemical substances, main switch for gas- and electrical supply, asf..
- Inform yourself about any possible dangers of the used chemical substances, micro organisms and devices and also take in account any possible personal risks such as pregnancy or allergies.

e.g. GESTIS data base of harmful substances:
<http://www.hvbg.de/d/bia/gestis/stoffdb/index.html>



9

General safety and hygienics in labs

- Safety equipment including buttoned lab coats and anti-skidding closed-toe shoes must always be worn. The lab coat has to be taken off on leaving the lab – also for short-term breaks.
- For all tasks where harmful substances could be sprinkled or released in any other way, suitable safety glasses, safety gloves and a face shield must be worn.



10

General safety and hygienics in labs

- Never use a pipette with your mouth!
- The consumption and storing of food, drinks, tobacco goods and cosmetics is forbidden, same as the inserting of contact lenses
- Before starting a task and after completing it, the hands must be washed, respectively disinfected.



11

Management of danger situations

- Stay calm and try to avoid imprudent actions
- Save - personal security has higher priority than the safety of materials.
- Extinguish – fight the fire with the help of the fire extinguisher (fire alarm, emergency call)



12

Management of danger situations

- Stop all activities and testings, disconnect power supply (main switch!)
- Inform colleagues
- After accidents with dangerous substances which have resulted in injuries, indisposition or skin reactions, see the doctor

13

Management of fire situations

- Stay calm and try to avoid imprudent actions
- Fire alarm, call 122, mobile phone, asf.
- Save - personal security has higher priority than the safety of materials.
- Extinguish – fight the fire with the help of the fire extinguisher

14

Management of fire situations

- Stop all activities and testing procedures, disconnect power supply (main switch!)
- Inform other personnel
- In case of fire, don't use elevators.
- Move to the gathering points that have been defined by the lab management and verify if the personnel has gathered completely.



15

Cleanliness and order

- Work surfaces should always be clean and tidied up. Tools and devices should be easily reachable. In order to avoid unwanted breaks during a work process, all this should be done prior to starting a task



16

Cleanliness and order

- All tasks should be performed in a highly clean way, as dirty or contaminated work surfaces would endanger also the next person to work on them.
- Generally, who ever causes a contamination, must clean used tools and surfaces or other equipment he or she has used. This includes also the removal of lettering and of putting away cleaned and dried parts. Shattered substances must be removed immediately and after that professionally disposed.

17

Handling of chemicals

- Never be careless when working with chemicals! Basically, chemicals have to be regarded as harmful substances. No damage of health, regardless if for the individual or for the environment should be caused.
- Before working with harmful substances, the risks arising from them and from their transformation products must be considered. The specific risks are binding parts of lab rules

18

Handling of chemicals

- All containers must be labelled regarding their content, person in charge and date; hazardous materials should additionally be marked with the danger symbol.
- Hazardous substances must not be stored together with food, so that they could be mistaken for them (e.g. bottles of juices).
- The quantity of waste must be reduced by the use of only the necessary amount of material needed for tests



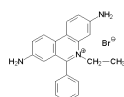
19

Handling of chemicals

- Please inform yourself about the correct disposal of hazardous waste in your lab! Do not simply pour away chemical waste.

20

Examples of dangers arising from chemicals e.g. ethidiumbromide



T+ very poisonous
Indications of special dangers (R-sentences) :
R 22 dangerous to health on swallowing
R 26 very poisonous when inhaling
R 36/37/38 irritates the eyes, the respiratory organs and the skin
R 68 irreversible damage

Possible safety tips (S-sentences) :
S 26 In the case of eye contact rinse immediately with water and see the doctor
S 28 In the case of contact with skin wash immediately with a lot of water and soap.
S 36/37 When working, always wear suitable safety gloves and protective clothing
S 45 In the event of an accident or nausea, immediately contact the doctor (if possible, present this label)

21

Examples of dangers arising from chemicals e.g. xylol isomeric mixture

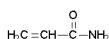


Xn dangerous to health
Indications of special dangers (R-sentences) :
R 10 flammable
R 20/21 dangerous to health when being inhaled or on skin contact
R 38 irritates the skin

Safety tips (S-sentences) :
S (2) Must be kept out of reach of children (if meant for public use)
S 25 Contact with eyes should be avoided

22

Examples of dangers arising from chemicals e.g. acrylamide



T poisonous

CLASSIFICATION
Carc. Cat. 2; R45
Muta. Cat. 2; R46
Repr. Cat. 3; R62
T; R25-48/23/24/25
Xn; R20/21
Xi; R36/38
R43

Indications of special dangers (R-sentences) :
R 45 can be cancerous
R 46 can cause hereditary damage
R 20/21 Harmful when inhaling and on skin contact
R 25 Poisonous when being swallowed
R 36/38 Irritates eyes and skin
R 43 possible sensitisation on skin contact
R 48/23/24/25 also poisonous: danger of serious injury to health in the event of a longer inhaling, skin contact or swallowing
R 62 Can possibly impair fertility

Safety tips (S-sentences) :
S 53 avoid any exposition – before use, gain special directions
S 45 In the event of an accident or nausea, immediately contact the doctor (if possible, present this label)

23

Examples of dangers arising from chemicals e.g. ammonia



C caustic
N dangerous for the environment
Indications of special dangers (R-sentences)
R 34 causes cauterizations
R 50 very poisonous for water organisms

Safety tips (S-sentences) :
S 26 If a chemical splashes into your eye, flush your eye thoroughly with water and contact your doctor.
S 36/37/39 When working, always wear suitable safety gloves, protective clothing and a face shield
S 45 In the event of an accident or nausea, immediately contact the doctor (if possible, present this label)
S 61 Avoid release into environment. Gain special directions. See safety data sheets.

CLASSIFICATION OF PREPARATIONS
Classification /labeling :C>=25%C,N; R34-50
10%<= C< 25%C; R34
5%<= C< 10%Xi; R36/37/38

24

Examples of dangers arising from chemicals e.g. paraformaldehyde

Xn dangerous to health 

Indications of special dangers (R-sentences):
R 20/22 Dangerous to health on inhaling and
R 36/37/38 irritates the eyes, the respiratory organs and the
R 40 Suspect of cancerous impact
R 43 Possible irritation on skin contact

Safety tips (S-sentences) :
S 22 do not inhale dust
S 26 If a chemical splashes into your eye, flush your eye thoroughly with water
and contact your doctor.
S 36/37 When working, always wear suitable safety gloves and protective clothing

25

Performance of poisons

local:	Effect only at the very place of effect
systemic:	Effect on the complete organism, not only at the very place of effect; distribution in the blood system
latent:	delayed reaction, mostly with acute poisoning (example: I Phosgen: up to 48 hours!)
latency:	period of time between the uptake of the substance and the reaction Carcinogenic substances: 10 – 40 Jahre

26

Performance of poisons

type	period of time	aim of investigation
Acute:	single dose of the	effect of single high dosage
Sub acute:	28 days	
Sub chronic:	90 days	determination of the effective barrier
chronic:	> 6 months	repeated dosages over a longer time
carcinogenic:	2 years	carcinogenic effect

27

Handling and storage of poisons

What, in connection with the storage of poisons, has to be considered?
Poisons have to be stored in a proper way and separately from medicaments, food,
feed, asf. The storage area (entrance doors, safety cabinet and outdoor area) has to
be marked with the below **warning sign**



What is the proper way to store poisons in buildings?

Poisons can only be stored
– in locked **store rooms**, which can not be entered by unauthorized persons
or
– in **safety cabins** in rooms.

A safety cabin must be fixed and protected from misuse by a keylock.

28

Handling and storage of poisons

In rooms where poisons are being stored or regularly used, the emergency
number of the **central information center for poison emergencies** (01/406 43
43-0) has to be set at a clearly visible place.

In case that there is no land line in this room, this telephone number has also to
be placed at the nearest land line.



29

Handling of poisons, obligation to keep records

Which records are to be provided when using poisons?

The following records regarding the **origin and storage** of any poison are
obligatory :
– chemical or commercial description of the poison
– purchased amount
– reference to any receipt of the purchase (delivery note, invoice...)
– date of purchase
– name of seller
– used amount and purpose of use; in the event that the poison has been
processed, also the description of the newly formed products and the amount of
poison used for this purpose have to be mentioned

There are no special formal requirements. Once a year, the remaining amount of
poison has to be recorded. The records have to be stored for at least **7 years**
(starting from the last record).

30

Handling of poisons, terminology

LD und LC-values indicate the acute toxicity of a substance.

LD50: lethal dose. This indicates the dose of a substance which is lethal to 50% of all laboratory animals.

LC50: lethal concentration. This is a concentration in inhaled air, which, when inhaled, becomes lethal to 50% of all laboratory animals within 4 hours.

Example: acrylamide

The acute dermal toxicity was, on rats, relatively high with a LD value of 400 mg/kg relatively high.

No poisoning symptoms have been reported.

There is no information – even from animal experimentation.

Oral LD50-values have ranged between 150 and 251 mg/kg KG in various tests and in tests with rabbits and guinea pigs between 150 and 180 mg/kg KG. In one of the tests on rats, the animals showed, after a LD50-dose a tremor, which persisted up to 48 hours.

31

Preventive thinking – management of disruptive incidents on the example of unwanted release of quicksilver



MANAGEMENT OF UNWANTED RELEASE

Try to achieve sufficient aeration

Evacuate affected area.

Warn others in the surroundings of the affected area.

In order to eliminate the dangerous state, the danger zone must not be entered without suitable security measures (breathing apparatus, safety glasses, shoes and gloves).

Widely spread quicksilver can be swept with a clean hand brush and must then be separated from normal dust.

Drops of quicksilver can be collected with a zinc sheet treated with hydrochloric acid and poured into a collection bin (place any safety plate underneath. Smaller amounts can be collected with usual quicksilver pliers or binded with special absorbants and can then be disposed.

Finally, air the room and clean contaminated objects and floor. Also, a release testing of the air in the room can be performed.

32

Why are instructions being performed?

Tasks where individuals can get in touch with

- microorganisms
- cells or
- parasites



bear specific **health risks**

33

What are biological substances? (1)

- **micro organisms** (viruses, bacteria, mykoplasmas, blue-green algaes),
- **cells** (especially parasitic protozoa, yeast, molds, algae, eukaryotic cells),

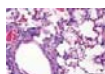


34

What are biological substances (2)?

- **endoparasites** (multi-cellular parasites, especially helminths (Würmer), genetically generated variants of these organisms)
- **agents of transmissibles**, bovine spongiform encephalopathy

in the event that they cause an infection or a transferable disease.



35

Lawful regulations



These regulations refer to all safety requirements and measures when handling biological substances

- **regulations of biological substances – VbA**
- **regulations of genetic engineering – GTG**
- **regulations regarding the safety when working with genetic organism in closed systems**
- **system regulations**

36

Ways of uptake (1)

Uptake via the mouth:

- eating, drinking, smoking without previous cleaning of the hands at the work place
- contaminated food and beverages

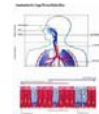


37

Ways of uptake (2)

Uptake via the respiratory organs:

through bioaerosoles (small drops, haze and dust, since a raised development of dust means a higher bacterial count).



38

Ways of uptake (3)

Uptake via the skin or mucous membrane

- penetration through injuries,
- soaked skin (wet works),
- splashes into the eyes,
- bites and stab wounds caused by animals.



39

Industrial hygienics and routes of infections

The higher the bacterial count in surrounding air, on work surfaces, on hands is, the more likely **microorganisms, that are rated as critical**, will occur.

Ubiquitous germs are a starting point of pathogenic germs.

The essence of all that is that a good **hygienic situation** – meaning a good microbiological technique – stands for the most vital part of biological safety.



40

Ways of transmission and –vectors (1):

Aerogenic (vectorsial transmission) :

dust: carrier of fungal and bacterial spores, viruses, eggs of parasites, toxins, allergens; the ratio of bacterial count to the amount of particles = 1:1000 to 1:5000.

Dust arises from:

- **chronically insufficient hygienics of rooms** (problem: storage of materials on top of cabins and under tables),
- **leaky windows and doors** (depression!),
- **insufficient filtering of** the input air



41

Ways of transmission and –vectors (2):

Aerogenic (vectorsial transmission) :

Dusts rise from:

- **insufficient filtering of air** or re-circulation (enrichment)
- **free convectors in rooms:**
 - heat exchangers of refrigerators,
 - insufficiently isolated surfaces of incubators and drying ovens,
 - too hot heaters.

42

Ways of transmission and –vectors (3):

Aerogenic (vectorsial transmission) :

Bio-aerosole (main source of infection; size of particles 0,5 – 100µm; transmission of rabies via aerosoles has been recorded! can be **acutely** created in the course of the work process

- improper handling of pipettes or refilling (sprinkles),
- opening of monovettes, caps, bottles with cultures,
- handling of water jet pumps (without a filter
- spilling

43

Ways of transmission and –vectors (4):

Aerogenic (vectorsial transmission) :

Bio-aerosoles can be acutely created in the course of the working process:

- x-ray
- improper centrifuging,
- refilling into into dustbin bags (risk: intermediate depots of infectious waste),
- moistening of room air through water hazel

44

Ways of transmission and –vectors (5):

Aerogenic (vectorsial transmission) :

Bio-aerosoles (recorded!) can be **acutely** created during the working process:

- wet, porous filters, e.g. in air conditioning
- forming of condensate on heat exchangers
- rinsing of material
(**always disinfect before rinsing!**)

45

Ways of transmission and –vectors (6):

smear infection (direct and indirect contact) e. g. contamination with:

- cell- and bacteria cultures,
- stools specimen,
- body fluids (**even dried blood can be infectious!**).



46

Ways of transmission and –vectors (7):

smear infection (direct and indirect contact) e. g. contamination with:

- sprinkles onto the mucous membrane (eye, mouth) or wounds on skin,
- insufficiently fixed tissue,
- **often!:** transport containers contaminated from the outside.

47

Ways of transmission and –vectors (8):

accidents (direct contact):

- stabs
- cuts
- burns

48

Ways of transmission and –vectors (9):

working with animals

- zoonosis,
- side infections after scratches and bites.



49

Ways of transmission and –vectors (10):

- ignorance,
- lacking concentration,
- technical failures multiply these risks



examples:

- using pipettes with mouth, eating, drinking, smoking,
- cold, working without safety gloves, asf.
- contamination of generally accessible objects with contaminated gloves – door handle, phone

50

Basic rules of a sound microbiological technology (GMT) 1

General rules:

- Windows and doors of the work rooms should be kept shut during the working process
- Eating and smoking is forbidden in work rooms. Also, no food must be stored in these
- Lab coats or other safety dresses must be worn in work rooms.



51

Basic rules of a sound microbiological technology (GMT) 2

General rules:

- It is not allowed to operate pipettes with the mouth. Pipetting devices are to be used.
- Injections and drainage tubes should be only used when absolutely necessary
- All manipulations should be carried out in a way that the formation of aerosole is being prevented as far as possible.



52

Basic rules of a sound microbiological technology (GMT) 3

General rules:

- After completing the work and before leaving the work rooms, hands must be cleaned thoroughly, if necessary, disinfected and greased.
- Work places should be kept clean and in order. On working tables, only those devices and material should be placed which is needed. Supply material must be kept in designed places or cabinets.



53

Basic rules of a sound microbiological technology (GMT) 4

General rules:

- If this is relevant for the determination of the risk potential, the identity of the used biological agents has to be checked regularly. The periods of checking should be fixed according to their potential danger.
- Employees working with biological agents should be instructed prior to the uptake of the working procedure and, consequently, at least once a year – verbally and work scope related.

54

Basic rules of a sound microbiological technology (GMT) 5

General rules:

- Workers unskilled in the fields of microbiology, virology or cell biology, have to be instructed in a very complex way and also must be monitored thoroughly.
- If necessary, a regular vermin control has to be carried out.



55

Management of pathogens (1)

General rules:

- All work places are to be disinfected daily. If necessary, the change of disinfection materials should prevent the formation of resistant germs.
- safety clothes must not be worn outside the work places.
- contaminated work devices must be autoclaved or disinfected before they are being cleaned.

56

Management of pathogens (2)

General rules:

- Pathogen-containing waste must be collected in a safe way and neutralized by autoclaving or disinfection.
- In the event that infectious material is being shattered, the contaminated area must be locked and disinfected immediately.
- In the case that staff has to work with pathogens harmful to humans, a vaccination, if available, should be provided to all staff members, unless they are not already immune. The maintenance of this immunity must be verified in a suitable way regularly.

57

Management of pathogens (3)

General rules:

- The health status of staff must be monitored in regular check-ups in respect to industrial medicine.
- First-aid instructions for accidents with pathogen micro-organisms and viruses must be at hand immediately in the work rooms. All accidents must be reported to the immediate manager in charge.

58

Additional measures for risk groups 2 (1)

- Works with biological substances must be carried out at separated work places.
- Works with biological substances must be carried out in a safety work bench or in closed apparatuses.
- In the event of breakdowns or incidents, the uncontrolled exit of biological substances must be prevented with the help of special measures.



59

Additional measures for risk groups 2 (2)

- In the work places, an autoclave or a similar device for decontamination must be installed (e.g. pass-through autoclave).
- If this is necessary and technically possible, uncontrolled spread of biological substances has to be checked on a test basis - this in order to make out the presence of biological substances at work places and also in their surroundings.

60

Fire prevention and evacuation 1



- Thoroughly take care of **cleanliness and order**.
- Please keep in mind that smoking is prohibited at work



61

Fire prevention and evacuation 2



- **Escape routes, traffic routes and emergency exits** have to be kept clear



- The **fire brigade area** surrounding the building and driveways must be **kept clear** (parking ban – insurance consequences!)

62

Fire prevention and evacuation 3



- Inform yourself about the location and type of fire extinguishing devices.
- Fire extinguishers and fire extinguishing agents must not be re-adjusted, blocked or placed out of sight, neither relocated.
- Fire doors must always be kept closed.



63

Danger of falling

- Use only faultless ladders
- defect ladders are either to be repaired immediately or must be disposed.
- please make sure you are steadfast on the ladder.
- Only ladders are to be used to reach upper areas. Never stand on chairs or stools!!!!



64

Electrical devices

- Damaged outlets, switches or cables:
 - Inform co-workers in charge of property management
 - Do not use damaged devices
- Please make sure that the **power distribution box** can always be accessed.



65

Lifting and carrying

- Please use supporting devices for heavy loads.
- Ask co-workers to assist you when carrying or lifting heavy loads.
- Please make sure that the way you lift, carry or depose heavy loads is performed in an ergonomic way (bend knees, keep your spine straight and keep the load as close as possible to the body)



66