Prepared by
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College of Pathologists of Sri Lanka

Guidelines on **Waste Management in Histopathology**

First edition

2021

Ministry of Health, Sri Lanka

and

College of Pathologists of Sri Lanka

Guidelines on

Waste Management in Histopathology

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Message by the Director General Health Services
Ministry of Health

I am extremely grateful to the College of Pathologists of Sri Lanka for identifying the need and formulated the guidelines on waste management in histopathology laboratories.

As the first edition, Guidelines on Waste Management in Histopathology gives comprehensive guide to manage the waste generated by histopathology laboratories during routine laboratory work. This guide will invariably helpful in improving the waste management in the histopathology laboratories especially in collaboration with the Sri Lanka Accreditation Board to promote accreditation of government sector laboratories.

These guidelines will be available in an easy to use, electronic format to allow maximum accessibility to the histopathologists as well as the technical staff working in the histopathology laboratories.

I wish the College of pathologists of Sri Lanka all the success in their future endeavours to improve the quality of histopathology services in the country.

Dr. Asela Gunawardena,
Director General of Health Services,
Ministry of Health,
Sri Lanka.

Message from Deputy Director General
Laboratory Services
Ministry of Health

It is a privilege to pen this message for the publication of the Guidelines on Waste Management in histopathology laboratories.

Waste management is an important element of environmental protection. It's purpose is to provide hygienic and efficient waste management without polluting the environment. It is our responsibility to eliminate the dangers to the communities which are at risk due to hospital waste and thereby decrease the incidence of harmful events caused by them. Waste management in hospitals in Sri Lanka is an area that needs more attention; hence, these Guidelines on waste management in histopathology laboratories are a timely need for providing effective services to the public.

This is a comprehensive guide with free access to the histopathologists and the laboratory staff working across the country.

I wish to express my sincere gratitude to all technical experts who contributed to developing these guidelines to ensure safe and accurate waste management in histopathology laboratories and wish them all the success in their future commitments.

Dr. Sudath Dharmaratne

Deputy Director General - Laboratory Services

Ministry of Health

Sri Lanka,

Message by the President
College of Pathologists of Sri Lanka

A guide to proper waste management in histopathology had been a dire need for the histopathologists working across the country, as an official guideline for proper waste management in histopathology was not available. This need was identified by the members of the accreditation subcommittee of the College of Pathologists of Sri Lanka.

The first edition on *Guidelines on Waste Management in Histopathology* was formulated after extensive discussion by the members of the accreditation subcommittee at several meetings held during the Covid-19 pandemic, utilizing the lockdown periods effectively.

As a decision was taken by the College of Pathologists of Sri Lanka in 2021 to promote accreditation of government sector histopathology laboratories, these guidelines on waste management would undoubtedly help to streamline proper waste management methods in histopathology laboratories.

The guidelines are published in the electronic format to allow maximum visibility to histopathologists working across the country.

On behalf of the College of Pathologists of Sri Lanka, I wish to acknowledge the contributions made by the authours, editor and all the members of the accreditation subcommittee and thank them for their commitment.

I am also grateful to the Director General of Health Services Dr. Asela Gunawardena and the Deputy Director General Laboratory Services, Dr. Sudath Dharmaratne for facilitating the electronic publication process of these guidelines.

I hope that the histopathologists working across the country will make full use of these guidelines to improve the waste management in histopathology in their laboratories.

Prof. Dulani Beneragama,

President, College of Pathologists of Sri Lanka.

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Waste Management in Histopathology

Introduction

Waste management in a histopathology laboratory is crucial to prevent accumulation of toxic waste products. The World Health Organization (WHO) has categorized laboratory waste into six groups.

WHO categorization of laboratory waste

1. Chemical waste
2. Infectious waste
3. Pathological waste
4. Sharps
5. Pharmaceutical waste
6. Non-hazardous general waste

In waste management, the following standard steps that are required to be followed will be discussed under each category of waste.

A. **Categorization**
B. **Segregation**
C. **Storage**
D. **Disposal**

In routine histopathology practice, laboratory waste is collected into a specially designed, well ventilated, separate storage area/room where waste materials are collected for disposal by waste collecting agents or waste disposal personnel.

Designing a proper waste disposal drainage system is an essential component in the initial planning of laboratory infrastructure.

Chapter 1
Management of Chemical Waste in Histopathology

A. Categorization

Table 1- Compatible chemical waste types

Waste category	**Compatible waste** ***There are compatible chemical waste types that can be stored in the same waste container prior to disposal***
Flammable solvents	Acetone, methanol, ethanol, toluene, xylene, acetonitrile, benzene etc.
Halogenated solvents	Halothane, methylene chloride, chloroform, carbon tetrachloride, trichloroethane, trichloroethylene
Organic acids	Formic acid, acetic acid, propionic acid
Waste category	**Incompatible waste** ***These chemical waste types cannot be stored in the same waste container bottle and each type needs to be separately stored prior to disposal.***
Heavy metal solutions	Aqueous solutions containing arsenic, barium, cadmium, chromium, copper, lead, mercury, osmium, selenium, silver etc.
Mineral acids	Hydrochloric acid, nitric acid, sulphuric acid, perchloric acid
Inorganic bases	Sodium hydroxide, potassium hydroxide, ammonia
Oxidizers	Potassium nitrate, hydrogen peroxide, potassium permanganate, bleach

Cautions:

Handling, mixing or adding of chemicals to containers should be done with great care at all times.

* Following types of incompatible chemical waste should never be placed in the same container, adjacent to each other or in the same storage compartment of the rack.

1. Acids and bases.
2. Organic solvents and acids.
3. Cyanide, sulfide or arsenic compounds and acids.
4. Alkali or alkali earth metals, alkali lithium etc. and aqueous waste.
5. Powdered or reactive metals and combustible materials.
6. Mercury or silver and ammonium containing compounds

* These incompatible chemical waste containing bottles/jars should be stored in separate cabinets, preferably as far apart as possible.
* If there is breakage of a waste container with incompatible chemical waste, the results could be disastrous.

B. Segregation

a) Separation of the chemical waste during storage.

- As described under the section of categorization, proper segregation of laboratory chemical waste is essential for a safe workplace environment.
- All chemical waste should not be placed in the same cabinet or fume hood.
- Only chemically compatible waste should be stored together.

  If chemically incompatible waste materials were stored together, an accidental spillage would be disastrous.

b) Label all chemical waste bottles.

- All bottles of chemical waste must be labelled to indicate date of purchase, date of opening and type of contents.
- If the contents of the bottle are not known, label as “Unknown Chemical" as these could accidentally be mixed with incompatible chemicals causing a fire and explosion.
- Used chemicals awaiting recycling/reuse/disposal should be labelled as "Used Chemicals "instead of "Waste chemicals”. eg; Used alcohol should not be labelled as "Alcohol Waste", instead label as "Used alcohol".
- The old label of the container should not be torn off or defaced but needs to be replaced with a new label instead.

c) Precautions need to be taken during segregation of chemicals labelled as "Hazardous Waste".

Cautions:

- *Acids and bases should not be stored in the same shelf or cabinet.*
  Leaking containers or a spill could cause a violent chemical reaction and emit toxic gases.
- *Acids and organic waste should not be placed in the same shelf or cabinet*
  Accidental mixing of these chemicals may result in a fire or explosion.
- *Incompatible solvents should not be mixed in a waste container.*
  For example, an explosive mixture can be formed if nitric acid and ethanol are mixed together.

C. Storage

- *Chemical waste should not be stored in a fume hood*.
  In the event of mixing of incompatible chemicals in a fume hood, these could react together, resulting in an explosion or a fire.
- *Metal containers are not suitable for storage of chemical waste.*

Even at neutral pH, solids and liquids can corrode metal cans. Recommended containers for chemical waste storage are either made of glass or polyethylene.

- *Do not store flammable waste containers on a bench or floor*.
  Store waste containers in an explosion-resistant solvent cabinet.
- *Toxic chemical waste should not be discarded into a sink or floor drain.*
  Emptying of above substances into a sewer might lead to release of toxic gases causing health hazards or explosions.
- *Capping or placing lids on waste containers*
  Organic waste storage bottles must be capped. However, to avoid building up of pressure inside the bottle, it should be loosely capped.
- *The funnel should not be left in the mouth of the waste bottle.*
  The funnel might get dislodged to an adjacent incompatible waste bottle and cause a fire or explosion. Once the waste bottle/container is filled with chemical waste, the funnel should be removed and the bottle should be loosely capped.

Accumulation of laboratory waste

- It is advisable to have a separate single container with adequate capacity for each type of chemical waste generated in the laboratory.
- If the organic waste bottle is full, it should be moved to the waste storage area.
- A serious fire hazard can be prevented by frequent removal/disposal of organic chemical waste bottles from the laboratory, without letting them accumulate ~~accumulating those~~ in the premises.

D. Transport and disposal of chemical waste

Precautions have to be taken during transportation of chemical waste to the waste storage area.

- All waste containers must be labelled with a "**Hazardous waste**" label and the intended date of transportation.
- Contents in each container should be listed on the label.

- Cap/lid of the bottle or jar should be fitted tightly.
- During transportation of a liquid chemical waste, there should be adequate space (at least 1 inch of empty space) from the top of the container to the filled liquid level.
- Keep the outer surface of the bottles/jars clean and dry.
- Incompatible waste should not be mixed.
- Halogenated waste should be separated from "regular" organic waste whenever possible.
- The pH of the discarding chemical solution should be mentioned on the disposal tag.
- Chemical waste should always be labelled with chemical names instead of trade names. Avoid labelling with abbreviations and chemical formulae names. (i.e. label as "Sulphuric acid" instead of "H_2SO_4").
- Approximate percentage/proportions of each waste component should be indicated on the label.

References:

1. Dhanlal De Lloyd, Chem. Dept, The University of The West Indies, St. Augustine campus The Republic of Trinidad and Tobago. Copyright: delloyd2000©
2. Brazilian Journal of surgery and clinical research; Xylene: Features, risk and management of waste. Vol 17,n.2pp.68-73 (Dez 2016-Fev 2017)
3. The role of recycling and chemical substitution in pollution prevention programs. Laboratory Medicine vol 29, Number 6 June 1998.
4. The journal of plastination; Recycling Histopathology Solvents; A Funding Source for Plastination. 26(2):16-20(2014)
5. Bancroft J. D. (1977) Bancroft's theory and practice of Histological techniques; Chemical safety in laboratory, (Feldman A.T.) 2019:6th edition. Elsevier.

Guidelines on handling of the following commonly used chemical waste are briefly discussed in the next sections of this chapter.

I - Formaldehyde

II- Ethanol (Ethyl alcohol)

III- Xylene

IV- Other commonly used chemicals in the histopathology laboratory

I. Formaldehyde

Introduction

Formaldehyde in its purest form, is a colorless, highly toxic and flammable gas with a strong odour. However, it is most commonly used as an aqueous solution called formalin, which typically also contains some methanol as a stabilizer**.**

Formaldehyde is produced by the oxidation of methanol (Formaldehyde is also known as methylene oxide or methyl aldehyde, $CH3OH + O_2 \rightarrow 2\ CH_2O + 2H_2O$).It has a strong odour at room temperature. Exposure to formaldehyde vapours can have various side effects on humans, depending on the level of exposure. It can produce eye irritation during initial exposure. However, with acclimatization, these effects tend to be decreased in severity, and can lead to over exposure of workers without their knowledge. Therefore, one should not rely on the smell or eye irritation as a way of alerting for formaldehyde exposure in persons who have long-term exposure to formaldehyde.

Exposure limits

- Due to effects of formaldehyde exposure, it is very important to maintain a formalin vapour monitoring system in all laboratories with formalin standard operating procedures (SOP).
- The legal airborne permissible exposure limit (PEL) is 1 ppm (parts of formaldehyde per million parts of air) in an 8-hour working day.
- Short-term exposure (15 minutes) is limited to 2 ppm while the action level for formaldehyde is 0.5 ppm.

Storage

- Ready to use formalin should be properly labelled and stored in a cool, dry, well-ventilated area.
- Used formaldehyde, (from spillage or change of specimen containers) must be stored in a properly labelled, hazardous waste container and sent for recycling or neutralization.

- Storage of waste formaldehyde should be in an area away from laboratory workers and in a well-ventilated area that is not subjected to heat cycles.

Contingency spills and actions to be taken in an accidental spill

- Use cold water to a volume of twice the volume the spillage and use adequate absorbent material to absorb small spills.
- For moderate spills, neutralizing agents can be used (For further assistance, seek the help of an authorized body)
- Avoid skin exposure during cleaning of a spill.
- If a spillage occurs in a poorly ventilated area, the area should be vacated immediately and others should be prevented from entering the spillage area.

Precautions that should be taken during handling and mixing of formaldehyde

- A well-ventilated area (eg: open air table) should be used if mixing is done outside the laboratory.
- In the laboratory, it should be done under an appropriate fume hood.
- Opening of the bottle or mixing should not be performed inside a vehicle.
- To avoid accidental splashing, a face shield should be worn during mixing or pouring.
- Use of gloves is mandatory.
- Make sure the workbench is free of smoke or open flame while working with formaldehyde.

Minimum safety requirements during neutralization of formaldehyde

- Lab coat/gown
- Chemical goggles
- Chemically resistant gloves
- Neutralization substance
- Tissue strainer
- Precautions- Wear the proper personal protective equipment (PPE)

Transportation

Formaldehyde must be transported only in the original container. The container should be fully labelled and stored properly within the vehicle to prevent toppling over, spillage or breakage.

Disposal of formaldehyde

Formaldehyde is a hazardous waste. Therefore, disposal of this waste has to be done carefully to avoid toxic effects on humans and the environment. Formaldehyde contains methyl alcohol, a biocide which could harm the "good" bacteria in the wastewater treatment.

Formalin disposal without neutralization

- Formaldehyde solutions having concentrations less than 0.1% (1000 ppm) can be disposed of to a sanitary sewers.
- Formaldehyde concentration equal to or less than 4% can be diluted with water to get concentration of less than 0.1% and can be disposed of in sewers. However, diluted formalin should be tested to ensure that the pH is between 6-9 and the formaldehyde concentration is < 10 mg/L, using commercially available pH and aldehyde test strips. (Note: 10% Neutral buffered formal saline has formaldehyde concentration of 4%)

Formalin disposal with neutralization

- Un-neutralized formaldehyde (concentration > 0.1%) should NEVER be disposed into a drain. It can be drained to a specially designed standard chemical waste collecting tank for recycling.
- A formaldehyde concentration greater than 4% must NOT be diluted with water before neutralizing. Formaldehyde solutions having concentrations greater than above must be neutralized using products available to neutralize formaldehyde and render them non-hazardous before disposal.

- Neutralization will reduce formaldehyde solutions to a concentration of less than 0.1% and neutralize the pH to 6-9.
- Some products of neutralization form neutralized 0.1% formaldehyde in liquid state, which can be disposed down the drain to the sanitary sewer. Some products of neutralization convert formalin into solid state which can be used for landfills.
- After neutralization, neutralized formalin should be tested to ensure that the pH is between 6-9, and formaldehyde concentration < 10 mg/L using commercially available pH and aldehyde test strips.
- Disposal of neutralized formaldehyde should be done by an authorized body only

Methods used for disposal

Disposal options

A professional hazardous waste contractor should be hired to assist with disposal of formaldehyde.

1. **Recycling -** Via specially designed equipment for formalin recycling
2. **Final - neutralization**

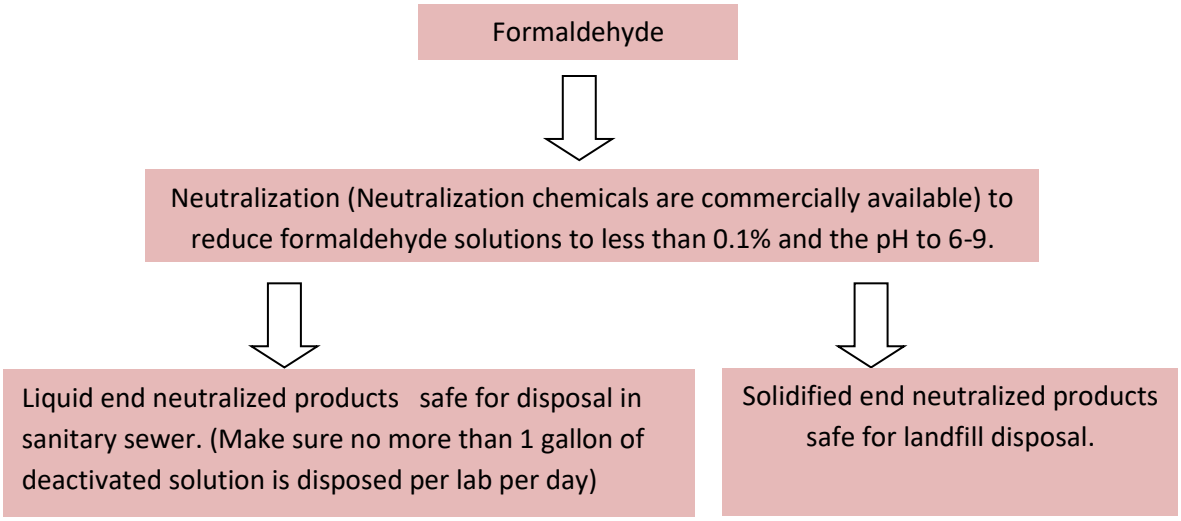

Figure 1 - Steps in formalin neutralization

Commercially available formaldehyde neutralization products

1. Neutralex (ScigenInc, CA, USA)
2. Aldex
3. Tissue-Tek FormaGO (Sakura Finetek USA)

Liquid end neutralized products are safe for disposal in sanitary sewer. (Make sure no more than 1 gallon of deactivated solution is disposed per lab per day)

References

1. www.ehs.washinton.edu,Environmental health and safety, University of Washington.
2. https://www.rcpa.edu.au RCPA guidelines; fixation of tissue-2019.

II. Ethanol (Ethyl alcohol)

Introduction

Ethanol is an expensive, highly flammable liquid (Class IB). Inhalation of ethanol can be controlled by air filters. This is a common skin and eye irritant. But the chronic toxic properties are not likely to be significant under the intended conditions of use in the laboratory.

The time-weighted average exposure value is 1000 parts per million.

Handling of ethanol in the laboratory

Protective equipment

- Safety glasses/ goggles and latex/butyl or nitrile safety gloves should be used when handling ethanol. Do not use rubber or neoprene gloves.
- A lab coat should be worn for body and skin protection.

Contingency spill

- Ethanol is rapidly degraded in the natural environment and completely dissolved in water. It is volatile and has a short half-life. Hence, absorption to the surface is not likely to occur.
- Simple washing of the surface with an ample amount of water will be adequate in the event of a spillage. Alternatively, the spill can be absorbed into an inert dry material and placed in an appropriate waste disposal container.
- In the event of a chemical spill on the body or clothes, clothing should be removed, and the body should be rinsed thoroughly under a shower for 15 minutes.
- Immediate rinsing of eyes with water is indicated in the event of accidental splashing of ethanol into an eye.

Storage and transportation

- As for any other inflammable substance, ethanol waste should only be stored in a specialized cabinet. This cabinet must be clearly labelled as “FLAMMABLE - KEEP FIRE AWAY “
- Storage should be in a cool, well-ventilated area and positioned away from doors.
- Glass, approved plastic containers or safety cans can be used to store ethanol waste.
- Storage must be in a closed container.

Disposal

- On-site recycling of ethanol waste by fractional distillation is a better option to reduce the volume of waste and the cost of purchasing this expensive chemical.
- The process of recycling should be done meticulously by following a standard operation procedure (SOP) formulated on par with the specifications of the supplier of the recycler and the tissue processor for any source of waste ethanol.

References

1. Bancroft J. D. (1977) Bancroft’s theory and practice of Histological techniques; Chemical safety in laboratory, (Feldman A.T.) 2019:6th edition. Elsevier

III. Xylene

Introduction

Xylene is a volatile, inflammable, toxic substance which is insoluble in water and hence should not be poured down the drain. Inhalation is usually the most common route of exposure. Ingestion and direct skin contact can also occur. Both short-term and long- term exposure to xylene can result in many health effects such as nausea, vomiting, headache, eye irritation, abdominal pain, drowsiness and even loss of consciousness. Most effects occur after exposure to xylene concentrations greater than 100 parts per million. Therefore, proper disposal of these chemicals ensures laboratory and environmental safety.

Handling of xylene in a laboratory

- Use of safety glasses and safety gloves is mandatory. Those who do not wear protective equipment should be asked to leave the room.
- Inhalation of xylene vapour should be avoided by usage of a mask.

Contingency spill

- Clean up any spills with sand or an absorbent material that does not combust, such as silica gel.
- Spray the air with water to reduce the risk of fire.
- In the event of a fire, use carbon dioxide, foam or dry chemical extinguishers.

Storage

- Place xylene waste in a non-chlorinated container for disposal. The container must be marked as “Hazardous Waste”.
- Storage should be done outdoors or in an unoccupied fire-proof storage unit prior to disposal.

Disposal of xylene

- Xylene is a waste chemical which should be subjected to disposal by controlled incineration.
- On-site recycling of xylene waste by fractional distillation is a better option to reduce the waste disposal and the cost of purchase of the chemical. Process of recycling should be done meticulously, following a standard operation procedure (SOP) formulated on par with the specifications of the supplier of the recycler and the tissue processor for any source of waste xylene.
- However, if facilities for recycling are not available, controlled incineration needs to be done by a licensed hazardous hauler recommended by the Central Environmental Authority.

References

1. Dhanlal De Lloyd, Chem. Dept, The University of The West Indies, St. Augustine campus The Republic of Trinidad and Tobago. Copyright: delloyd2000©
2. Brazilian Journal of Surgery and Clinical Research; Xylene: Features, risk and management of waste. vol 17, n.2 pp.68-73 (Dez 2016-Fev 2017)
3. The role of recycling and chemical substitution in pollution prevention programs. Laboratory Medicine vol 29, Number 6 June 1998.
4. The Journal of Plastination; Recycling Histopathology Solvents; A Funding Source for Plastination. 26(2):16-20(2014)
5. Bancroft J. D. (1977) Bancroft's Theory and Practice of Histological Techniques; Chemical safety in laboratory, (Feldman A.T.) 2019:6th edition. Elsevier.

IV Management of other commonly used chemical waste in a histopathology laboratory

A. Categorization:

- Staining solutions. eg: haematoxylin, eosin and special stains
- Metal compounds. eg: Compounds containing silver, chromium, arsenic, barium, cadmium, lead, mercury , selenium , etc.
- Concentrated acids and bases.
- Disinfectants.
- Sodium azide containing antibodies.
- Fluorescent bulbs, containing mercury.

B. Segregation and storage:

- These chemicals should be stored in a cool, dry, well-ventilated and fireproof area away from the general population or workers.
- These should be labelled as “HAZARDOUS”.
- Corrosive chemicals should be stored in glass containers.
- Acids and bases should be stored in separate containers.
- Any hazardous disinfectants must be stored in a container which is sealed to prevent evaporation.
- Metal compounds should be stored in a separate container to avoid any unwanted reactions.

C. Transportation and disposal

- All the chemicals including disinfectants contain a safety data sheet with the disposal method. (Please see the references for safety data sheets).
- Staining solutions like haematoxylin and eosin, metal compounds, concentrated acids and bases and disinfectants are regarded as hazardous waste (If indicated as hazardous in the safety data sheet). Therefore, this type of waste should be placed in appropriate containers to be picked up by relevant authorities.

Table 2A: Storage of other commonly used chemicals

Chemical	Storage and Handling		Disposal Method
	Incompatibility	**Handling and storage**	
Allyl alcohol	Strong oxidizing agents		Incineration
4-Aminopyridine	Strong oxidizing agents, acids, chlorides, anhydrides	Avoid dust generation, Ignition hazards	Incineration
Ammonia	Most common metals, strong oxidizing agents, strong acids	Store in high density polyethylene containers (HDPE) when possible	Recycle and landfill
Arsenic	Strong oxidizing agents, acids	Avoid dust generation, Ignition hazards	Landfill
Arsine	Heat, acid, oxidizers	Store in stainless steel containers	Small amounts - absorption with KMnO4. Larger amounts - Landfill.
Haematoxylin	Light	Avoid formation of dust and aerosols. Keep the container tightly closed in a dry and well-ventilated place and store in a place with exhaust ventilation. Light sensitive. Keep in a dry place.	Do not let the product enter drains. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.
Eosin	Strong oxidizing agents eg. nitrates, oxidizing acids, chlorine bleaches.	Keep the container tightly closed in a cool, dry and well-ventilated place. Provide proper ventilation.	Contains no substances with occupational exposure. Offer surplus and non-recyclable solutions to a licensed disposal company.

Table 2B: Storage of heavy metals, acids, alkali

Chemical	Storage and Handling		Disposal Method
	Incompatibility	**Handling and storage**	
Chemicals containing heavy metals	No special measures required. Do not store the chemicals with food. Do not store with animal feed stocks. Do not store it with acids or alkalis. Do not store it with combustible materials. (Strong oxidizing agents)	Provide good ventilation of the working area (local exhaust ventilation, if necessary). The product is not combustible.	Chemical precipitation to remove the metal ions • Sedimentation • Filtration • Electrolysis • Reverse osmosis: • Ion exchange Solid material must be sent for metal recovery or treated as hazardous waste. Disposed by incineration or by landfill methods. **Should not be used as agriculture fertilizer**.
Strong acids and alkalis	Heat **Never add water to a base.**	Cool, dry condition in a well-sealed container. Avoid aerosol generation. Liquid strong bases must be stored in isolation from all other chemicals in an approved base or corrosives safety cabinet. (If a corrosive cabinet is not available, use a secondary container to store bases.) Do not allow water to get into the container because of possible explosive reactions. When mixing with water, always add slowly to the water and stir continuously.	Should not reach sewage or open water systems. Waste material generated should be treated as hazardous waste. The empty container must be rinsed three times with a COMPATIBLE solvent. The solvent and water used for rinsing must be disposed of as hazardous waste. The un-rinsed empty containers must be capped. Do not mix with incompatible waste streams. Decontamination of the empty container to use it for other purposes is not permitted.

Table 2C: Storage of disinfectants and other chemicals

Chemical	Storage and Handling		Disposal Method
	Incompatibility	**Handling and storage**	
Disinfectants		Store in suitable labelled containers. Storage temperature : 0 °C to 50 °C	Recycling is preferred. Disposal in compliance with local regulations or incineration. Do not contaminate ponds, waterways or ditches with chemicals or used containers. Do not reuse empty containers.
Sodium azide		Always transport in closed containers that are upright and secure. Store in the original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials. Containers that have been opened must be carefully re-sealed and kept upright to prevent leakage.	Waste should not be disposed of untreated. Incineration or landfill should only be considered when recycling is not feasible. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues.

References:

1. WHO publication. Safe management of wastes from health–care activities.
2. Sengupta S (1990). Medical waste generation, treatment and disposal practices in the state of Florida. Gainesville, State university system of Florida, Florida center for solid and hazardous waste management (Report 90-3)
3. Datta, Priya et al. "Biomedical waste management in India: Critical appraisal." Journal of Laboratory Physicians vol. 10,1(2018): 6-14
4. Bancroft J. D. (1977) Bancroft's Theory and practice of histological techniques; Chemical safety in laboratory, (Feldman A.T.) 2019 Elsevier
5. JRC science for policy report; Best environmental management practice for the waste management sector, Learning from frontrunners, Dri M.,Canfora P., Antonopoulos I. S.,Gaudillat P.
6. Safety data sheets for following chemicals can be downloaded from the below mentioned web sites.

   HCL, hypoclorite - Global safety management. www.gsmds.com

   Haematoxylin - Sigma- aldrich.com

   Mercury, silver - www.carlroth.de

Chapter 2

Management of Biological Waste in Histopathology

A. Categorization

Biological waste can be categorized into the following types.

1. Infectious waste
2. Pathological waste
3. Sharps wastes

1. Infectious waste

Waste contaminated with infected blood and other body fluids are categorized under this group.

- Culture media and stocks used to grow infectious organisms.
- Petri dishes.
- Pipettes and pipette tips.
- Microtiter plates.
- Disposable waste materials from infected patients.

  e.g., swabs, bandages and disposable medical devices

2. Pathological waste:

The following types of waste products are categorized as pathological waste.

- Human blood, serum, plasma, body fluids (e.g., cerebrospinal fluid, synovial fluid, peritoneal fluid, pericardial fluid) and blood products.
- Non-glass containers filled with body fluids that need to be discarded.
- Any substance contaminated with visible blood, semen, vaginal secretions or body fluids, human tissues, organs, body parts, surgical biopsies and autopsies.

3. Sharps waste

These are highly hazardous, health care waste. Even without contamination with infectious material, these have the potential to penetrate and damage the skin and body parts.

Sharps waste include,

- Needles
- Scalpel blades
- Razor blades
- Syringes with attached needles
- Pasteur pipettes
- Disposable pipettes
- Vials
- Test tubes
- Pipette tips
- Microscope slides
- Cover slips
- Plastic or glass culture dishes
- Other sharp waste like broken and unbroken glassware

B. Segregation and handling:

- An appropriate container should be used to collect biological waste.
- Containers should be clearly labelled as '*Biohazard waste'.*
- The label should indicate whether the waste is treated or non-treated.

1. Infectious waste

a) Liquid waste - These should be collected in leak-proof, unsealed, autoclavable containers.

b) Solid waste - These should be collected in a specially designed, clearly labelled container. e.g., plastic pails.

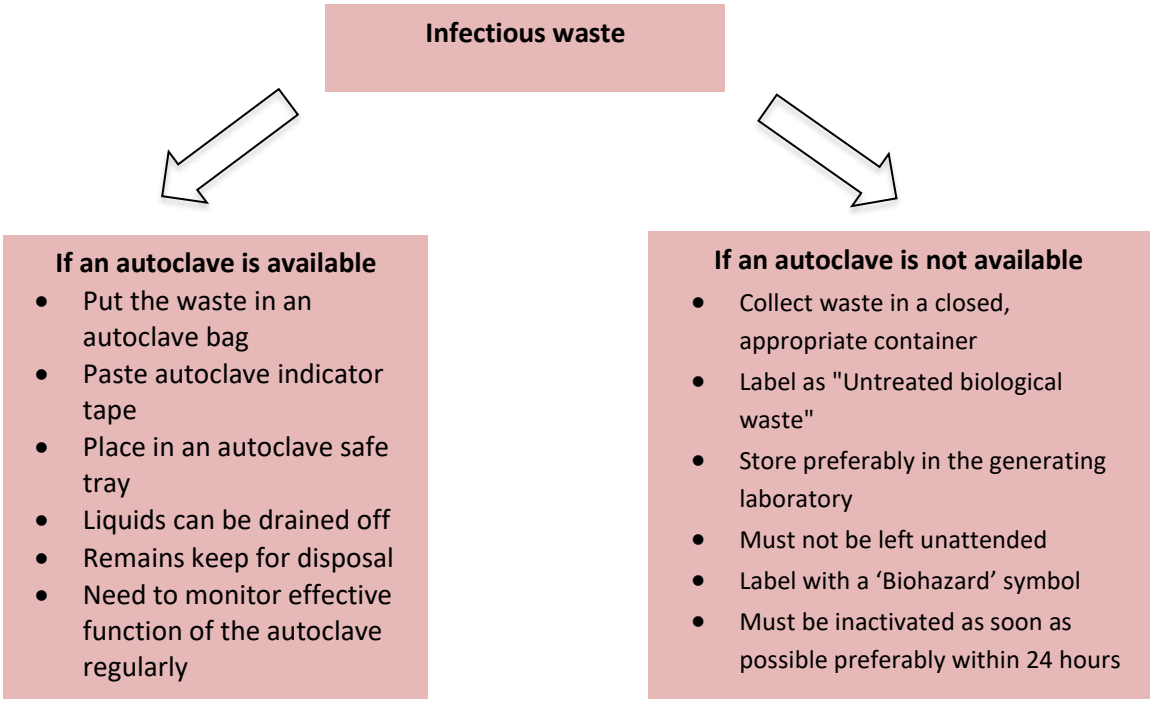

Figure 2 Handling of infectious waste

2. Non-infectious biological waste

- Inactivation is not required.
- Place in a closed, leak-proof, appropriate container in a secure place until disposal.

3. Sharps waste

- Place in an approved sharps container even if unused.
- Close when three quarters full and place in an appropriate bag or container for disposal.
- Label with the 'Biohazard' symbol.
- Infectious or potentially infectious sharps should be autoclaved or chemically disinfected before disposal.
- Collect any sharps that can cause penetrating injury e.g. fragile glass, glass slides, cover slips, pipettes, pipette tips in a rigid box.

C. Storage and transportation

- Store in a designated area until collected for disposal by an authorized body.
- Non-treated infectious biological waste should be kept away from general traffic and preferably stored in a secure area.
- Do not leave unattended.
- Protect from weather.
- Do not allow it to accumulate. Dispose daily or on a regular basis.
- Maintain a schedule for regular disposal.
- Pathological waste such as human body parts, organs or tissues and surgical biopsies should be stored in a refrigerator. The date of generation should be clearly mentioned on the label. If putrefaction has occurred, disposal should be done as soon as possible.
- Display a poster with separate colour codes to guide the storage and disposal of different types of waste in the laboratory and storage areas.
- Always use closed, leak-proof containers to transport outside the laboratory and from storage areas.
- Regular training should be given to all employees who handle biological waste on
  - Proper use of personal protective equipment (PPE).
  - Method of waste segregation.
  - Handling, packaging, labelling and storage procedures

D. Disposal

a) Disposal of pathological waste

- Incineration is the preferred method.
- Precautions are mandatory during transport of waste for incineration as they are usually located some distance away from the waste generation areas.
- Human body parts, organs or tissues and surgical biopsies must be disposed of by cremation or burial.
- Proper waste disposal locations and regular pickup procedures must be arranged by the individual institutions.

b) Disposal of Liquid biological waste

- Sanitary sewer systems and sanitary pits should be designed by each institution for disposal of liquid biological waste. This will lower the chance of leaks or spills during transport and lowers the disposal costs.
- Once liquid biological waste is decontaminated or neutralized, it can be disposed through the sanitary sewer by using running water. The efficacy of disinfectants should be tested regularly.
- Human blood and body fluids can be disposed through the sanitary sewer system with thorough rinse and disinfection after disposal procedure.

c) Disposal of sharps waste

- Sharps should be disposed into proper sharps containers placed in readily accessible areas.
- Sharp destruction devices if available should be used and kept located near sharp generating areas. e.g. - Needle melters and needle cutters preferably with disinfectants
- Syringes can be shredded and re-melted after disinfection either by autoclaving or chemical methods.
- Shredding of disinfected sharps can be used to reduce the bulk of sharp waste.
- A special sharp pit or a secured area can be used to bury sharps, or they can be placed in drums, sealed in cement and then buried in landfills.

References

1. Health-care waste-WHO/World Health Organization, Feb 8,2018, www.who.int
2. Module 2: The Healthcare Waste Management system-WHO, Module 17.www.who.int
3. University of Connecticut. Environmental Health and safety. Biological Waste Guide. www.ehs.uconn.edu
4. Biological Waste Management and Disposal. Environmental Health and safety. Sep 14, 2020. www.ehs.ufl.edu
5. Biological Waste Disposal Procedures, Protect IU. Biosafety Sop. www.protect.iu.edu
6. Laboratory biological waste disposal guidance, www.sRuI.ac.uk

Chapter 3

Management of Non-hazardous General Waste in Histopathology

Introduction

Non-hazardous general waste can be described as waste material that has not been contaminated with hazardous or harmful agents or material; namely infectious agents, toxic chemicals, radioactive substances and sharps which can be injurious to the body.

General waste contributes to a significant proportion of the waste bulk generated in a histopathology laboratory.

A. Categorization

Types of non-hazardous general waste generated from a histopathology laboratory:

- Plastic - specimen containers, tissue cassettes, syringes, goggles, face shields
- Glass - slides, specimen containers, glass pipettes, chemical stored bottles
- Latex /rubber - gloves, aprons
- Polythene - aprons, surgical gowns
- Synthetic materials - masks, caps
- Paper wastes - record books, reports, data entry books (please follow the guidelines on minimum retention times- CPSL-GL/01)
- Food waste

B. Segregation

Similar to the other categories of waste, segregation is an important step in the general waste management. Colour coding according to the waste type is a very practical and a popular method which enables the separation of waste during transport, storage, treatment and disposal.

A commonly used colour coding system is given below.

- Black bins for paper waste
- Green bins for food waste
- Yellow bins for clinical waste- eg: gloves/aprons/plastic containers

Colour coding is easy to understand and directs the laboratory staff and patients to the appropriate container for disposal of wastes.

Further, availability of appropriate waste containers in the waste generating area is essential.

- Cut up room - Yellow bins for gloves and aprons
- Rest/Lunchroom - Green bins for food wastes

The above method reduces unnecessary transport of waste across the laboratory and encourages the staff to dispose of waste into the appropriate waste receptacles. Size of the waste receptacle is equally important. All containers should preferably be of similar size to prevent the laboratory staff from disposing waste into the largest available waste receptacle. In addition, the waste containers need to be large enough to contain the generated waste until it is collected.

Waste containers need to be made out of sturdy, durable and reusable materials. eg. plastic or metal. These should have an adequate, wide-mouthed and a well-fitting lid; preferably operated by a foot pedal.

Receptacles need to be leak-proof and reusable. These should be lined by a leak proof, sturdy plastic or polythene bag. Both the waste container and the lining bag should be in the same colour to avoid confusion. Labels with big letters and instruction posters need to be displayed in the segregation area to guide the staff.

C. Storage and transportation

Ideally, the waste bags from waste containers should be sealed or tied when it is three quarters full and kept ready for collection.

Prior to collection, polythene or plastic bags should be sealed with an appropriate knot. Stapling of the bags is not recommended. At the time of removal of the filled waste bag, the waste receptacle should be immediately lined by a new waste bag.

As a routine practice waste bags need to be labelled with the type of waste, date of generation, and the point of generation to allow proper tracking of the disposal process.

Ideally, most wastes should be collected daily. Collection times should be organized according to the pattern of waste generation during the day. eg; food waste should be collected daily after the lunch break.

Transportation of collected waste within the hospital or laboratory premises should take place during less busy times as far as possible (e.g., visiting hours should be avoided). Fixed regular routes for transport and collection times need to be practiced to prevent exposure to staff and patients and to minimize the passage of loaded carts through patient care and other clean areas. Depending on the design of the laboratory and the hospital, the internal transport of waste should be done using separate corridors, stairways, or elevators as far as possible. Transport staff should always be instructed to take adequate protective measures including use of personal protective equipment (including gloves, covered shoes/boots, and masks).

Hazardous and non-hazardous waste should never be transported together. Waste transportation trolleys for general waste should be painted in a different colour, preferably black to avoid confusion with other hazardous waste categories.

D. Disposal

Reusing or recycling of waste is preferred over waste disposal whenever possible as it is economical and prevents environmental pollution.

e.g., Plastic specimen containers, glass bottles, glass tubes, polythene aprons can be reused several times after proper cleaning/disinfection.

Necessary action should be taken to minimize waste generation within the laboratory.

e.g., Reuse of aprons after proper cleaning

Electronic reports instead of printed materials will reduce the generation of paper waste. Use of reusable lunch boxes will reduce the paper and polythene waste–generation in the lunchrooms.

Recycling is another method that needs to be practiced. From an environmental perspective, recycling is less desirable and more expensive than reusing a waste item, because it frequently requires substantial energy input and transport to offsite recycling centres. The recycling of waste can be explained by two methods, those are either energy recovery or waste recovery. Energy recovery refers to conversion of waste into fuel e.g., Biogas for generating electricity or for direct heating. Alternatively, waste recovery refers to conversion of waste material into new products such as compost or organic fertilizer to be used in agriculture. Some of the hazardous infectious portion of the waste will contain recyclable materials (e.g., paper, cardboard, packaging, tubing). These materials can also be recycled, provided they are disinfected to eliminate possible pathogens, and safe handling guidelines are followed.

Food wastes can be collected and can be recycled into compost or where regulations allow, sterilized and used for animal feed.

Regional waste collection or waste recycle centres coordinated by the Central Environment Authority and Ministry of Health should be established to facilitate this process.

Note;

Disposal of some of the paper waste in histopathology laboratory, including patients reports, records and other important documents need to be arranged in a responsible way, as these contain confidential information. Prior to disposal, permission from the head of the laboratory is essential and the important paper material should have exceeded the minimal retention times before disposal. These records or reports should be shredded and adequately mixed up before handing over for recycling.

Transport trolleys

For the purpose of transportation of waste, there should be appropriately designed transport trolleys or carts for hard use. Those need to be wheeled and designed for the purpose of proper transport of waste and to avoid injuries and infection transmission.

These trolleys and carts should be

- Easy and safe to carry waste bags
- Easy to load and unload waste
- Smooth and without sharp edges that could damage waste bags packaging
- Easy to clean and drain after cleaning
- Easy to handle by the unskilled workers
- Of appropriate in height, not be too high or low (e.g., too high trolleys will block the view of staff transporting waste and too low trolleys will be difficult to push)
- Adequate in size to contain the waste generated at the laboratory.

References

1. Yves Chartier, Jorge Emmanuel, Ute Pieper, Annette Prüss, Philip Rushbrook, Ruth Stringer, et.al. WHO- Safe management of wastes from health-care activities. 2nd edition: 2014:1-88.
2. Code of Practice for the Management of Clinical Waste- Major Clinical Waste Producers and Waste Collectors (Environmental Protection Department-The Hong Kong Special Administrative Region Government June.
3. Laboratory safety manual -Feb 2020. St' George's University of London.