EUROPEAN FEDERATION OF CLINICAL CHEMISTRY AND LABORATORY MEDICINE

Green Labs

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TASK FORCE-GREEN LABS

MANUAL FOR LABORATORY WASTE MANAGEMENT

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Introduction

Of the total amount of waste generated by health-care activities, about 85% is general, non-hazardous waste.

The remaining 15% is considered hazardous material may be infectious, toxic or radioactive.

Measures to ensure the safe and environmentally sound management of health care wastes is essential to prevent adverse health and environmental impacts from such waste.

Strategy

The management of clinical laboratory wastes should be premised upon the three pillars of good environmental practices:

Reduce

Reuse

Recycle.

The best strategy for managing laboratory wastes should be considered from the time of purchase.

The overriding principle governing the prudent handling of laboratory waste is that no activity should begin unless a plan for the disposal of non-hazardous and hazardous waste has been formulated.

Strategy

While the impact of each source of waste may seem relatively minor, their potential cumulative effect on the environment can be significant.

Waste production needs to be measured and managed. Laboratories should aspire to manage their wastes in the following ways:

Reduce its quantity

Reuse or redistribution of unwanted, surplus materials.

Treat and/or recycle materials within the waste; and

Dispose through incineration, treatment, or land burial.

One of the ways wastes can be minimised is by ensuring that only tests that are necessary are performed. It also makes good economic sense.

Waste Categories and their Management

Clinical laboratory wastes can be classified in several ways, and we wish to propose the following categories:

Non- biological solids such as plastics, packaging, e-wastes (electrical and electronic wastes) and miscellaneous solid wastes such as paper.

Biological wastes; this category includes glass, sharps, etc.

Chemicals: liquid, organic, solid**s;** include disinfectants, solvents, detergents used for laboratory purposes, batteries, and heavy metals from medical equipment such as mercury from broken thermometers.

The management of Chemical waste will be discussed in the presentation on Chemicals

Management of Non-Biological Solids

Plastics. Globally, in 2019 the production and incineration of plastic pumped more than 850 million tonnes of greenhouse gases into the atmosphere.

Single-use plastics account for 40 percent of the plastic produced every year. Many of these products, may persist in the environment for hundreds of years. The biomedical sciences are a particularly high-volume consumer of especially single-use plastics.

Microplastics i.e., tiny plastic particles, come from many sources and are ubiquitous. They enter into human beings via food and water, as well as breathing them in. Microplastics have been shown to harm wildlife and to damage human cells in the laboratory.

Reduction of Plastics

Labs can reduce their consumption of plastics by choosing substitutes for plastics. A return to glass might be the answer.

Reduced use of plastics can also be achieved at the time of tendering for equipment and reagents. Choose IVD companies that:

Produce equipment with reduced plastic content.

Choose products with reduced packaging and/or environmentally friendly packaging e.g., purchase bagged falcons

Are willing to take back shells of used equipment for future use

Allow for reusable plastic accessories e.g., reuse original racks

At the time of tendering for diagnostic reagents, negotiate with suppliers to take back packaging and used plastic reagent containers.

Reuse of Plastics

Labs should reuse as many items as possible. Re-usable items can have comparable performance to single-use items materials.

Where possible consider the following items for reuse: pipette tip boxes, pipettes and pipette tips when aliquoting, weigh boats, gloves (decontaminate with ethanol), tubes and cuvettes (with a rinse between) beaker or tip-collecting container.

Labs should substitute disposable plasticware even in sterile procedures e.g., glass tissue culture dishes instead of disposable, plastic dishes. However, if there is concern, consider reuse in only for situations where sterile procedure is not necessary, such as bench work.

Recycling of Plastics

In Europe, energy recovery is the most used way to dispose of plastic waste, followed by recycling. Some 25% of all the generated plastic waste is landfilled. Half of the plastic collected for recycling is exported to be treated in countries outside the EU.

Usually, laboratory waste plastics are bagged and “autoclaved” – an energy- and water-intensive sterilization process often using pressurized steam – and then they are sent to landfill.

But not all plastic waste is too contaminated to recycle. Kuntin and his colleagues developed a “decontamination station” with a 24-hour soak in a high-level disinfectant, followed by a rinse for chemical decontamination.

They also buy plastics that would be easier to recycle. They have reduced the plastic they were previously sending to landfill by about a ton a year. They have worked out how they can bulk buy whenever possible, to cut down on packaging waste, for example.

Recycling of Plastics

Plastics that can most commonly be recycled are polystyrene (PS), polypropylene (PP) and high-density or low-density polyethylene (HDPE/LDPE). Commonly used consumables such as centrifuge tubes are made of PP, while culture dishes and flasks are usually made of PS. HDPE and LDPE are most commonly found in lids.

Recycling nonhazardous plastic waste is also becoming an option for labs. Many waste haulers are starting to accept non-hazardous plastic waste from labs,. Several vendors offer recycling programs for their products. (EUROPEAN RECYLERS. Polycarbin (**https://polycarbin.com/**) have developed a circularity concept for laboratories to recycle plastics and it is important that diagnostic laboratories start to assess the feasibility of recycling plastics.

Alternatives to Current Plastics

Several companies have been working to develop plastics that are made from renewable and biodegradable sources.

These include BASF and NatureWorks (Innetonka, Minnesota, USA). BASF has developed a compostable polyester film called “Ecoflex®” and are making and marketing fully biodegradable bags, “Ecovio®,” made of this film along with cassava starch and calcium carbonate.

None of these, however, are in widespread use.

Packaging

Packaging materials are items such as Styrofoam and cardboard, paper, electronic wastes. They contribute much of the excess waste. Laboratories can therefore:

- negotiate with suppliers to take back and reuse packaging materials.
- In addition, laboratories can also negotiate with suppliers to reduce the volume of waste cardboard and plastic that is incorporated in the packaging of their products. However, this cannot be changed without going through due regulatory process.

RECOMMENDATION: This group calls for an amnesty period agreed by all the regulatory authorities globally to allow companies to review and refine their packaging strategies to minimize waste through a simplified documentation process. This would allow all manufacturers to contribute to this effort.

e-waste (Electrical and electronic wastes)

It is estimated that 57.4 Mt (Million Metric Tonnes) of e-waste was generated globally in 2021.

Europe has by far the highest collection and recycling rate at 42.5%. There is over **347 Mt** of unrecycled e-waste on earth in 2022.

E-waste does not biodegrade, and therefore will accumulate wherever it is dumped.

Landfilling e-waste is harmful to the environment because of toxins such as mercury, lead, cadmium, nickel, beryllium and arsenic can leach into the soil and water course and become harmful to human health.

e-waste (Electrical and electronic wastes)

Medical equipment no longer in use, fluorescent tubes, batteries, phones, computers, etc. should be recycled or disposed of in accordance with local regulations.

A paper that reviews the approaches for both the laboratory and the manufacturers outlining a 10-point plan has been made by Cambridge Design

Buy environmentally friendly electronics. Look for products labeled Energy Star or certified by the Electronic Product Environmental Assessment Tool (EPEAT).

Recommended Actionable measures for IVD Manufacturers

***Green products and labelling (also** called environmental labels, eco-labels):* Green products may be defined as products that contain recycled materials, reduce waste, conserve energy or water, use less packaging, and reduce the amount of toxics disposed or consumed.

Manufacturers should subscribe to a green labelling model such as has been introduced in the EU where domestic electrical technology has a rating from A to E based on agreed criteria.

Hardware: From a hardware perspective more consideration should be given to extending the life of equipment whether through a refurbish/recycle model on site with longer replacement times and/or through cannibalization initiatives that use at the minimum the skins of pre-used instruments.

Recommended Actionable measures for IVD Manufacturers

Software: Obsolescence of software often leads to the introduction of new hardware. We call on manufacturers to look at future proofing their products that will allow new software with Artificial Intelligence (AI, machine learning) to be used without replacing the total instrument.

Microscale chemistry: Scaling down test procedures to a practical minimum reduces the total amount of waste generated. It also has safety and cost benefits.

Definition and Description of Biological Wastes

Laboratory biological waste may be defined as infectious or potentially infectious pathological waste, and the receptacles and supplies generated during its handling and/or storage. **Biological waste** includes:

- Liquids: cell culturing media, supernatant, blood or blood fractions (serum), etc. which contain viable biological agents;
- Any part of the human body, tissues and bodily fluids; hair, nail clippings and the like that are not infectious;
- Any part of an animal infected [or potentially infected] with a communicable disease;

Definition and Description of Biological Wastes

Biological waste includes:

Non-sharp, solid laboratory waste (empty plastic cell culture flasks and petri dishes, empty plastic tubes, gloves, wrappers, absorbent tissues, etc.) which may be, contaminated with viable biological agents;

All sharp and pointed items used in medical care, diagnosis, and research.

Laboratory glassware which is thought to be contaminated with hazardous biological agent

Any material collected from a **spill of infectious or chemotherapy waste**.

Waste mixed with infectious waste that cannot be considered as chemical hazardous waste or radioactive waste.

Disposal Procedures- Liquid waste

Biological liquid waste can be poured down the drain (sanitary sewer), under running water **after it has been decontaminated** by autoclave or chemical means. The sink should be rinsed well and disinfected after the disposal procedure.

Chemical decontamination: This may be achieved using PRESEPT™, a biocidal disinfectant based on the action of NaDCC (troclosene sodium).

It provides protection against all organisms including MRSA, HIV, Hepatitis B and Herpes viruses. The denatured blood may be discarded via a sluice or laboratory sink with plenty of water.

Any solids that are too large for the laboratory sink can be disposed of via biological non-sharps waste.

Disposal Procedures- Sharps waste

Some sharps containers may melt if autoclaved, in which case chemical decontamination of the contents should be used.

For chemical decontamination, the disinfectant shall be an equivalent of the US EPA registered tuberculocidal agent such as standard household bleach diluted to the final concentration of 10%. Fill with the appropriate dilution of disinfectant and let stand over-night. Empty liquid, seal and label receptacle and put in box-bag unit.

Alternately, untreated sealed sharps containers may be placed in the box-bag units with other untreated biological waste. The institution's address must be affixed to each sharp's container, treated or untreated, that is placed in the box-bag unit

Disposal Procedures- Non Sharps waste

The acceptable methods for disposal are as follows:

Biological waste decontaminated by an autoclave, chemical disinfection or other appropriate decontamination method can be labeled and disposed of as non-biohazardous/non-infectious waste in regular trash.

If autoclave is available, autoclave the waste in an autoclave bag, affix autoclave indicator tape and place in an autoclave safe tray. After autoclaving and the bag has cooled, drain off any remaining liquid and place the sealed waste in the box-bag unit for pickup. Do not pour liquefied agar media down the drain. **Do not autoclave containers or other receptacles containing bleach.** The combination of bleach and residual cotton and oil (improperly cleaned autoclaves) may result in an explosive combustion within the autoclave.

Mixed waste: Follow the formula below to determine which waste stream.

Biological + Hazardous Chemical = Chemical Waste

Disposal Procedures

Mixed waste: Follow the formula below to determine which waste stream.

Biological + Hazardous Chemical = Chemical Waste

Storage of Biological Waste

Biological waste must not be allowed to accumulate and should be decontaminated and disposed of daily or on a regular basis.

If the storage of contaminated material is necessary, it must be done in a rigid container away from general traffic and preferably in a secured area.

Treated biological waste, excluding used sharps, may be stored at room temperature until the storage container or box-bag unit is full, but no longer than 48 hours.

It may be refrigerated for up to 1 week from the date of generation.

Storage of Biological Waste

Biological waste must be dated when refrigerated for storage.

If biological waste becomes putrescent during storage it must be moved offsite within 24 hours for processing and disposal.

Sharps containers may be used until 2/3 to 3/4 full at which time they should be decontaminated, preferably by autoclaving, and disposed of as regulated medical waste.

Labelling of Biological Waste

Each individual bag or sharps container should be labeled with the institution's address, the generator's building and room number and whether the waste in the box is treated or untreated.

Non-biohazardous/non-infectious waste should be tagged with labels.

Autoclave indicator tape should be used as evidence of decontamination.

Transport of Biological Waste

The transport of biological waste outside of the laboratory, for decontamination purposes or storage until pick-up, must be in closed leak-proof containers that is labeled "biohazard".

The transport of regulated medical waste or biohazardous biological waste through public streets must comply with government transportation regulations

Decontamination by Autoclaving

Steam autoclaving usually is considered to be the method of choice for decontaminating cultures, laboratory glassware, pipettes, syringes, or other small items known to be contaminated with infectious agents.

The location of the autoclave within the laboratory minimizes storage and transport problems.

Autoclaved waste can be disposed of as general waste.

THANK YOU FOR YOUR ATTENTION