
VirtuaLAB
2023

Implementation of sustainable practices in medical laboratories
Switching clinical labs to green labs

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- *EFLM, President*
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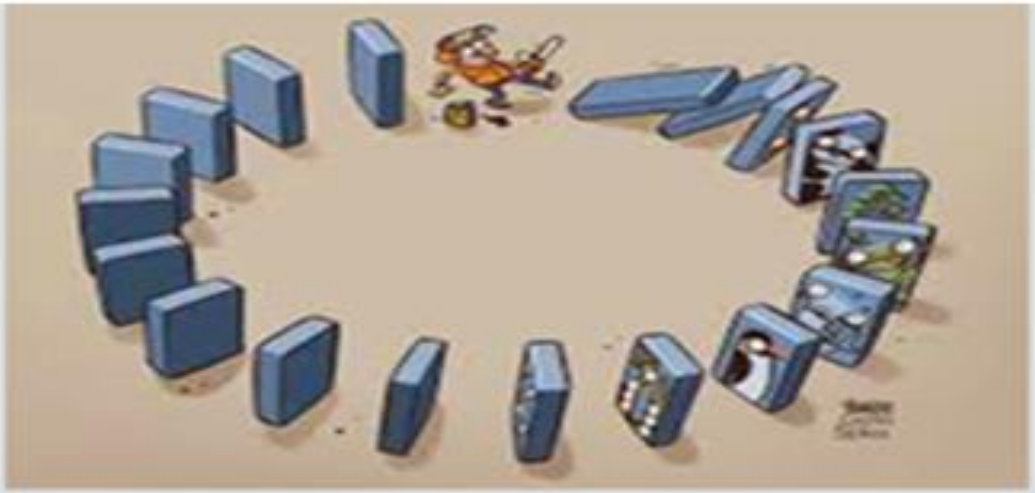
ENVIRONMENT and CURRENT SITUATION

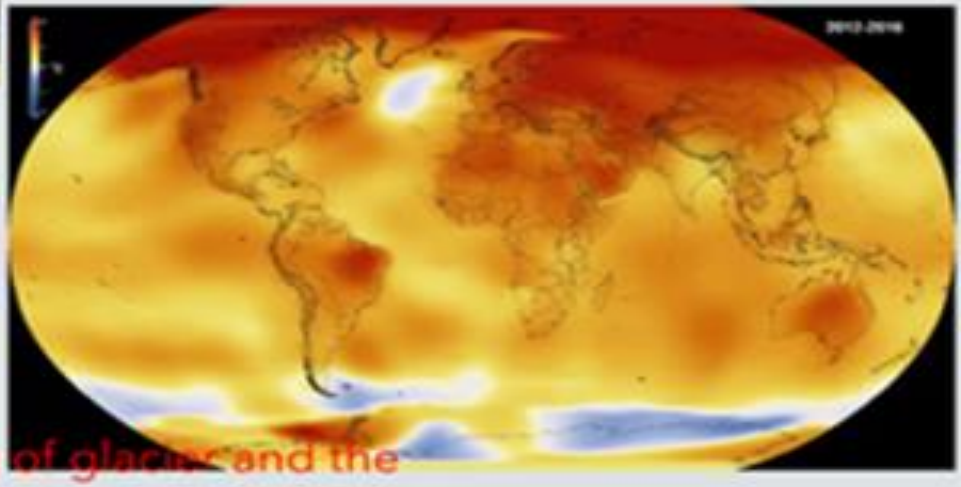
- ENVIRONMENT is the external conditions with which an organism interacts.
- This interaction has been going on since the existence.
- Environmental issues have become more widespread and intense due to increasing industrial and human impacts on the environment.
- Environmental unconsciousness and excess consumption caused deterioration and exhaustion of natural resources.
- Rapid population growth has triggered this situation.
- **50% of the world' s current environmental pollution has occurred in the last 35 years.**

Environmental Awareness; An important approach to prevent environmental pollution.



The COVID-19 crisis and the climate climate and biodiversity loss are deeply connected
Biodiversity loss can cause changing hosts of the pathogens

GLOBAL PROBLEMS ARE GROWING
OUR WORLD IS SOUNDING THE ALARM !!!!
OUR NATURAL RESOURCES ARE DIMINISHING
OUR WORLD IS WARMING-CLIMATE IS CHANGING



drought,floods,pandemic,melting of glaciers and the permafrost

United Nations Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

European Climate Pact

The European Commission in line with the Paris Agreement for climate has taken some initiatives to decrease carbon footprints.

The European Green Deal (EGD) Investment Plan, also known as the Sustainable Europe Investment Plan, is aimed at making Europe the world's first climate-neutral continent by 2050.

SUSTAINABILITY IN LABORATORY MEDICINE: GREEN LABS

Sustainability is important in a rapidly changing healthcare environment.

Sustainability measures in the healthcare sector are needed to reduce its negative impacts on the environment and economy.

Laboratory medicine should contribute to a **sustainable healthcare system** ensuring that **resources** are used efficiently from **ecological, social, and economical perspectives**, **while providing high-quality services to patients and physicians.**

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SUSTAINABILITY IN LABORATORY MEDICINE. GREEN LABS

Clinical laboratories are large consumers of energy and comprise the largest percentage of carbon emissions. Labs use also more water than offices and generate huge amounts of hazardous waste every year.

Due to their relatively high energy requirements, hospitals and laboratories must shift to renewable energy sources to achieve the long-term CO_2-reduction targets set by the European Commission.

Incorporating sustainable practices into daily lab routine will go towards saving energy, reducing emissions, and helping the European Green Deal (EGD) to reach its Climate and Sustainability Action Plan.

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EFLM TASK-FORCE GREEN and SUSTAINABLE LABS

Chair: Tomris Ozben

aimed
to implement
sustainable
practices
in medical
laboratories

ENVIRONMENTAL MANAGEMENT SYSTEM
ISO 14001

EFLM and its Member Societies will lead the laboratory medicine community for the shift to carbon neutrality in line with the European Green Deal (EGD) Investment Plan, which is aimed at making Europe the world's first climate-neutral continent

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EFLM is proud to announce the launch of the

EFLM CERTIFICATION FOR GREEN AND SUSTAINALBLE LABORATORIES

aimed to implement sustainable practices in medical laboratories

In line with the European Green Deal, the EFLM Executive Board has established in November 2021 the EFLM Task Force "Green and Sustainable Labs" with the aim that EFLM should lead the way in implementing sustainable practices in clinical and medical laboratories in Europe.

The goal is to transform 15 000 Clinical Laboratories in 49 EFLM member societies in Pan-Europe into a safe and sustainable spaces by decreasing their deleterious environmental impact and implementing efficient everyday actions in laboratories, and taking steps to minimize energy, water, and hazardous chemical use, as well as waste generation without compromising the quality of healthcare.

WE ARE NOW READY TO RECEIVE APPLICATIONS FROM MEDICAL LABORATORIES

Click here to know more and to apply

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Good collaboration among the European Union healthcare systems and a common vision for future actions would help to achieve such goals and environment-friendly laboratories.

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Completed activities of the EFLM Task Force "Green and Sustainable Labs" (2022)

- Manual
- Checklist
- Videos
- Workshops
- Exams
- Surveys
- Assessments

1. The EFLM Task Force-Green and Sustainable Labs was established on November 17th 2021, and its official establishment was announced to the

-EFLM National societies,
-EFLM and IFCC newsletters,
-EFLM mailing list of 10000 contacts and announcement via socials.

2. **EFLM National Societies** were invited to name an officer acting as NS Representative for the Task Force-Green Labs. The new initiative of EFLM "Green Labs" has been appreciated by the EFLM National Societies and they appointed **49 National Society Representatives** in addition to the **Task Force-Green Labs members.** https://eflm.eu/site/page/a/1732

3. The European Commission (EC) entitled **"European Green Deal (EGD)** was informed about the establishment of the EFLM Task Force-Green Labs. EC Commissioner EGD Executive Vice President and his cabinet are following our activities closely. They expressed congratulations for the establishment of the EFLM TF-Green Labs. We are in close contact with the EGD Commission in our further progresses.

4. **MedTech Europe** was informed at the same time. They were interested with the EFLM initiative and appointed their Senior Manager on "Environment & Sustainability" to the EFLM TF-Green Labs as a TF member.

5. A session was dedicated at the **EFLM Strategic Conference**. http://www.eflm-strategic-conference.eu/

6. **Guidelines, Checklists, PowerPoints, video recordings** on main topics: Energy, Waste, Water, and Chemicals were completed. A logo was prepared, and ISBN code was received for the guidelines.

7. They were shared with the EFLM National Societies.

Actions of the EFLM Task Force "Green and Sustainable Labs" (2023)

- Manual
- Checklist
- Videos
- Workshops
- Exams
- Surveys
- Assessments

8. Guidelines were translated into French, German, Spanish and Italian. Completed

9. A software was prepared for assessing the applications of laboratories. Completed

10. Exams were performed for the National Society Representatives to become Green Lab Experts. Completed.

11. A call was launched to receive "Green and Sustainable Lab Certificate" applications from Laboratories. Completed

12. Meetings with the National Societies (Presidents, National Representatives, members and experts). Completed

13. Evaluation/assessment of the applications of the laboratories for Green Lab certificates have been started. Ongoing

14. EFLM Green and Sustainable Lab Certificates are given to the laboratories fulfilling the EFLM Green Lab requirements. Ongoing

15. Organization of a Workshop for the whole EFLM Community. Being planned and under preparation

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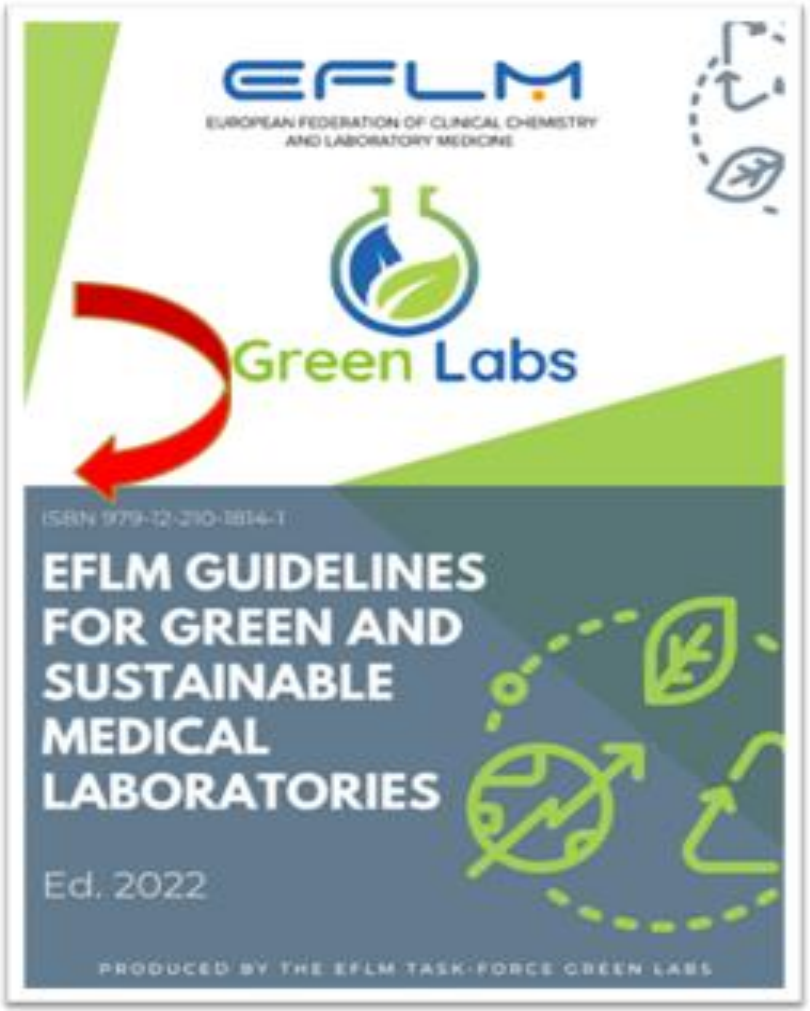
EFLM GUIDELINES FOR GREEN AND SUSTAINABLE MEDICAL LABORATORIES



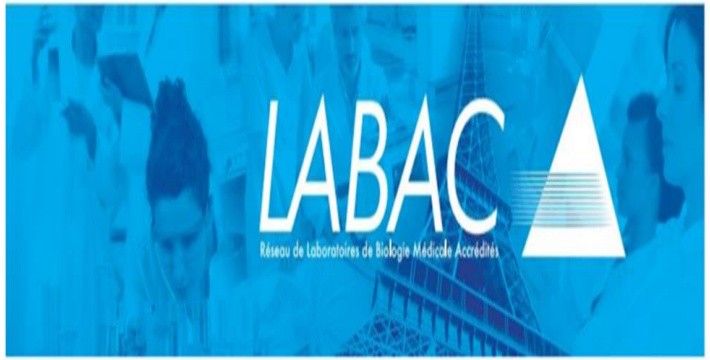
To help EFLM National Societies in the transition to Green Lab!

EUROPEAN FEDERATION OF CLINICAL CHEMISTRY AND LABORATORY MEDICINE

EFLM GUIDELINES FOR GREEN AND SUSTAINABLE MEDICAL LABORATORIES

Version Française Avril 2023 (LABAC)

Guide EFLM pour des
LABORATOIRES de BIOLOGIE MEDICALE (LBM) ECO-RESPONSABLES
ET DEVELOPPEMENT DURABLE



Traduit de l'anglais par Irving Bouilloux, Jean-Pierre Bouilloux, Jean-Marc Giannoli, Hélène Muller et Bernard Gouget pour Labac.

Avec l'aimable autorisation de la Professeure Tomris Ozben, Présidente de l'EFLM et Chair EFLM TF-Green labs

Le présent document est une traduction fournie à titre informatif et pédagogique . Elle n'engage aucunement la responsabilité de l'EFLM. En cas d'ambiguïté et/ou de divergences d'interprétation dans la version française des modalités pratiques recommandées de l'EFLM, les utilisateurs devront se référer à la version originale en anglais, qui prévaut toujours car elle représente la seule version contraignante.

24 National Experts

A group of National Green Lab Experts have been formed by the TF-GSL to act as mentors for those laboratories undergoing the certification process to become Green & Sustainable Labs

Contribution of Laboratory Medicine to sustainable healthcare system: ensure that resources are used efficiently from ecological, social and economical perspectives while providing high quality services to patients and clinicians

EFLM TF-GSL MISSION IS IMPLEMENTATION OF SUSTAINABLE PRACTICES IN MEDICAL LABORATORIES: SWITCHING CLINICAL LABORATORIES TO GREEN LABS!

A special issue of CCLM is dedicated to the lectures and contributions presented at the EFLM 3rd Strategic Conference 2022 "Implementing Emerging Technologies, IVDR, and Sustainable Practices in Smart and Green Medical Laboratories. Opportunities and Challenges

The EFLM Green Labs certification programme!

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Green Labs

EFLM is proud to announce the launch of the

EFLM CERTIFICATION FOR GREEN AND SUSTAINABLE LABORATORIES

aimed to implement sustainable practices in medical laboratories

Clinical laboratories worldwide interested in receiving EFLM Green Lab Certification are welcome to apply!

The Certification Process

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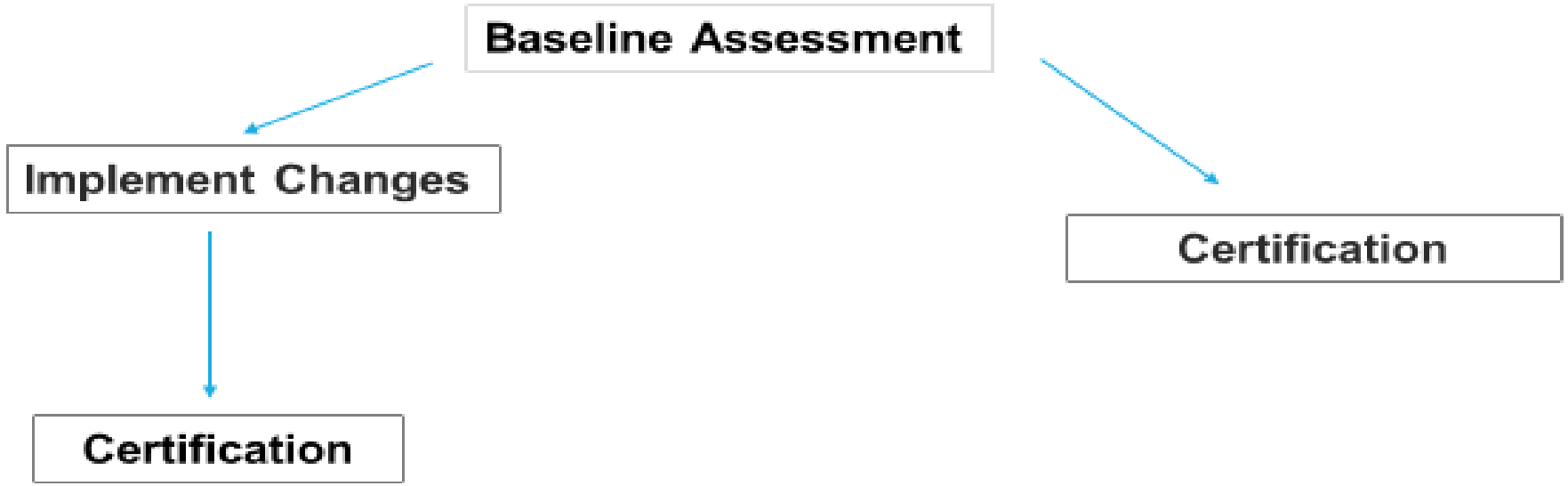
Green Laboratory Certification program is designed allowing laboratories to improve the conditions of the laboratories through a continuous improvement process.

In the beginning a survey using the checklist will be performed assessing the conditions of the laboratory as indicated in the figure.



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EFLM GREEN LAB CERTIFICATE

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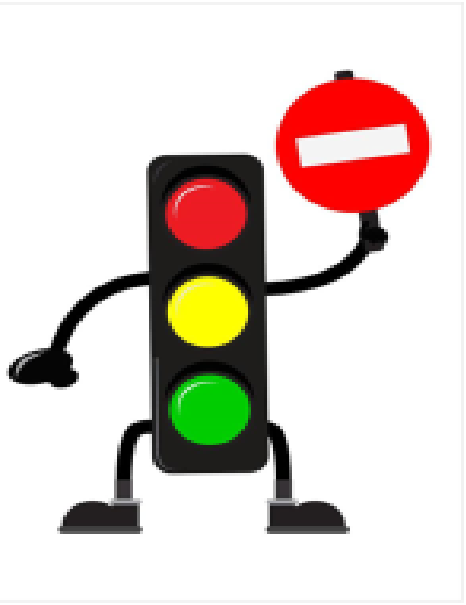

RED: Below 50% of Green Lab criteria implemented

YELLOW: 50-75% Green Lab criteria implemented

GREEN: 75% or more of Green Lab criteria implemented

This is the certificate which is released to those laboratories obtaining more than 75% of scores for each section of the checklist.

The certificate is valid for two years from the date of issuing.

EFLM Green Labs Program
Reductions in Four Key Areas

- **Through simple, easy changes, and making reductions in four key areas, clinical laboratories might limit their environmental impact and provide sustainable laboratory services.** By being mindful of the environmental impact of everyday actions in a lab, and by **taking simple, easy steps to minimize energy, water, and hazardous chemical use, as well as waste generation, a clinical lab can be transformed into a green and sustainable space.**

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STRATEGIES GREEN and SUSTAINABLE LABORATORIES

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REDUCE

- the consumption of energy, water
- natural resources
- unsafe products, hazardous chemicals

REUSE

- as much as possible before replacing

RECYCLE

- preventing waste
- reduce the consumption of fresh raw materials, energy usage, air and water pollution

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Energy Management

- Reduce energy consumption in the laboratory's workflow.
- Reduce gasoline consumption by laboratory logistics and staff.
- Design Energy-efficient and environmentally friendly laboratory/hospital buildings.
- Use of renewable energy sources when and where possible.
- Collaborate between laboratory networks for resource sharing.

HOW CAN LABS REDUCE ENERGY CONSUMPTION?

- Turning off equipment when it is not in use is one of the easiest and most obvious ways to save energy.
- If equipment has a warm-up time or a set temperature, simply put it on an outlet timer to ensure that it is ready when lab operations begin.
- Labs should also consider purchasing freezers having Energy Star certification.
- A transformation in cold storage has occurred over the past few years, with **energy-efficient ultra-low temperature freezers** and **-20°C freezers** now available. **These freezers often consume 50-60% less energy than standard freezer models.**
- **Send less emails:** Each email sent emits **4g of CO_2** to the atmosphere and if the email includes an attachment, it emits another **50 g of CO_2 or** more. You can select "upload to ONEDRIVE" when sending large attachments, which minimizes the carbon footprint.

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Water Management

Less than 1% of the Earth's water is freshwater.

Less than 40% of that is unpolluted.

→ Minimising water consumption ensures that there is more clean fresh water available for all species.

The water services industry is the fourth most energy intensive sector in the EU.

→ Minimising water consumption can further cut energy use and carbon footprint.

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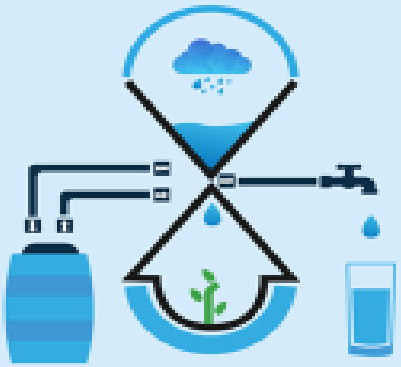

General Good Practices for Water Conservation

https://www.jalbharat.com/rainwater-harvesting-for-a-better-tomorrow/

Use	Rinse	Run	Monitor	Improve	Use	Adopt	Collaborate	Use
Use purified water appropriately and sparingly (producing it by reverse osmosis)	Rinse bulky glassware or equipment with regular tap water before utilizing deionised water for the last stage of rinsing	Run autoclaves and sterilizers at full capacity and run dishwasher only when it is fully loaded	Monitor consumption to detect leaks and to identify improvement opportunities	Improve laboratory process equipment (cooling of equipment, rinsing, and flow control)	Use of alternative water sources(air-conditioning condensate recovery and rainwater harvesting)	Adopt of a green purchasing policy (buy water efficient devices)	Collaborate between hospital buildings and laboratory networks for resource sharing	Use alternative source of water for nonpotable water: •Recover condensate water •Harvest rainwater as another source for non potable water use •Reclaim wastewater for some non potable applications such as cooling tower make-up

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WASTE MANAGEMENT

- About **85%** of the total amount of waste generated by health-care activities is **non-hazardous waste.** The remaining **15%** is considered **hazardous** material. They may be **infectious, toxic or radioactive.**
- 25% of the generated plastic waste is landfilled. Laboratory plastic wastes are bagged and "autoclaved" – an energy- and water-intensive sterilization process often using pressurized steam – and then they are sent to landfill.
- Half of the plastic collected for recycling is exported to be treated in countries outside the EU.
- No activity should begin unless a plan for the disposal of non-hazardous and hazardous waste has been formulated.
- 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 manage their wastes in the following ways:
  - Reduce its quantity
  - Reuse or redistribute of unwanted, surplus materials
  - Treat and/or recycle materials within the waste
  - Dispose through incineration, treatment, or land burial

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Waste Categories and their Management

- Clinical laboratory wastes can be classified in several ways:
  - **Non- biological solids:** plastics, packaging, e-wastes (electrical and electronic wastes) and miscellaneous solid wastes including paper.
  - **Biological wastes**
  - **Chemicals:** liquid, organics, disinfectants, solvents, detergents used for laboratory purposes.

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Management of Non-Biological Solids
Plastics

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

Single-use plastics account for 40% of the plastics produced every year. Many of these products, may persist in the environment for hundreds of years. The biomedical sciences are particularly high-volume consumers 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 damage human and animals.

HOW CAN LABS REDUCE WASTE GENERATION

Reducing the amount of waste coming into a lab by consolidating purchases and choosing products with reduced packaging is a great place to start.

Labs should reuse as many items as possible, using glassware instead of disposable plasticware whenever feasible.

Recycling nonhazardous waste is also becoming an option for labs.

Many waste haulers are starting to accept non-hazardous plastic waste from labs, including pipette tip boxes, and several vendors offer recycling programs for their products.

Plastics

10 ways to reduce plastics in laboratories

Can your packaging be sent back?
Several suppliers offer this so it can be reused. Engage your suppliers on what options they can offer.

Glass vs. Plastics: Could you switch from plastic to reusable glass?
The energy used for washing is far less than that to remake and transport plastic.

Do you require gloves?
Much research was successfully done without gloves in the past. Choose the appropriate gloves for your task – a thinner version may be just as safe.

a. Can you reuse gloves between experiments?
b. Thicker gloves are easier to reuse but have more plastic. Consider the balance between thickness and reuse that is best for your work.

Could your leftover plastic containers be used for something else in the lab?

Purchase 'flexible' kits:
Many labs use kits for standard processes – purchase kits which allow you to buy the contents separately – avoiding waste bottles/reagents.

RE-FILL

Can you recycle your packaging?
Most packaging doesn't require incineration. Consider if there are ways to avoid excess clinical waste, e.g. targeting a few items which aren't contaminated to no longer go through clinical waste.

Create reagents/kits in-house:
Many common reagents and materials may be produced on site e.g. pour your own gels for DNA electrophoresis

DIY

Could you buy bulk?
Combine and share with other labs. Only do so when certain to utilise all contents.

Can you downsize your plastics?
Sometimes there are alternatives which perform the same task with less plastic. E.g. smaller tube sizes.

Tip boxes: Can you reload tip boxes?
Non-contaminated tip boxes can be recycled or some suppliers offer take-back schemes.

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Reduction of Plastics

- Labs can reduce their consumption of plastics by choosing substitutes for plastics. A return to glass might be an answer.
- Select renewable and biodegradable alternatives to current plastics.
- 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.
  - Take back shells of used equipment.
  - Allow for reusable plastic accessories.
  - Take back packaging and used plastic reagent containers.

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Reuse of Plastics

- Labs should reuse as many items as possible. Re-usable items can have comparable performance to single-use items.
- Consider the following items for reuse: pipette tip boxes, pipettes and pipette tips when aliquoting, weight boats, gloves (decontaminate with ethanol), tubes and cuvettes (with a rinse between) beaker or tip-collecting container.
- Labs should substitute disposable plasticwares even in sterile procedures e.g., glass tissue culture dishes instead of disposable, plastic dishes.

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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. Not contaminated plastic waste can be recycled keeping in a **"decontamination station"** with a 24-hour soak in a high-level disinfectant, followed by a rinse for chemical decontamination.

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.

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e-waste (Electrical and electronic wastes)

- It is estimated that 57.4 Mt (Million Metric Tonnes) of e-waste was generated globally in 2021. There is over **347 Mt** of unrecycled e-waste on earth in 2022.
- Europe has the highest collection and recycling rate is 42.5%.
- E-waste does not biodegrade and 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 and animal health.
- Medical equipment no longer in use, fluorescent tubes, batteries, phones, computers, etc. should be recycled or disposed in accordance with local regulations.
- Buy environmentally friendly electronics labeled **Energy Star** or certified by the **Electronic Product Environmental Assessment Tool (EPEAT).**

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Paper use

- Buy chlorine free paper
- Recycle and reuse paper
- Reduce printing
- Encourage printing only where necessary

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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.

- ***Steam autoclaving*** is considered to be the method of choice for decontaminating cultures, laboratory glassware, pipettes, syringes, or other small items contaminated with infectious agents. Autoclaved waste can be disposed of as general waste.

- ***Chemical decontamination:*** This may be achieved using **PRESEPT™**, a biocidal disinfectant containing NaDCC (Sodium dichloroisocyanurate, troclosene sodium). It provides protection against all organisms including Methicillin-resistant Staphylococcus aureus (MRSA), HIV, Hepatitis B and Herpes viruses.

- The denatured blood may be discarded into laboratory sink with plenty of water.

Chemical Strategy for Sustainability

-Chemicals are essential components of our daily lives, for the well-being, high living standards and comfort of modern society.

-They are used in many sectors, including health. However, some chemicals have hazardous properties which can harm the environment and human health.

-There is an increase in health problems that can be partially explained by the use of chemicals. Some man-made chemicals are found in the most remote places in the environment, but also in our bodies. Chemicals are everywhere.

-Clinical labs must choose safer, more sustainable alternatives to hazardous chemicals.

-Comprehensive chemical legislations should be implemented in the clinical laboratories all around Europe.

- Created by Paul Anastas and John Warner
- Started to develop in early 1990s, published in 1998
- These principles can be grouped into "Reducing Risk" and "Minimizing the Environmental Footprint"

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Aim of Green Chemistry

- The aim of Green Chemistry is to reduce chemical-related impact on human health and eliminate contamination of the environment through dedicated, sustainable prevention programs.
- Green chemistry searches for alternative, environmentally friendly reaction media and at the same time strives to increase reaction rates and lower reaction temperatures.
- The concept of Green Chemistry, along with the EU strategy for a non-toxic environment, can be viewed as part of the global sustainability goals.
- Safe and sustainable-by-design chemicals is a pre-market approach that strives to deliver substances that minimize their health and environmental impacts.

Essential uses

The most harmful chemicals are only allowed if their use is necessary, or if their use is critical for the functioning of society and if there are no acceptable alternatives.

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Suggestions for Clinical Laboratories

Safer chemical substitutions should be implemented. Using hazardous chemicals should be avoided whenever possible.

Chemical inventory must be mandatory for all labs to know the supplies not to over order.

Chemicals should be dated when opened and used on a first-in, first out-basis to keep supplies fresh.

Reduce and Recycle Solvents:

- Reduce the use of organic solvents by recycling them, which reduces exposure and chemical waste – many solvents (**acetone, acetonitrile, xylene, alcohol, formalin**) can be efficiently distilled back to +99% purity through on-site recyclers and vendors:

- Xylene, alcohol and formalin may be recycled by the use of a CBG Biotech Supreme Solvent Recycler (Thermo-Fisher Scientific).

- Small volumes need to be purchased intermittently to replace the dead volume lost during the recycling process, which is also economically favourable.

Rational number of tests

Laboratory testing costs constitute approximately 3% of all clinical costs. Unnecessary tests should be avoided to reduce healthcare expenditure and laboratory budgets. 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.

Auditing requests of laboratory tests to identify test redundancy can decrease the number of reagents and hazardous chemicals used. Reduction of blood tubes collected from each patient, reduces material costs, decreased water usage and waste.

World Health Organization **(WHO)** published an **Essential in Vitro Diagnostics (IVD) List,** which identified **35 test categories** of general IVDs that can be used for the diagnosis of several **common diseases** and **27 test categories** of IVDs for the management of **HIV infection, tuberculosis, malaria, hepatitis B and C, syphilis and HPV infection**.

EFLM Green Labs

Procurement

- Clinical laboratories should shift towards green alternatives by adopting a green purchasing policy, which includes the selection and acquisition of products that minimize environmental impacts over their entire life-cycle.
- Give priority to manufacturers who use **environmentally friendly manufacturing processes** and/or to those who have **ISO certification for good environmental practices**
- (If possible) include a **green element to procurement**

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Green Labs

Making the laboratory SUSTAINABLE and GREEN may not be an immediate action.

- To ensure the involvement of all laboratory personnel
- To increase environmental awareness
- To be aware of UN and EC sustainable development goals
- Precautions has to be taken to reduce environmental pollution
- The important thing is to make the decision and start from somewhere.

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