COMMENTARY

# Green Lab Concept: Towards Sustainable Healthcare Practices in Malaysia

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**ABSTRACT**

Clinical laboratories in the healthcare sector are notable contributors to $CO_2$ emissions due to high energy and resource demands. In Malaysia, where carbon emissions reached 298.53 million metric tonnes in 2022, adopting sustainable practices in clinical laboratories is increasingly critical. This paper explores the Green Lab Concept, which aims to reduce laboratories' environmental impact through energy efficiency, water conservation, waste management, and sustainable procurement. By aligning with Malaysia's green technology policies, these practices have the potential to support national sustainability goals and global climate action targets. However, implementing green lab practices faces challenges, including financial constraints, resistance to change, and regulatory compliance requirements. Despite these obstacles, green lab initiatives could foster a culture of environmental responsibility and align laboratory practices with sustainable development goals. With focused stakeholder engagement and strategic implementation, Malaysia's clinical laboratories may play a pioneering role in advancing sustainable healthcare practices.
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## INTRODUCTION

Climate change, with the healthcare sector contributing 4.4% of global CO2 emissions as reported in 2019, presents an urgent threat to humanity (1). Clinical laboratories, in particular, are energy-intensive, consuming three to six times more energy per unit area than typical commercial buildings, and requiring substantial water and gas resources. This consumption, coupled with the generation of various disposables, including toxic materials, creates a significant carbon footprint, highlighting the need for sustainable practices within these facilities (1).

Malaysia, facing its own environmental challenges, saw its carbon emissions reached 278.53 million metric tonnes in 2022, a 6.5 % increase from the previous year, driven by its reliance on fossil fuels (2) . In response, the nation has implemented green technology policies, including the National Energy Transition Roadmap (3). Aligning clinical laboratories with these initiatives is crucial not only for minimising their environmental impact but also for advancing national sustainability goals and contributing to the global fight against climate change (3).

## THE GREEN LABORATORY CONCEPT

A "Green Lab" is a medical laboratory that minimizes its environmental impact through sustainable practices, reducing resource use and waste while maintaining healthcare quality. The Green Lab movement not only enhances eco-friendly operations but also saves costs, improves compliance, and offers broader benefits beyond environmental protection (4).

At its core, a Green Lab concept embodies a laboratory environment devoted to sustainability and environmental stewardship. This includes cutting energy consumption, minimising waste, procuring sustainable resources, and judiciously managing resources (5). These core principles are essential for building a sustainable future. Green Lab initiatives not only focus on reducing the environmental impact of laboratory operations but also foster a culture of sustainability within the organisation. By promoting and implementing eco-friendly practices, laboratories contribute to broader efforts to mitigate climate change, support national green initiatives, and enhance the institution's reputation and commitment to corporate social responsibility (6).

In Malaysia, Green Lab initiatives align with the 2030 Agenda for Sustainable Development Goals (SDG) by implementing energy-efficient technologies and monitoring carbon footprints to support Climate Action (SDG 13), and by promoting resource efficiency and

sustainable procurement for Responsible Consumption and Production (SDG 12) (7,8) . These efforts not only aim to reduce carbon emissions and advance sustainable development but also enhance ethical responsibility and strengthen the laboratory's reputation among stakeholders and funding bodies, contributing to Peace, Justice, and Strong Institutions (SDG 16) through transparent and accountable practices (8).

The sustainability practices in laboratories have been embraced by renowned institutions worldwide. Harvard University's Sustainable Labs Programme fosters eco-friendly practices through initiatives like the "Shut the Sash" programme, which cuts energy use by closing fume hood sashes, and the annual Freezer Challenge, which enhances the efficiency of ultra-low temperature freezers (9). Similarly, the University of California, Berkeley's Green Labs Programme focuses on resource efficiency, including water conservation through optimised cooling systems and the promotion of sustainable purchasing and recycling practices, ensuring laboratories minimise their environmental footprint (10).

## KEY STRATEGIES FOR IMPLEMENTING GREEN LAB PRACTICES

Clinical laboratories in Malaysia can minimise their environmental impact by implementing these key strategies (5) :

1. Energy Efficiency: Invest in energy-efficient equipment such as ENERGY STAR-certified devices, LED bulbs, motion sensors, automatic switches, programmable thermostats, and ventilation systems equipped with energy recovery ventilators (4, 11). Regularly maintaining these devices ensures optimal operation, significantly reducing energy consumption without compromising performance. This approach aligns with SDG 13 (Climate Action) by mitigating carbon emissions (8).

2. Water Conservation: Recycling water within the laboratory using closed-loop systems reduces the need for fresh water and minimises waste, contributing to SDG 6 (Clean Water and Sanitation) by promoting efficient water use (8). Recirculating water baths instead of once-through systems saves substantial water, while investing in water-efficient equipment, such as autoclaves with water-saving features and high-efficiency faucets, further supports conservation efforts. Regular water audits identify areas for reduced consumption, ensuring ongoing optimisation (4, 5).

3. Waste Management: Waste management practices in clinical laboratories align with SDG 12 (Responsible Consumption and Production) (8) by ensuring proper segregation of chemical, biological, and general waste, reducing environmental harm. Implementing the "1-tube philosophy" helps minimise plastic waste (12) , while recycling glass, plastics, and paper promotes resource efficiency. Careful inventory management prevents excess ordering, and digital documentation reduces paper waste. These strategies promote sustainability, resource efficiency, and cost-effectiveness, aligning with SDG 12's goals of reducing waste and encouraging responsible consumption (4, 8).

4. Sustainable Procurement: Selecting eco-friendly products, consumables, and equipment with minimal packaging, biodegradable materials, and sustainable processes aligns with SDG 12 (Responsible Consumption and Production). Key factors include energy efficiency and reducing environmental impact (4,8). In Malaysia, the MyHIJAU Directory promotes sustainable procurement by listing certified green products and services (13).

## CHALLENGES AND BARRIERS TO IMPLEMENTATION

Significant challenges to implementing Green Lab practices include initial investment costs, budgetary constraints, and resistance to change by practioners (4, 14). Transitioning to eco-friendly equipment and materials often requires substantial upfront financial resources not readily available within constrained healthcare budgets. Additionally, while sustainable practices offer long-term economic benefits such as reduced energy costs, immediate costs often overshadow these (14).

Resistance to change among laboratory personnel may stem from a lack of awareness or training on the benefits and procedures of green lab initiatives. Overcoming this resistance requires comprehensive education and training programmes to help staff understand the importance of sustainability, and how to implement new practices effectively (4,14).

Integrating ISO 15189 standards with Green Lab practices requires aligning quality management systems with sustainability goals, involving modifications to processes, training, and metrics. This integration, while potentially beneficial, presents challenges in balancing stringent quality requirements with environmental objectives, necessitating careful planning and management commitment (4).

Logistical challenges in implementing new processes and protocols, which often require restructuring laboratory workflows, can be disruptive and time-consuming. Effective change management strategies are crucial to minimize disruption and ensure the smooth integration of new practices (4, 14).

To overcome these challenges, engaging stakeholders from the outset is vital. Involving laboratory staff, management, and other stakeholders in the planning process fosters ownership and commitment to the

initiative. Ongoing training and education build a culture of sustainability while seeking funding opportunities like grants and partnerships with environmental organisations can alleviate budgetary constraints (4, 14).

## GREEN LAB CERTIFICATION AND ACCREDITATION

Pursuing Green Lab certification and accreditation demonstrates a commitment to environmental stewardship, promotes resource efficiency, aligns with global sustainability goals, and benefits the laboratory, its stakeholders, and the broader community (4).

The My Green Lab Certification is an internationally recognised initiative with a five-step programme. This programme provides laboratories with a comprehensive framework and practical methods to continuously improve environmental sustainability practices and foster a culture of environmental responsibility (5). Another relevant accreditation is the ISO 14001 certification, which offers a robust framework for environmental management systems. It helps laboratories systematically manage their environmental responsibilities, improve resource efficiency, and reduce waste (4).

Malaysian laboratories can leverage local green certification and initiatives. The Malaysian Green Technology and Climate Change Corporation (MGTC) promotes energy efficiency and low-carbon solutions through programs like the Energy Management Gold Standard (EMGS), which assists organisations, including laboratories, in optimizing energy use and reducing their carbon footprint (15). Additionally, the SIRIM QAS eco-labelling programme helps consumers identify and choose eco-friendly products, encouraging laboratories to procure sustainable supplies and equipment (16). Initiatives such as the Green Building Index and Malaysia Green Building Confederation GreenRE Certification further support the comprehensive adoption of sustainable practices through energy, water, and waste management strategies tailored for tropical climates (7).

## THE WAY FORWARD

Protecting our environment is a shared responsibility, and implementing sustainable laboratory operations is vital for minimising our collective environmental impact. Laboratory practitioners must understand the importance of sustainability and actively adopt Green Lab practices. Educating current and future practitioners about efficient resource management, waste reduction, and sustainable procurement contributes to a more sustainable future.

A crucial first step towards a greener lab includes conducting baseline carbon emissions assessments and current sustainability practices. By evaluating the laboratory's environmental footprint, including energy consumption, waste production, and resource usage, areas for improvement can be identified, and meaningful goals established.

Clinical laboratories should urgently address the overuse of pathology tests to reduce their carbon footprint. Studies highlight the pre-analytical stage as a significant contributor to laboratory emissions, partly due to a high percentage of inappropriate test orders (17). By minimising unnecessary tests and implementing sustainable practices, laboratories can significantly reduce their environmental impact, improve operational efficiency, and support broader sustainability goals.

Every step towards sustainability, however small, makes a difference. By working together and embracing Green Lab practices, we can create a more sustainable future for ourselves and generations to come.

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