

Expert Interview: Building Sustainable Medical Laboratories: Balancing Environmental Responsibility, Quality, and Innovation

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EXPERTS:

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Introduction

Every laboratory has a responsibility that extends beyond delivering accurate test results—it must also protect the resources for future generations. Sustainable laboratory practice is about making smarter choices every day e.g, reducing waste, conserving energy, optimizing testing processes, and embracing innovations that improve efficiency without compromising patient care. True sustainability also includes supporting laboratory professionals, maintaining financial viability, and ensuring equitable access to quality diagnostics. Truly, by embedding sustainability into routine operations and decision-making, laboratories can contribute to better healthcare outcomes while minimizing their environmental impact. Thus, creating a healthier future for patients, communities, and the planet.

QUESTIONS:

Q1. Can healthcare ever be truly sustainable while laboratory testing volumes continue to increase globally?



Prof. Tomris Ozben

Healthcare can become sustainable despite increasing laboratory testing volumes, provided that growth is accompanied by greater efficiency, innovation, and responsible resource management. Sustainability does not require reducing access to diagnostics; rather, it requires ensuring that testing is appropriate, resources are used efficiently, and environmental impacts are minimized while maintaining high-quality patient care. Laboratory medicine plays a critical role in sustainable healthcare. A key priority is optimizing test utilization by reducing unnecessary and duplicate testing, which lowers reagent consumption, hazardous chemical use, waste generation, and healthcare costs. The World Health Organization's Essential In Vitro Diagnostics (IVD) List supports this approach by identifying high-value diagnostic tests for common diseases and infectious disease management.

Additional strategies include improving energy efficiency, reducing water consumption, minimizing plastic and hazardous waste, adopting automation and digital technologies, and promoting sustainable procurement practices.

Emerging technologies such as artificial intelligence can further enhance efficiency and resource utilization. Ultimately, sustainable healthcare is achievable if laboratories focus on delivering high-value diagnostics while continuously improving environmental, economic, and operational performance. In this way, laboratory medicine can support both better patient outcomes and a more sustainable healthcare system.



Dr. Tony Badrick

Yes, not only can we, but we have no choice. Increasing volumes make an already bad situation worse but also make the issue more obvious. Thus, more labs and governments will see that we are a part of the problem. Indeed, the more waste we produce, the more we ourselves impact on the health of individuals. The solution is not difficult for a profession that is health care minded and understands how to improve.



Dr. Tjan Sian

Sustainability is a collaborative effort to meet current requirements without depriving future generations. In the current laboratory practice, there are still a lot of non-value added processes, inefficiencies, non-energy friendly practices, and high volume of waste. With increased awareness of the healthcare system for sustainability practice, more targeted and personalised tests, more environment friendly equipment and methods, digitalization and efficient lab practice, studies have shown great reduction in carbon footprint and energy utilization can be achieved even with increased laboratory testing volumes. The inclusion of environment protection in accreditation requirements also supports sustainable environment friendly laboratory practice.

Q2. Should laboratories prioritize carbon reduction targets even when sustainability measures increase operational costs?

Prof. Tomris Ozben

Yes, laboratories should prioritize carbon reduction targets even when sustainability measures increase short-term operational costs, because these investments often generate long-term environmental, economic, and operational benefits. However, implementation must be balanced with patient safety, diagnostic quality, and financial sustainability. Several challenges can slow progress. Upfront investments in energy-efficient equipment and infrastructure may be substantial, particularly in resource-constrained healthcare systems. Workforce training requirements, cultural resistance to change, and regulatory or accreditation constraints can also limit flexibility in adopting greener practices. Despite these barriers, strong leadership and institutional commitment are essential. Clear sustainability strategies, measurable goals, and pilot projects can demonstrate feasibility,

build confidence, and support gradual implementation. Sustainable practices often improve operational efficiency, reduce waste, lower energy consumption, and enhance organizational resilience over time. Carbon reduction should therefore remain a strategic priority. Success depends on a structured and evidence-based approach that addresses financial, regulatory, and cultural challenges while maintaining the high standards of quality and patient care expected from modern laboratory services.

Dr. Tony Badrick

There are many ways to measure the environmental impact of medical laboratories, all related to waste. Measuring greenhouse gas emissions is standard, though difficult to calculate. Just reducing the use of water, electricity and solid waste (plastic, paper, clinical) is critical and easy to measure. It is not true that sustainability measures increase costs. Sustainability is about reducing waste, which must reduce cost. Reducing error in an assay reduces waste as well. It reduces laboratory staff, patient and clinician time, and reagent use. This is the cost of error. Similarly, reducing waste in operations reduces the cost of a laboratory.

Dr. Tjan Sian Hwa

Sustainability initiative calculation should not only be based on short term cost efficiency but also long-term operational cost efficiency. A broader benefit of carbon reduction toward quality in laboratory service, staff safety, mankind and environment should also be considered. Sustainability initiatives should cover not only environmental protection, but also consider social equity, and economic viability. Like all programs, a risk management evaluation should be done and should be balanced with the available resources in each laboratory. There are still many inefficiencies in laboratory processes, and a thorough process mapping can give other carbon reduction initiatives to be considered.

Q3. Who bears the greatest responsibility for laboratory sustainability—the laboratory, manufacturers, regulators, or healthcare systems?

Prof. Tomris Ozben

Laboratory sustainability is a shared responsibility. Laboratories can optimize daily operations and resource utilization, manufacturers can develop more sustainable instruments, reagents, and consumables, regulators can establish supportive policies and standards, and healthcare systems can create incentives for sustainable procurement and environmentally responsible practices. While laboratories play a central role because they directly manage testing processes, meaningful progress cannot be achieved by laboratories alone. Many sustainability challenges, such as excessive packaging, single-use plastics, energy-intensive equipment, and supply-chain emissions, require action from manufacturers and healthcare organizations. Similarly, regulators can accelerate progress by integrating sustainability considerations into accreditation standards and procurement frameworks. Collaboration among healthcare professionals, industry partners, policymakers, environmental experts, and laboratory leaders is essential to develop practical, evidence-based solutions that balance environmental goals with quality, safety, patient care, and financial sustainability. Sustainable laboratory medicine will advance most effectively when all stakeholders accept shared responsibility and work together to implement coordinated, measurable actions that reduce environmental impact while maintaining excellence in patient care.

Dr. Tony Badrick

Everyone is responsible, but at different levels, based on the responsibilities. It's the same question we could ask about global responsibility? 'Who has the greatest responsibility for global sustainability? It is every one of us. We should all practice reduce, reuse, and recycle. We all need to act appropriately in the lab, switching off unused equipment and lights, not mixing different waste streams, and not wasting paper. Managers need to lead sustainability in the lab and consider what manufacturers provide the most sustainable products. Regulators should ensure laboratories follow best practice for sustainable operations. Eventually, governments will mandate that all parts of the healthcare system implement sustainable practices.

Dr. Tjan Sian Hwa

It is an inter linked process that is initiated with awareness of each stakes-holder. Regulation, national program and endorsement by the government will be an anchor for an effective laboratory sustainability. Healthcare policies that integrate sustainability requirements and risk management



in each activity, including in the selection of a new procedure, test and instrument, will guide and control laboratory sustainability. Technology advancement and innovation in sustainability is a key element in the implementation. And successful laboratory sustainability indeed is depended on laboratory management and staff commitment.

Q4. What is the biggest misconception currently limiting progress toward sustainable laboratory medicine?

Prof. Tomris Ozben

One of the biggest misconceptions is that sustainability and quality are competing priorities. Many healthcare professionals assume that environmentally sustainable practices inevitably compromise diagnostic accuracy, patient safety, or operational efficiency. In reality, sustainability and quality are often mutually reinforcing. Well-designed sustainability initiatives can improve laboratory performance while reducing environmental impact. Measures such as optimizing test utilization, reducing waste, improving energy efficiency, digitalizing workflows, and adopting innovative technologies can decrease resource consumption while maintaining or even enhancing quality, productivity, and patient outcomes.

Another misconception is that sustainability is primarily an environmental issue. In fact, sustainability encompasses environmental, economic, and social dimensions. Sustainable practices can reduce costs, strengthen operational resilience, improve resource management, and support long-term healthcare delivery. Rather than being viewed as an additional burden, sustainability should be recognized as an opportunity to improve efficiency, reduce waste, and create more resilient and responsible healthcare systems. The challenge is not choosing between quality and sustainability, but integrating both into routine laboratory practice.

Dr. Tony Badrick

That we have a choice about implementing sustainable management systems.

Dr. Tjan Sian Hwa

The biggest misconception that limits sustainability in laboratory medicine is the opinion that sustainability is the top management responsibility and requires expensive technology. In some places, staff initiatives and collaborative small efforts from each department result in an impactful sustainability result that drive further other sustainability practices

Q5. If you could change one aspect of current laboratory practice to improve sustainability worldwide, what would it be and why?

Prof. Tomris Ozben

If I could change one aspect of current laboratory practice to improve sustainability worldwide, I would focus on improving test appropriateness and reducing unnecessary laboratory testing. A significant proportion of tests performed globally provide limited clinical value, contributing to waste, increased healthcare costs, and avoidable environmental impacts. Promoting evidence-based test ordering through clinician education, laboratory stewardship programs, clinical decision-support systems, and closer collaboration between laboratory professionals and clinicians would improve patient care while reducing unnecessary resource consumption. Fewer inappropriate tests would mean lower use of reagents, consumables, energy, water, and transportation resources, while also decreasing waste generation. Looking ahead, artificial intelligence and digital technologies have the potential to further optimize test utilization, streamline workflows, and improve operational efficiency. Combined with process optimization and sustainable diagnostic innovations, these advances can help laboratories deliver high-quality care with a smaller environmental footprint. Improving test appropriateness represents one of the most effective and immediately achievable strategies to enhance the sustainability of laboratory medicine worldwide.

Dr. Tony Badrick

Mandate ISO 14001 for all laboratories.

Dr. Tjan Sian Hwa

With the availability of Internet of Things, healthcare information system, cloud system, and other information technology advancements, optimization in digitalization and artificial intelligence capability is a great opportunity to improve sustainability using the available resources.



Digitalization can minimize paper consumption, reduce patient and staff mobility, automate instrument and electricity usage, and optimize logistics. Artificial intelligence and machine learning used in laboratories can support long distance virtual diagnostics, hence reducing carbon footprint. Integration of health information data in a hospital or national-wide will improve effective use of laboratory results and reduce retesting.

Conclusion: Despite broad consensus that sustainability must become integral to laboratory medicine, translating this ambition into everyday practice remains difficult. A central gap is the lack of standardized indicators for measuring and benchmarking environmental performance across laboratories. Sustainability criteria are also inconsistently reflected in accreditation frameworks, procurement policies, and healthcare regulations worldwide. For laboratories in resource-limited settings, financial and infrastructure constraints often slow the adoption of greener technologies and digital solutions, widening the gap between intent and implementation. Perhaps most importantly, sustainability needs to be reframed as a collective responsibility, embraced at every level of laboratory practice, rather than treated as a top-down management directive. Closer collaboration between laboratories, manufacturers, regulators, and professional bodies will be key to driving innovation, curbing unnecessary testing and waste, and building the evidence base showing that sustainable practices strengthen not just environmental outcomes, but efficiency, quality, and the long-term resilience of healthcare systems.

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1. Prof. Tomris Ozben

Is President of the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) and Past President of both the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) and the Balkan Clinical Laboratory Federation (BCLF). She also serves as Chair of the EFLM Task Force on Green and Sustainable Laboratories, Board Member of the IFCC Foundation for Emerging Nations (FEN), and Forum Consultant to the IFCC Task Force for Young Scientists.

A distinguished academic and laboratory medicine leader, Prof. Özben has held senior positions at Akdeniz University, including Vice Rector, Director of the Central Laboratory, and Chair of the Department of Medical Biochemistry. Her research focuses on cancer biomarkers, liquid biopsy, diagnostic and prognostic markers, laboratory automation, and quality management. She has published more than 300 scientific papers, edited several books, serves on the editorial boards of international journals, and has delivered over 500 invited lectures and keynote presentations worldwide.

2. Dr. Tony Badrick

Is Chief Scientific Officer of the Royal College of Pathologists of Australasia Quality Assurance Programs (RCPAQAP), having served as its CEO from 2015 to 2025. A globally recognized leader in laboratory medicine and quality assurance, he is President of the Asian Pacific Federation of Clinical Biochemistry and Laboratory Medicine (APFCB) and Secretary-Elect of the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC). He holds several academic appointments at leading Australian universities and serves as Chief Examiner of the Faculty of Science of the Royal College of Pathologists of Australasia. Prof. Badrick has published more than 300 peer-reviewed papers and 11 textbook chapters, with major contributions to quality control, external quality assessment, liver function testing, and sustainability in laboratory medicine.

3. Dr. Tjan Sian Hwa

Is a distinguished Clinical Pathologist with experience in laboratory management, accreditation, quality assurance, sustainability and professional society leadership. She is actively involved in advancing Clinical Chemistry and Laboratory Medicine through national and regional organizations. Dr. Tjan is Chairwomen of the APFCB Laboratory Management Committee. She is Former President, Indonesian Association for Clinical Chemistry (IACC), Executive Board Member, Indonesian Association of Clinical Laboratory and Member, Indonesian Association of Clinical Pathologists. She chairs IACC Scientific and Research Committee. She is also a Member of External Quality Assessment (EQA) Committee, Indonesian Association of Clinical Pathologists and IACC- Green Laboratory Environment and Mankind (GLEAM) Committee. She currently serves as Head of the Clinical Laboratory Department at Premier Jatinegara Hospital and Laboratory Director of Westerindo Private Medical Laboratory in Jakarta. Management Committee, and a Lead Assessor for ISO 15189 and assessor of ISO 17043.

