INTEGRATING ENVIRONMENTAL SUSTAINABILITY INTO CLINICAL LABORATORIES

Why • The Case for Change
What • The Tools for Change
How • The Strategy for Change

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Canada

CASCADES

Interior Health

NAVIGATION

Click on a topic on the table found on the right to navigate the document

INTRODUCTION

CASCADES develops playbooks as step-by-step guides to implementing well-evidenced change ideas for high-quality, low-carbon, sustainable and climate-resilient health care and health systems.

Playbooks are developed in collaboration with partners and experts and include key sustainability opportunities, references to evidence, examples, and implementation resources. This playbook provides information and resources that are relevant to many roles in the health system, including laboratory technicians, clinicians, facilities, health leaders, sustainability and energy managers, etc. The recommendations in this report are geared towards medical laboratories (including anatomical pathology) but the principles of sustainability interlaced throughout can apply to many departments in a health-care setting, or other laboratories such as research or educational.

This playbook was adapted from a Greening the Lab Opportunity Investigation conducted by the Environmental Sustainability team at British Columbia's Interior Health Authority.

LAND ACKNOWLEDGEMENT

Interior Health would like to recognize and acknowledge the traditional, ancestral, and unceded territories of the Dãkelh Dené, Ktunaxa, Nlaka'pamux, Secwépemc, St'át'imc, syilx, and Tŝilhqot'in Nations where we live, learn, collaborate and work together.

The flowers pictured are Arrowleaf Balsamroot. Native to British Columbia's Okanagan region, these blooms grace the landscape every spring.

Suggested citation

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PLAYBOOK STRUCTURE

WHY
The Case for Change

An introduction to the issue being addressed in the playbook

WHAT
The Tools for Change

Sustainability opportunities for climate action and resources to plan and implement change

HOW
The Strategy for Change

An outline of strategies for sustaining change

WHY

The Case for Change

Enhancing Environmental Sustainability Efforts → Clinical Laboratories' Impact on the Environment → Impact of Climate Change on Clinical Laboratories

Enhancing Environmental Sustainability Efforts

ENVIRONMENTAL SUSTAINABILITY

Climate change and environmental degradation pose accelerating and complex threats for 21st-century health systems. No other sector in Canada faces as great a risk - and no other sector has as much to benefit from climate action as does the health-care system. Clinical laboratories have largely been overlooked in existing literature characterizing the environmental impact of health care. Their resource intensity tends to be grouped in with other areas of hospitals (1-4). It has been estimated that typical laboratories can use up to ten times more energy and four times more water than office spaces, however, these kinds of estimates are likely not specific to clinical laboratories (5).

There is a growing global movement to address laboratory environmental sustainability. New technologies and innovations for sustainability are being developed and the good news is that there is a lot of room for improvement. Such improvement can result in long-term cost savings, enhanced staff engagement, and increased resilience to a changing climate.

Environmental sustainability is a broad term encompassing many different impacts (i.e., ozone depletion, pollution of air, water or soil, habitat destruction, climate change, etc.). It is common for actions to have multiple environmental benefits, however, there can be tradeoffs. Although the goal is to improve the overall environmental sustainability of clinical laboratories, there is emphasis on climate change mitigation with co-benefits.

ENVIRONMENTALLY-CONSCIOUS SYSTEMS AND PRACTICES BENEFIT MORE THAN THE ENVIRONMENT

As Figure 1 shows, mitigating the impact of climate change will prevent much human harm and suffering. Many 'eco-friendly' changes also create opportunities to improve the health of people locally and globally. There can also be major economic advantages from improved resource efficiency and avoided future costs by taking action. These additional benefits of environmental action are often called co-benefits, and can include improved health, improved care delivery, and cost savings, for instance:

- Reducing unnecessary care, where appropriate, to avoid waste also prevents unnecessary testing and procedures, reducing potential harms to patients and health-care spending (6,7).
- Preventing nitrous oxide leakage mitigates greenhouse gas emissions (GHG) while preventing potential exposure risks to staff and patients, and results in cost savings (8).
- Strong primary and community care systems bring co-benefits through climate mitigation and resilience, supporting health and health equity (9,10).
- Healthy food and food systems reduce GHG emissions and are a vital part of health equity, and individual, community and quality care (11).
- Greening cities with trees, shrubs and other vegetation not only sequesters carbon dioxide, it provides benefits to our mental health and supports biodiversity (12-14).

We have the tools we need to not only address the climate crisis but to build a future where all can thrive, sustainably.

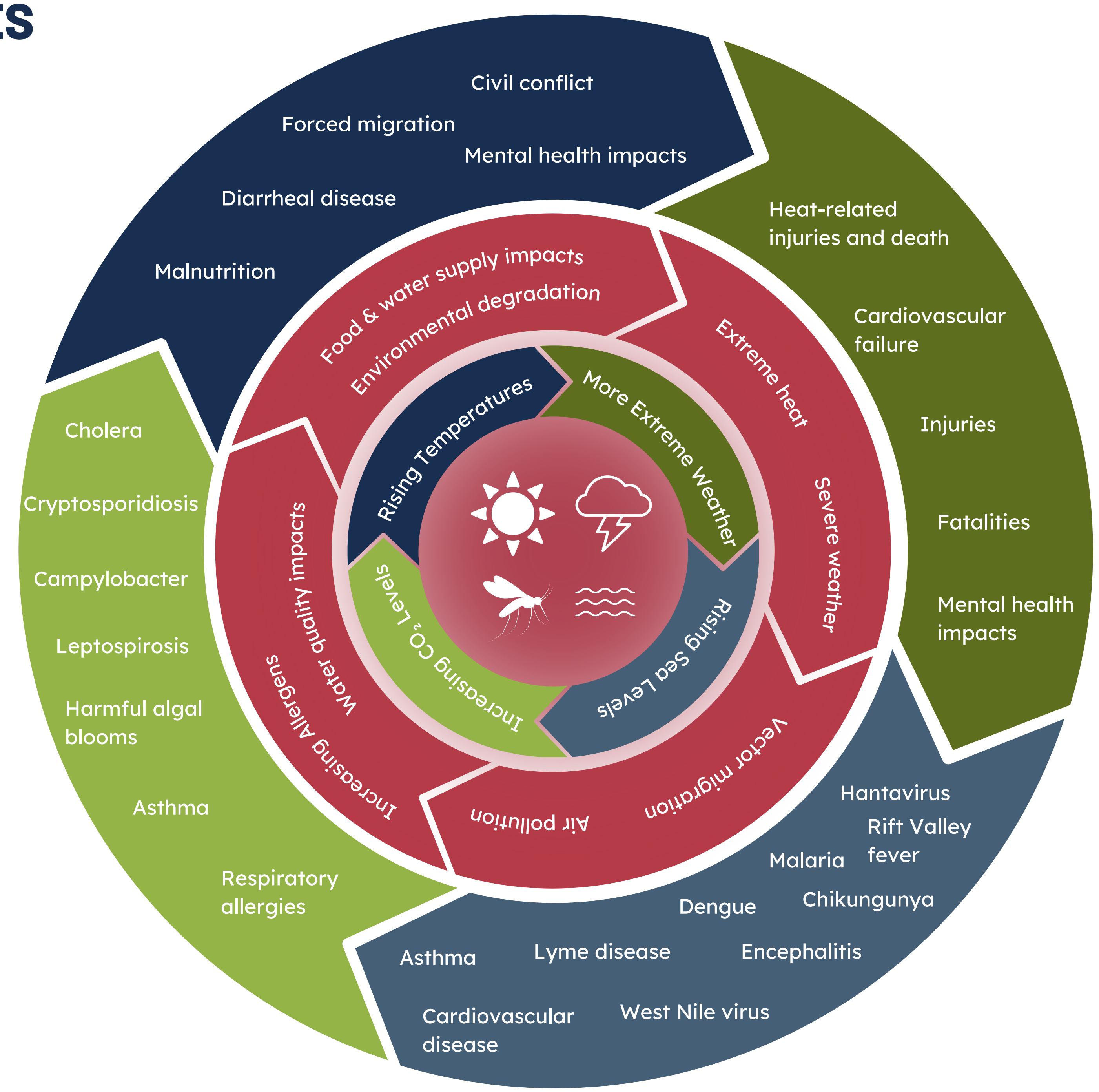


Figure 1: "Impact of Climate Change on Human Health", adapted from the United States Center of Disease Control, Preparing for the Regional Health Impacts of Climate Change in the United States

Clinical Laboratories' Impact on the Environment

"There is a new vision for medicine. Quality of care means meeting a standard that includes protection of the patient's climate." - Dr. Andre Mattman, Medical Biochemist

Clinical laboratories within a health-care facility collect and analyze samples of fluids or tissue (i.e., biological specimens) for scientific testing to aid health-care providers in diagnosing, treating, and managing patient care. Laboratory services are essential and operate around the clock, but as a result are energy intensive, consume water and produce large volumes of waste. Heavy reliance on single-use products in laboratories cumulates large life cycle impacts from production to disposal. Clinical laboratories also have direct environmental impacts from high energy consumption and use of chemicals harmful to humans and ecosystems.

Improving environmental sustainability can result in cost savings, improved patient care, enhanced staff engagement, and increased resilience to climate change. There is ample opportunity for solutions with co-benefits.

Improving the sustainability of clinical laboratories requires a coordinated effort across multiple departments, as there are many people involved in running them. This playbook outlines recommendations in the areas of appropriate testing, resource use, procurement practices and enhancing a culture of environmental sustainability.

RESOURCES

- Carbon Footprint Modeling of a Clinical Lab, MDPI (2023)
- Reducing the Environmental Impact of Clinical Laboratories, Clin Biochem Rev. (2017)
- An LCA of hospital pathology testing, Int J Life Cycle Ass (2021)
- Life Cycle Greenhouse Gas Emissions of Gastrointestinal Biopsies in a Surgical Pathology Laboratory, Am J Clin Pathol (2021)
- The unintended contribution of clinical microbiology laboratories to climate change and mitigation strategies: a combination of descriptive study, short survey, literature review and opinion, Clin Microbiol Infect (2022)
- Carbon footprint evaluation of routine anatomic pathology practices using eco-audit: Current status and mitigation strategies, Ann. Diagn. Pathol. (2023)
- Patient, hospital and environmental costs of unnecessary bloodwork: capturing the triple bottom line of inappropriate care in general surgery patients, BMJ Open Qual. (2023)
- Re-use of laboratory utensils reduces CO2 equivalent footprint and running costs, PLoS One (2023)
- Establishing sustainable quality improvement in the clinical laboratory: Redesign of the total testing process and digital transformation of routine quality assurance activities, Fung A. Clinical Biochemistry. Volume 137, June 2025

KEY DRIVERS OF CLINICAL LABORATORY IMPACTS

Climate change: Laboratories emit greenhouse gases, such as carbon dioxide, hydrofluorocarbons, and methane.

Energy use: Laboratories use an estimated three to ten times more energy per unit floor area than office buildings (15,16), the sources of which can have large environmental impact.

Water use: Laboratories may use about four times more water per unit floor area than an office building (5,17) and can contribute to decreased water quality (e.g., inappropriate disposal of waste chemicals).

Waste production: Laboratories produce waste from numerous streams, including single use products, biohazardous or cytotoxic waste, electronics waste, liquid waste and packaging waste.

Supply chain: Products and services purchased by laboratories all have environmental impacts, including the types listed above and more, from raw material extraction through to disposal.

Impact of Climate Change on Clinical Laboratories

CLIMATE CHANGE-RELATED SHOCKS AND STRESSES

Clinical laboratories provide essential services, critical to providing information health-care providers need for patient care. However, laboratories rely on many external factors to operate (i.e., staff availability, supply chains, access to health-care sites, and utilities), which are vulnerable to climate change-related shocks and stresses (18). Laboratory downtime or inaccurate results can impact the delivery of timely lifesaving treatments or correct diagnoses. Figure 2 (next page) shows the connections between climate hazards and facility and health risks.

STAFF

During localized extreme weather events, staff may be personally impacted and unable to prioritize work. Laboratory staff have specialized skill sets and credentials that can make covering shifts during emergencies challenging. Clinical laboratories across Canada, similar to the health-care system in general, are already experiencing staffing shortages, and climate-related disruptions only exacerbate these challenges (19).

SUPPLIES

Clinical laboratories are dependent on well-functioning supply chains, involving not only procurement of materials but specific storage requirements. Climate-related events may lead to supply chain disruptions, as experienced during the height of the COVID-19 pandemic (20), or power outages, infrastructure damage, or shifts to seasonal 'baseline' temperatures and humidity that may disrupt adequate storage of supplies during transport and in health-care facilities.

ACCESS

Staff and patients must be able to access health-care sites for sample collection and processing. Biological specimen testing requires access to the equipment in clinical laboratories. Extreme weather events (e.g., flooding, heat events, fires, etc.) can prevent access or sample transport, delaying essential test results that aid health-care providers in diagnosing, treating, and managing patients.

UTILITIES

Energy or water are required for most laboratory processes. Health-care facilities tend to have back-up power systems, but these systems may only be designed to meet demand for brief periods of time and can be highly polluting. A disruption to water access would present challenges for equipment and hand washing as well as potentially disrupt feed for onsite water purification systems.

CLIMATE ADAPTATION AND RESILIENCE

Extreme weather events as a result of climate change can lead to long-term compromised performance or catastrophic failures of buildings, which can in turn result in downstream consequences that impact the health systems ability to provide essential care services. A Climate Risk Assessment is an essential tool to ensure climate-resilient clinical laboratories in new and existing buildings. A risk assessment will establish the probability of a given hazard impacting a building or service combined with the predicted outcomes should the hazard occur.

Climate resilient clinical laboratories will have the capacity to cope with a hazardous event, trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation (21).

There is ample research demonstrating that the cost of climate adaptation is substantially less than the cost of repairing or rebuilding infrastructure after it has been damaged (22-24). Climate adaptation is also essential to avoid disruptions to emergency services and general health-care delivery (25,26).

Climate resilient laboratory services and supporting third party services (e.g., couriers) are a critical part of building a climate-resilient health system. Additionally, climate-informed business continuity planning for clinical laboratories has the potential to save money and improve health outcomes.

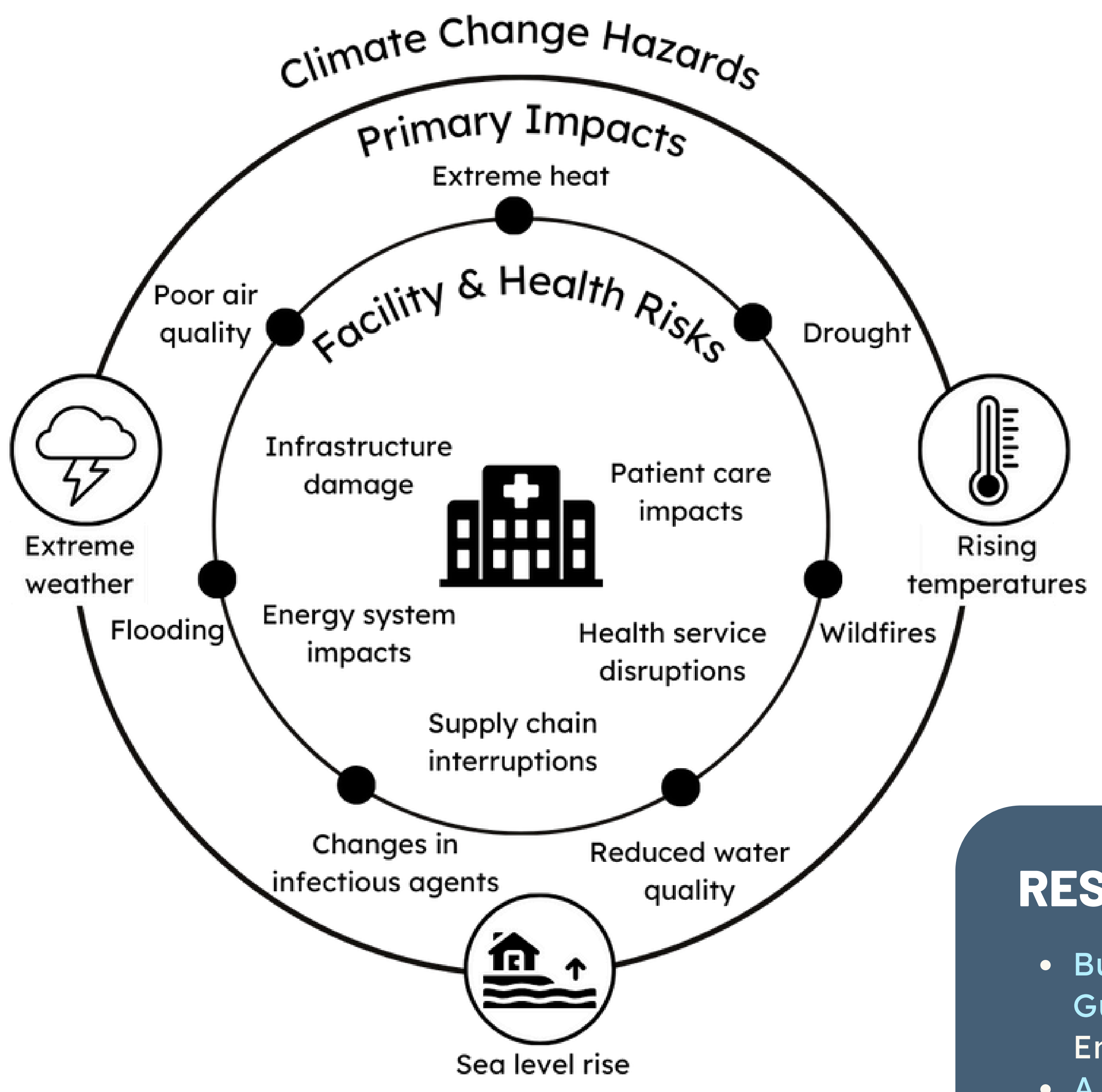


Figure 2: "From climate change hazards to facility and health risks", adapted from the Government of British Columbia, Managing climate risk for public sector organizations: Facilities fact sheet

RESOURCES

- Business Continuity Planning Guide for Laboratories, Yale Emergency Management
- A Practical Guide to Dealing with Laboratory Floods, Association of Public Health Laboratories
- Laboratory Continuity of Operations Plans, ASPR TRACIE Technical Assistance
- WHO Guidance for Climate-resilient and Environmentally Sustainable Health Care Facilities

WHAT

The Tools for Change

Appropriate Testing → Minimize Greenhouse Gas Emissions → Waste Management → Water Quality and Consumption → Procurement and Supply Chains

Sustainability Opportunities

Action Areas	Change Ideas
Appropriate Testing	Reduce low-value laboratory testing
	Participate in Using Labs Wisely
Minimize Greenhouse Gas Emissions	Purchase energy efficient fridges and freezers with low-global warming potential refrigerants
	Reduce energy consumption
	Reduce patient and sample transport
Waste Management	Reduce waste and promote redesign
	Reuse and recycle
	Segregate waste appropriately
Water Quality and Consumption	Reduce water consumption
	Improve wastewater quality sent for municipal treatment
	Use lowest appropriate grade of water
Procurement and Supply Chains	Practice sustainable procurement
	Integrate sustainable procurement from the top-down
	Consider green chemistry

RESOURCES:

- Laboratory Efficiency Action Network
- Building a Global Culture of Sustainability in Science, My Green Lab
- Sustainable Labs Guide, McGill University
- Laboratories: Building Design Standards, McGill University
- Energy Efficiency in Laboratories, United States Department of Energy
- Lab Recommendations, Choosing Wisely Canada
- Labconscious: Resources for Life Science Research Labs Based on Circular Economy
- International Institute for Sustainable Laboratories

Appropriate Testing

"Unnecessary tests and treatments expose patients to potential harm, consume precious health care resources, and contribute to the climate crisis" (27)

REDUCE LOW-VALUE LABORATORY TESTING

Reducing unnecessary lab testing is a highly efficient strategy to reduce the environmental footprint of clinical laboratories (28). While a single test may have low financial and environmental impacts, impacts accumulate quickly across health systems, making appropriate testing key for sustainability. There is opportunity to reduce widespread overuse of laboratory testing (29). Estimates vary widely, but as much as 40 - 60% of lab tests may be avoidable (30). Reducing low-value lab testing has the co-benefit of reducing harm to patients; such as by reducing complications from vein puncture, iatrogenic anemia from blood loss, and cascade testing that can ensue due to false positive results (29-32).

Laboratory professionals should work closely with test orderers (e.g., physicians) to promote appropriate testing. Choosing Wisely Canada has recommended test ordering "do nots" across medical specialties. Drivers of change can also include frontline clinicians, patients, administrators, researchers, and patient-family advocates. Effective strategies in lab testing stewardship include education, audit and feedback of testing practices, and updates to electronic ordering systems (e.g., adding hard and soft stops).

TEST ORDERING CULTURE

Systemically reducing low-value testing requires a change in test-ordering culture. Test overutilization is currently present in many care scenarios:

Tests ordered by specialist before patient appointment based on referring complaint (e.g., query dementia)

- Perform patient assessment (in person or virtual) before ordering the tests
- Check regional clinical information system to determine what lab tests have already been done which answer the question
- Value the environment as much as the doctor's time (e.g., it is convenient to have all information at hand when required but sometimes it's OK to wait and assess whether the information is needed at all))

Tests ordered to provide more information (as per a guideline which does not consider environmental impact) when more information is not the limiting factor in health achievement (e.g., Apo B and Lp(a) measurements and primary cardiovascular prevention)

Tests ordered to rule out an unlikely (but possible and potentially severe) outcome

- (e.g., serum protein electrophoresis testing in a 25 year old with as yet unexplained anemia or PSA testing in a 40 year old with back pain)

Consider patient values before testing and act accordingly

- Does the patient want "comprehensive testing" (i.e., when there is a 0.1% chance that patient care may be affected by performing the test) or
- Do they value environmental sustainability as well and so prefer specific testing (where a test is ordered when there is ≥1% chance of finding something)
- Hold off on testing for issues that are not going to contribute to patient comfort, when comfort care is the patient goal

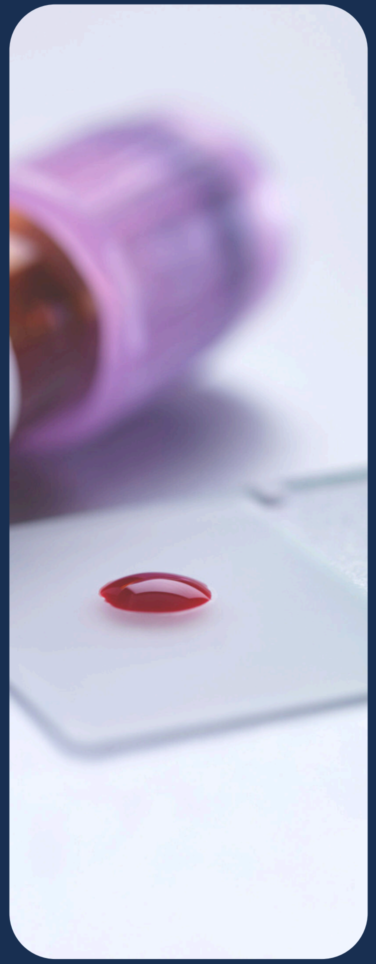
EXPERIENCE SPOTLIGHT: ST. MICHAEL'S HOSPITAL, ONTARIO

A multidisciplinary 'Pause the Draws' intervention reduced routine phlebotomy volume by 17% across their 30-bed medical surgical ICU (33). The intervention included an education campaign, ICU rounds checklist, audit and feedback of test ordering practices, an electronic test add-on feature, and order set changes.

Total blood volume taken from patients decreased from 41.1 mL to 34.1 mL per patient day. This reduced need for red blood cell transfusions from 10.5 to 8.3 transfusions per 100 patient days. Patients with longer ICU stays had the most substantial reduction in transfusion needs. Fewer transfusions decreases the risk of health complications for patients (34). No change in length of stay or mortality was observed.

Environmental savings were also significant with over 15,000 blood testing tubes and 23,000 plastic bits diverted from biowaste/landfill each year. Lab operating costs decreased by $8 per patient day or over $98,000 per year. Cost savings were calculated from blood testing reagents and disposable lab equipment but exclude fixed laboratory costs. This a great example of the 'triple bottom line' of reducing unnecessary care with benefit to patients, the environment, and the hospital operating budget.

Learn more



RESOURCES:

- What the Doctor Ordered: Improving the Use and Value of Laboratory Testing, C.D. Howe Institute
- Sustainable Perioperative Care playbook, CASCADES
- VIDEO: The Environmental Impacts of Unnecessary Blood Tests with Dr. Karina Spoyalo
- Climate-Conscious Recommendations by medical specialty, Choosing Wisely Canada
- CADTH Webinar: Using Labs Wisely, Choosing Wisely Canada
- Tips to avoid unnecessary lab tests, Dr. Ilona Hale
- Top 10 Choosing Wisely Canada's Recommendations for Conserving Laboratory Resources

MINIMUM RETESTING INTERVALS

There are now guidelines for minimum retesting intervals for five often repeated lab tests (35):

- antinuclear antibody
- hemoglobin ATC
- lipase
- serum protein electrophoresis
- thyroid stimulating hormone

Learn more

EXPERIENCE SPOTLIGHT: VANCOUVER GENERAL HOSPITAL (VGH), BRITISH COLUMBIA

A retrospective cohort study at VGH, a tertiary care hospital, characterized the extent of unnecessary care in general surgery inpatients using a triple bottom line approach (36). The study examined 20 commonly ordered laboratory tests in general surgery, looking at its impact on inpatients, hospital costs and the environment. The chart review included 83 patients admitted for acute uncomplicated surgery. The degree of unnecessary testing was determined by comparing ordered laboratory tests against previously developed consensus recommendations. Of the 83 patients in the chart review, 76% underwent unnecessary bloodwork, resulting in an average of 1.84 phlebotomies, 4.4 blood vials, 16.5 tests and 18 mL of blood loss per patient.

The added financial cost of the unnecessary tests totaled over $5,200 CAD (calculations included cost of labour, transport and consumables, reagents and energy required to process each test). The environmental cost of the unnecessary laboratory tests was 61 kg of CO_2e emissions. The carbon footprint of a common set of investigations (complete blood count, differential, creatinine, urea, sodium, potassium) was 332 g CO_2e. Adding a liver panel (liver enzymes, bilirubin, albumin, international normalized ratio/partial thromboplastin time) resulted in an additional 462 g CO_2e emissions.

Learn more

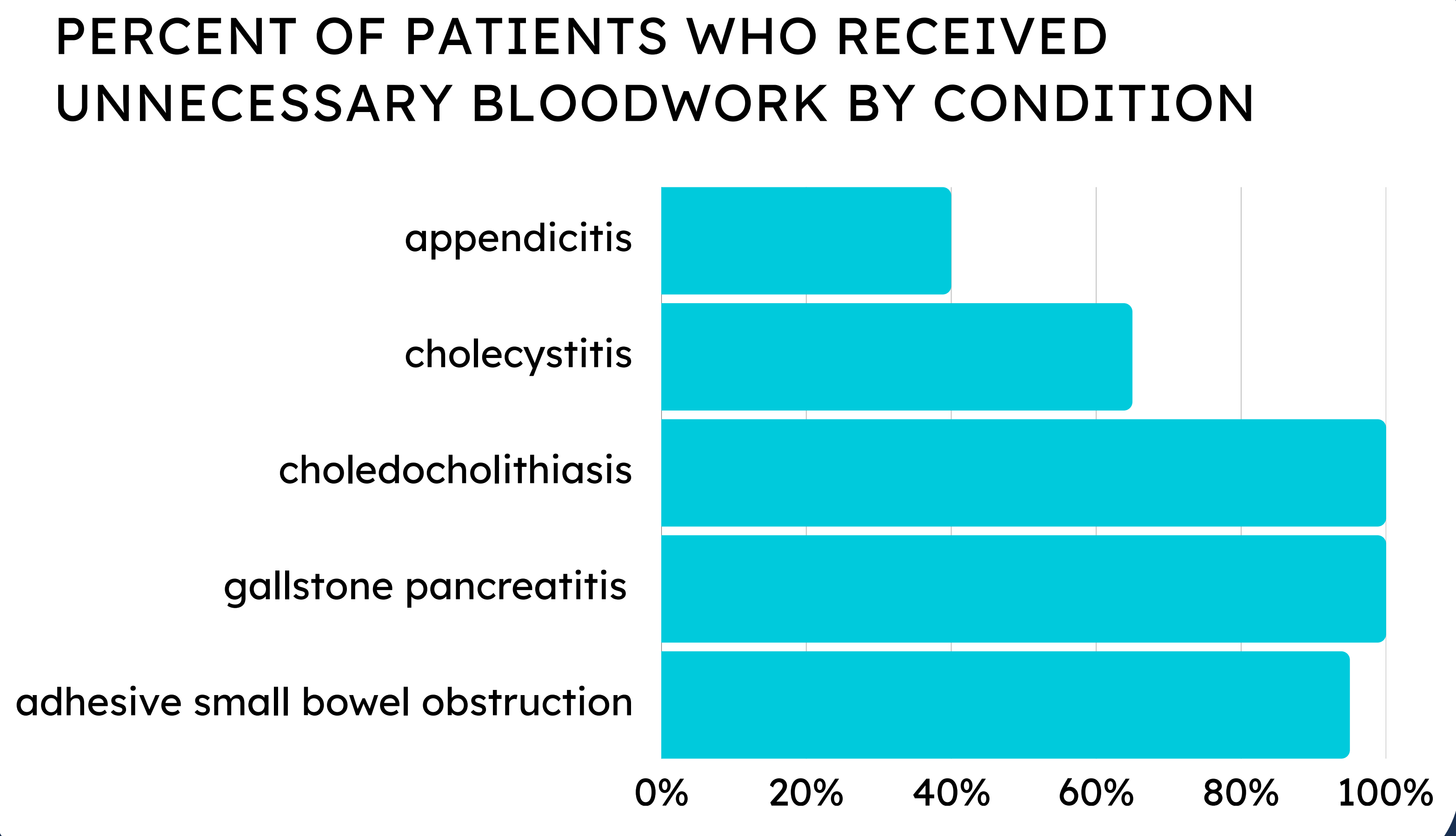


Figure 3: Unnecessary bloodwork in patients admitted for uncomplicated acute surgical conditions in VGH study, by condition (36).

PARTICIPATE IN USING LABS WISELY

Choosing Wisely is an international organization dedicated to promoting the appropriate use of clinical tools. In 2022, Choosing Wisely Canada launched Using Labs Wisely; a national consortium that aims to measurably reduce low-value lab testing. Hospitals across Canada are welcome to participate in the program, where they will learn with others, implement change and share data.

COMPARATIVE REPORTING

Using Labs Wisely participants routinely submit aggregate data on a set of lab tests that are commonly ordered unnecessarily. Participating hospitals receive comparative reports to benchmark their lab test utilization to other sites across Canada. This is a helpful measurement tool for quality improvement and sustainability initiatives and for engaging in discussions with hospital leadership. Below are the lab test indicators that Using Labs Wisely collects:

USING LABS WISELY INDICATORS

AST/ALT, Urea/Cr, PTT/PT/INR, Folate, CK-MB, Urine cultures, Vitamin B12, and ESR

CHOOSING WISELY TALKS

There is a database of past talks. Below are a few relevant for clinical laboratories:

- Reducing Unnecessary Repetitive Lab Testing
- Pre-Operative Testing for Low-Risk Surgery in Alberta: From Drivers of Behaviour to Behaviour Change
- Environmental Co-Benefits of Reducing Low-Value Care
- Using Labs Wisely in General Medicine During Global Blood Tube Shortage
- Using Audit & Feedback to Reduce Unnecessary Lab Tests
- What the Doctor Ordered: Improving the Use and Value of Laboratory Testing
- How to Talk About Unnecessary Tests and Treatments
- How Small Changes Make a Big Difference: Alberta & Manitoba Vitamin D Testing Case Studies
- Overutilization in Lab Medicine: Challenges and Opportunities

USING LABS WISELY SPOTLIGHT:
QEII HEALTH SCIENCES CENTRE, NOVA SCOTIA

Learn more

After joining Using Labs Wisely and submitting their indicator test data in 2022, the QEII Health Sciences Centre learned they averaged 113 serum folate tests per month (inpatients only). This put their institution in the top 75% percentile for serum folate testing compared to national counterparts. In response, they initiated a quality improvement project with two aims:

1) Discontinue RBC folate as an in-house test and provide it as refer out testing for a very small patient population

2) Limit in-house serum folate to those patients with specific criteria, outside of which the request would be cancelled.

These interventions were to be applied to both inpatients and outpatients. The team met with key players and reviewed the Using Labs Wisely recommendation and the status of folate deficiency, which was found to be virtually non-existent in Canada due to grain fortification since the 1990s. The most powerful evidence for change however, was an audit of their own serum folate test results, which demonstrated < 2% of our patients tested had low folate levels. As such, the project had stakeholder support and was able to move forward in April 2023. Initial findings demonstrated very favourable pre-and post-utilization numbers: they saw a 92% and 88% reduction in monthly RBC folate and serum testing, respectively. This was achieved with little if any negative feedback from their clinical requestors.

Minimize Greenhouse Gas Emissions

Every item clinical laboratories use requires energy for production, transport and disposal (e.g., equipment, single-use items, chemicals, water, etc.). Producing that energy, among other processes, emits greenhouse gases (GHGs) into the atmosphere (37). These are referred to as upstream and downstream life cycle emissions. Clinical laboratories also directly emit GHGs from operations and should seek to reduce these onsite emissions via electrification, fuel switching, selecting low global warming potential (GWP) refrigerants and minimizing refrigerant leaks.

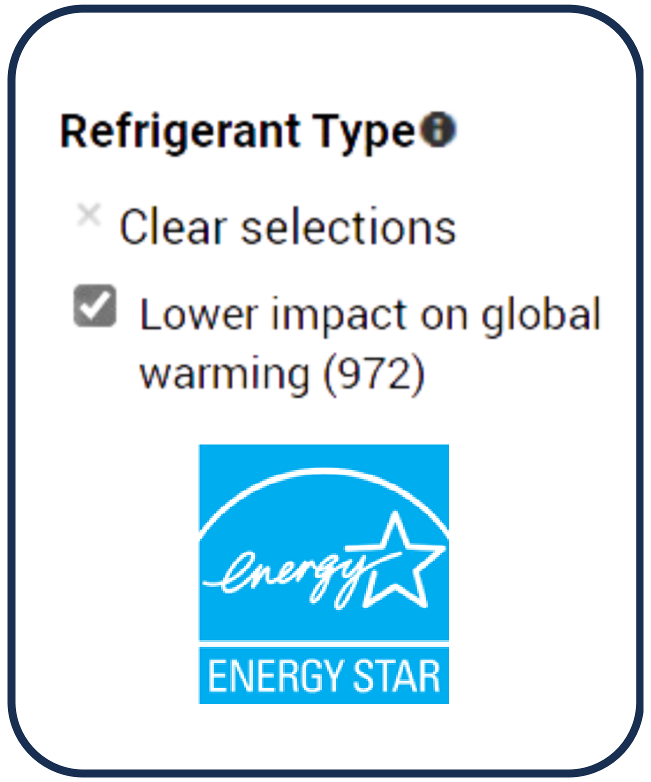
Table 1: Direct sources of GHG emissions in clinical laboratories:

Combustion	Source	Combustion emits carbon dioxide (CO_2) (e.g., internal combustion engine vehicular sample transport, Bunsen burners, natural gas space heating). Natural gas, predominantly methane, is an even more potent GHG than CO_2 and is emitted via leaks and incomplete combustion (38,39).
	Strategy	Switch to electric alternatives (e.g., electric vehicles, heat pumps and Bunsen burners).
Refrigerants	Source	The gases used by fridges and freezers to transfer heat, refrigerants, tend to have very high global warming potentials and can leak over time.
	Strategy	Procure the option with the lowest GWP refrigerant available (see next page).
CO_2 Incubators	Source	The CO_2 cannisters used to maintain the low oxygen environment release this GHG every time the door opens.
	Strategy	Opt for low-CO_2 consumption models with segmented inner doors. Ensure tight seals. Explore whether other incubator types could be feasible, sustainable alternatives (e.g., anaerobic or nitrogen purge; nitrogen (N_2) is not a GHG and is the primary component of air). Upstream impact of incubator gases and energy efficiency should be factored into environmental considerations.

PURCHASE ENERGY EFFICIENT FRIDGES AND FREEZERS WITH LOW-GLOBAL WARMING POTENTIAL REFRIGERANTS

All new fridges and freezers should be energy efficient and have low-global warming potential (GWP) refrigerants. The Energy Star website has list of lab-grade Energy Star rated fridges and freezers, with a filter for low-GWP refrigerants (screenshot below). You can also use this website as a barometer for good energy efficiency by appliance type, to contextualize efficiencies of non-Energy Star certified models.

Sometimes a refrigerant type is listed as "HC", meaning hydrocarbon, which is a low-GWP option, also safe for the ozone layer.



FLUORINATED REFRIGERANTS

Fluorinated refrigerants (commonly hydrofluorocarbons; HFCs) are greenhouse gases with global warming potentials (GWP) hundreds to thousands times more potent than CO_2 (40,41).

For example (42):

- CO_2 used as a refrigerant: R-744, GWP = 1
- Hydrocarbon (HC) refrigerant: R-290 (propane; C_3H_8), GWP = 4
- HFC refrigerant: R-507 (Freon 507), GWP = 3,985

RESOURCES:

- Purchasing Energy-Efficient Laboratory-Grade Refrigerators and Freezers, Federal Energy Management Program (United States)
- Lab fridges and freezers, Government of Canada
- Mayo Clinic: Replacing freezers leads to energy and cost savings, Practice Greenhealth

REDUCE ENERGY CONSUMPTION

Medical laboratories have high ventilation requirements, use energy-intensive equipment, and many operate for long hours (43). Reducing energy use lowers utility costs and environmental impact, and prolongs sufficiency of energy supply capacity, postponing or preventing costly upgrades. For instance, the University of California, Irvine's Smart Labs Initiative reduced energy consumption by 61% across 10 retrofitted academic laboratories, partly by ensuring ventilation systems did not exceed required air change rates (44). Co-benefits from their initiative were cleaner indoor air, faster detection of system malfunction, and extended life of building system components.

"Labs in older buildings often use medium pressure distribution systems which require substantial reheat inputs, so lab managers should consider replacing combustion-fed reheat systems with heat pumps to provide more comfortable environments at a lower cost than retrofitting the entire ventilation system. The reheat load can be more than 50% of the usage of the lab!"
- David Bligh, Efficiency Nova Scotia

Energy reduction and self-sufficiency are also climate resilience strategies.

A good approach for any energy management strategy is to first reduce, then improve efficiency and finally, optimize supply. For example, first turn off the lights when not in use, then switch to LED bulbs and finally, switch to a renewable electricity source.

EXAMPLE: WASTEWATER ENERGY TRANSFER

Toronto Western Hospital is retrofitting the world's largest raw wastewater energy transfer (WET) system, to provide 90% of the hospital's heating and cooling needs (45). They estimate a reduction of the hospital's GHG emissions by 10,000 tonnes CO_2e emissions per year (equivalent to 1,800+ cars annually).

Perhaps the most remarkable thing about these kinds of energy systems is the ability to recover heat from cooling loads (e.g., freezers) for use elsewhere.

RESOURCES:

- Best Practices Guide An Introduction to Low-Energy Laboratory Design, I^2SL
- Energy Efficiency in Laboratories, US Federal Energy Management Program
- Laboratories for the 21st Century: An Introduction to Low-Energy Design, US EPA & DOE
- CASCADES Greenhouse Gas Emissions Estimation in Canadian Healthcare playbook
    - Organizational GHG Emissions Measurement: Opportunities and Guidance Chart
- My Green Lab is a non-profit with many resources dedicated to lab environmental sustainability
- Fume Hood Sash Stickers Increases Laboratory Safety and Efficiency at Minimal Cost: Success at two University of California Campuses, US Department of Energy
- My Green Lab Accredited Professional Course Energy Module

ENERGY REDUCTION OPPORTUNITIES

Laboratories also have the basic energy equipment like computers and lighting. Let the screen go black instead of using a "screen saver" (46). Explore whether air change rate and temperature setbacks could be implemented during unoccupied hours using occupancy sensors to ensure safety. Explore heat recovery (e.g., capture heat from freezers) and use of heat pumps to move waste or ambient heat to where it's needed.

Fume Hoods

In a day, one fume hood may use the same amount of electricity as over three Canadian households* (47). Moving air takes a lot of energy, as does replacing the conditioned air that gets vented outside. Variable air-volume fume hoods can reduce air flow when the sash is lowered, saving energy (perhaps more than 40%) (48). Store chemicals in safety cabinets instead of fume hoods if they have potential to be turned off (e.g., ductless).

*The average Canadian household's electricity use was calculated using data from Statistics Canada's Households and the Environment Survey: Energy use, 2021. The average Canadian home used 30 kWh of electricity every day in 2021.

Biosafety Cabinets

Left on 24/7, a 4ft biosafety cabinet may use around 11 kWh daily, over one third of an average Canadian households'* daily electricity use (49). Turn off biosafety cabinets when not in use and choose energy efficient models (50). In addition, the Canadian Biosafety Handbook strongly discourages the use of UV light disinfection in biosafety cabinets due to limited effectiveness (51).

Ultra-low Temperature Freezers (ULTs)

One -80°C freezer can use almost the same daily energy as the average Canadian home*, depending on the model (49,52). Set ULTs to the warmest possible setting based on contents' requirements. Changing from -80°C to -70°C may save 2-7 kWh per day and has been established to be as effective for preserving many types of specimens (53).

Other Lab Equipment

Indicate what can and can't be turned off in your lab using energy stickers. If something needs to warm up, work with your facilities team to find an acceptable outlet timer model, which can be programmed to start equipment before working hours (54). Smart outlets with remote control could warm up equipment as soon as an off-hours call-in is initiated. Prioritize energy efficiency when selecting new equipment.

EXPERIENCE SPOTLIGHT: KOOTENAY LAKE HOSPITAL, BC

A small clinical lab in BC's Interior region has plugged their heat block into an outlet timer. The heat block went from being on 24/7 to off for 12 hours per day. It automatically starts warming up an hour before lab staff arrive in the morning.

ENERGY STICKERS

These are energy stickers Interior Health is developing to reassure staff of what can and can't be turned off, as well as remind staff to shut the fume hood sash (55). PDF sheets of these stickers using Avery template 5163 will be made available so laboratory staff can print their own.

RESOURCES

- Cold Storage, My Green Lab

REDUCE PATIENT AND SAMPLE TRANSPORT

Point of care testing (POCT), remote self-sampling and virtual care are alternative processes, when appropriate, to reduce the environmental impact of testing by reducing sample or patient transport. Internal combustion engine travel can be a proportionally large, direct source of greenhouse gas emissions from the medical testing process (56,57).

Investigate where POCT, remote sampling, and virtual test ordering or follow-up appointments can significantly reduce patient or sample travel. It is possible that POCT, remote self-sampling and virtual care will yield the greatest environmental benefit (and benefit to patient access) in remote and rural communities where long distances are travelled and public transit is scarce.

POCT and remote testing, however, may increase burden of single-use items, adding to environmental impact. We should also be mindful of the potential for increased laboratory testing for remote doctors appointments, which may occur to compensate for more uncertainty in diagnoses since physicians are not able to physically examine patients. Such environmental trade-offs should be assessed project-by-project.

STUDY: SELF-SAMPLING REDUCING CARBON EMISSIONS

A 2023 United Kingdom study found that remote self-sampling reduced the carbon footprint of cervical screening by 8.7 times (58). Self-screening is facilitated by mailing patients a vaginal swab kit, which they use and mail back. The life cycle analysis took into account all processes and products needed for the screening methods. Traditional in-person screening had higher emissions from the resources needed to run the health-care facilities as well as patient and staff travel. British Columbia is the first Canadian province to have implemented a similar self-screening program.

RESOURCES:

- Virtual Care Carbon Accounting Playbook, CASCADES
  - Virtual Care Carbon Accounting Tool
- Virtual Care Benefits Calculator (for patients), Canada Health Infoway
- Engineering a sustainable future for point-of-care diagnostics and single-use microfluidic devices, Ongaro et al.
- New self-screening program will help detect cervical cancer sooner, BC Cancer
- Evidence on Point-of-Care Testing, Canada's Drug Agency

Waste Management

Laboratories facilitate the highest volume of medical activity in health care: testing (59). The demand for laboratory services and the number of tests available to clinicians is only increasing (60). As such, clinical laboratories produce high volumes of waste from numerous streams, including plastic (e.g., single-use products), biohazardous and sharps waste, electronics, chemicals, and paper. The waste management hierarchy helps determine the most sustainable solutions for waste (Figure 4). Waste management includes: redesign waste out of products and processes, reduce waste (minimize single-use items; manage inventory), reuse materials (solvent repurification), recycle (soft plastics; paper) and responsibly manage unavoidable waste (segregate hazardous vs. non-hazardous waste; recyclable vs. non-recyclable).

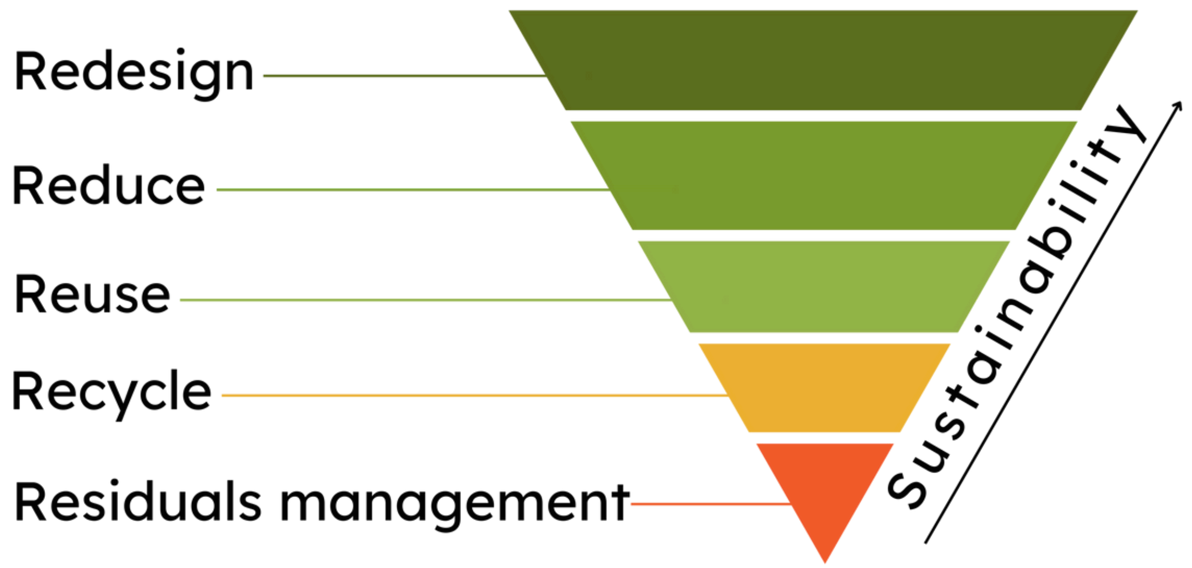


Figure 4: Waste management hierarchy to determine the most sustainable options for tackling waste (adapted from the Zero Waste International Alliance).

REDUCE WASTE AND PROMOTE REDESIGN

REDESIGN TO MINIMIZE WASTE

Work with procurement teams to choose products and processes designed to minimize waste. Products containing less or recycled material, that last longer (improved durability or reparability), or that generate less waste over time (improved efficiency) all reduce waste. Examples of redesign:

- Use short draw tubes (e.g., 3mL tube rather than 4mL, wasting less blood)
- Identify products creating excessive waste (e.g., packaging) and give suppliers suggestions for improvement

REDUCE WASTE

Embodied carbon is the greenhouse gas emitted to create a product (61). That “built in” environmental impact is carried through the product’s life. The longer a material is in use, the lower its embodied carbon intensity over time. Reusing materials, whether in the same form or after modification (recycling), reduces physical waste and new materials needed. Therefore, as a rule of thumb, reusable products are more sustainable than disposable ones. Recommendations to reduce waste in clinical laboratories include:

- Digitize workflows and stop unnecessary printing (though be mindful of storing data too, as that also has an environmental footprint (62))
- Prevent expiry with good inventory management practices and optimized purchasing
- Only use PPE as required (e.g., Gloves Off Campaigns) and utilize reusable PPE where appropriate
- Collaborate with other hospital laboratories or departments to exchange surplus materials and reagents that are still usable

EXPERIENCE SPOTLIGHT: PROVIDENCE HEALTH CARE, BRITISH COLUMBIA , BC

2

The clinical laboratories at St. Paul's Hospital and Mount Saint Joseph Hospital of Providence Health Care, British Columbia, redesigned their total testing process using the five Rs of waste management during implementation of new automated systems. The redesign focused on environmentally sustainable practices, choosing sustainable materials and analyzers, and digitalizing routine quality assurance workflows.

In the preanalytical process, updating the specimen container configuration reduced the number of containers used per month by 39.7% (from 10,710 to 6,459 (Figure 5)), without significantly changing the number of tests or collections. For the analytical process, changes included eliminating unnecessary test repeats, switching to larger reagent packs, and choosing analyzers that use less water and generate fewer solid wastes. In the post-analytical process, updating test-specific archival requirements reduced freezer archive storage volume by 67%.

Leveraging existing middleware infrastructure, digitalizing method evaluation and external proficiency test workflows reduced paper waste, improved efficiency, and enhanced quality. The shared information technology infrastructure among local health organizations allows digitalized workflows to be adopted by local laboratories with different analyzers, promoting scalability, interoperability, and resource sharing.

Learn more

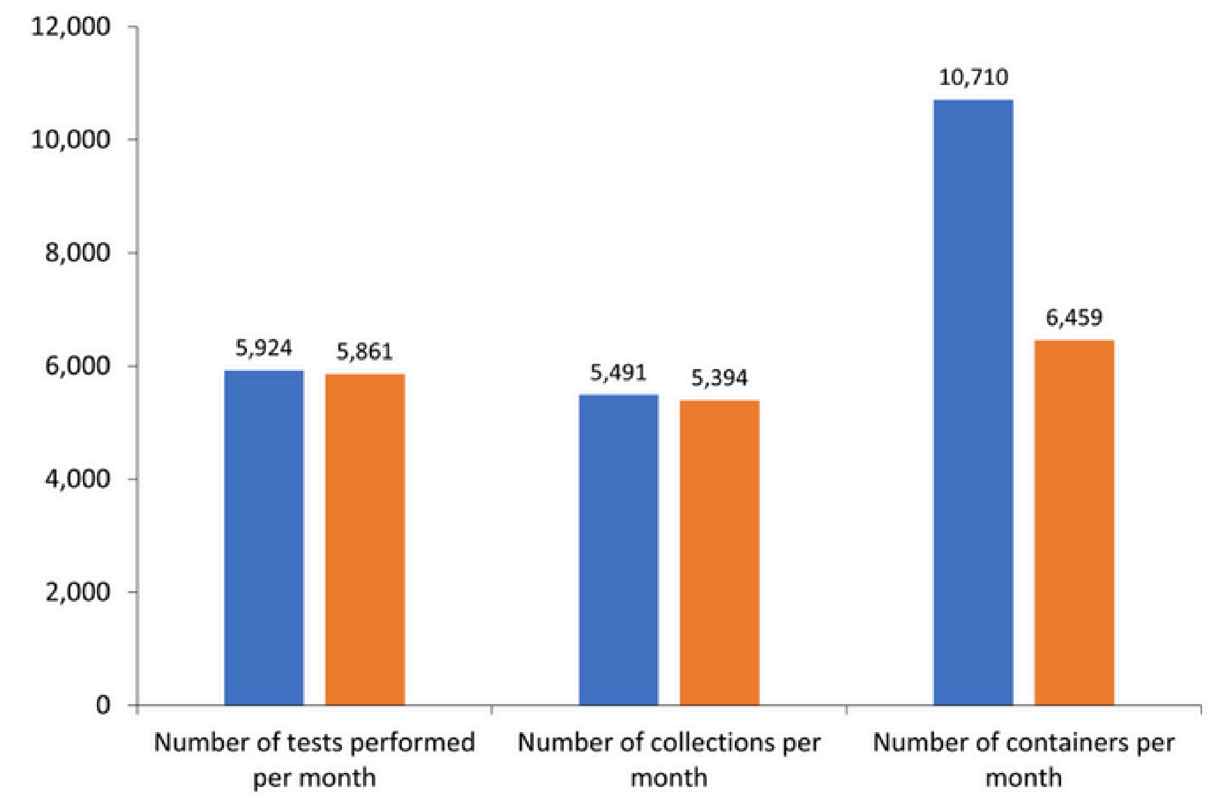


Figure 5: Reduction in monthly container usage for selected immunoassays through redesigning specimen container configuration in the laboratory information system, comparing pre-implementation (blue) and post-implementation (orange) (63).

REUSE AND RECYCLE

After reducing consumption or redesigning to minimize waste, the next best thing to do is reuse, whether for the original purpose or a new one. Reusable labware is better for the environment, can save money, and also ensures those tools will be available, despite outside economic or environmental conditions. Transitioning towards reusable products can improve climate resilience.

After reuse, material should be conserved by recycling it as many times as possible.

Environmental sustainability committees are good candidates to facilitate re-homing of unused equipment and consumables.

REUSE

Reuse opportunities for clinical laboratories:

- Purchase equipment that washes, sterilizes and dries pipette tips or microwell plates for reuse, or other cleaning systems.
- Implement reusable biohazardous and sharps waste bin programs (e.g., Daniels Health's Medismart and Sharpsmart).
- Purchase reusable glass or plastic labware, which is environmentally preferable to disposable labware, despite the resources needed for cleaning (64).
- Purchase refurbished lab equipment (e.g., REUSEit).
- Establish take-back programs with vendors for materials such as insulated coolers, old equipment or other packaging (65).
- Explore approving reuse of received packaging for outgoing shipments.
- Create an organization wide second-hand intranet page to re-home unused equipment.
- Donate surplus or unused items to educational institutions or other organizations, helping to extend the life of equipment (e.g., Seeding Labs).

RECYCLE

Staff need infrastructure to make sustainable choices but staff participation is also needed to make that infrastructure work. If recycling is missing or staff do not believe it is truly recycled, ask the Waste Management department to instate or verify recycling programs. Potential clinical laboratory recycling streams include:

- Onsite solvent and formalin repurification (e.g., CBG Biotech, heidolph, ISTPure), or offsite (e.g., Clean Harbors)
- Non-functional equipment (electronics), in addition to batteries and lightbulbs (e.g., Recycling Services, Clean Harbors)
- Soft plastics and expanded polystyrene (aka Styrofoam)
- Lightly soiled disposable personal protective equipment (e.g., nitrile gloves, face masks, disposable gowns, etc.) (e.g., Vitacore, Polycarbin)
- Polyvinyl chloride products (e.g., PVC 123)
- Pens, markers and printer cartridges
- Regular plastics and paper/cardboard
- Compost (i.e., in the lunchroom)

SEGREGATE WASTE APPROPRIATELY

RESIDUALS MANAGEMENT

Residuals management is where unavoidable waste is disposed of in a safe, environmentally sound way (e.g., engineered landfill). Proper waste segregation is essential to ensure waste is disposed of appropriately (i.e., coffee cups do not belong in the biomedical waste bin).

Every escalating level of hazardous medical waste goes through a more resource intensive disposal process. Proper segregation decreases volumes of biohazardous and cytotoxic waste, saving money and environmental impact. Contaminating recycling streams with non-recyclable products disrupts the process. Landfilling recyclable materials is a missed opportunity to save embodied carbon.

Pictures of common items are a universal way to communicate what goes where to support proper waste segregation.

PLASTIC WASTE

Plastics are lightweight, often non-reactive, and strong with the ability to be flexible, transparent or opaque, and cheap. In some cases plastic is the best material for the job and for minimizing environmental impact (e.g., protecting some foods). Plastic's environmental performance, compared to other materials like cotton, glass, or metal, depends largely on how many times it is used (66). Disposable plastic has led to the global plastic pollution problem because its material strength can make it last well past its useful life (67). Some plastics are only used for a few seconds (e.g., stir stick) but may last hundreds to possibly thousands of years on Earth (68).

Another challenge is that there is a limited number of times plastic can be recycled into material of the same caliber due to weakening chemical properties with each cycle (69). Most plastics recycling programs today involve melting and reforming the material (70). Most plastics today are also made from petrochemicals (akin to fossil fuels) (71).

Alternative plastics (e.g., BPI certified compostable, waste-fibre derived bioplastics, or more readily recyclable plastics (e.g., HDPE over PVC (72)) should be considered. Plastic, like life on Earth, is carbon-based. That means plastic can be made from biological materials (e.g., plant matter) and can be designed with the ability to break down as compost.

RESOURCES:

- Reduce, Reuse, Recycle: Top 10 Choosing Wisely Canada's Recommendations for Conserving Laboratory Resources
- CASCADES Navigating Biomedical Waste Management Policies for Sustainability playbook
- A case report: insights into reducing plastic waste in a microbiology laboratory (Alves et al, 2020)
- Smart Plastics Guide, Sea Studios Foundation
- Golden Design Rules for Plastics Packaging, Canada Plastics Pact
- i-CLIMATE: a "clinical climate informatics" action framework to reduce environmental pollution from healthcare, (2022) Sittig DF, Sherman JD, Eckelman MJ, et al.

Water Quality and Consumption

REDUCE WATER CONSUMPTION

Laboratories use up to an estimated four times more water per unit floor area than an office building (5,17). Water use has environmental impacts from directly releasing contaminants into ecosystems and from the resources needed for its treatment. The quantity of water used and quality of water waste are both areas for improvement. Water conservation protects ecosystems (e.g., delays supply expansion, leaves water in ecosystems), saves utility costs, and reduces scope 3 emissions from upstream and downstream water treatment. Additionally, climate change is projected to worsen the intensity and frequency of droughts, making water conservation a climate adaptation strategy in many places (73,74).

Actions to reduce water consumption in clinical laboratories include:

- Optimize laboratory processes:
    - minimize water use in protocols to reduce unnecessary water use (e.g., consider whether dilutions or rinses can be minimized)
    - consolidate rinses to avoid rinsing multiple times (i.e., use a single rinse or recycle rinse water, where appropriate)
    - eliminate single pass cooling (common in older walk-in fridges and freezers) and replace with a closed loop
- Explore low-flow faucets or devices that reduce flow for lab sinks
- When the tap isn't actively being used, it shouldn't be running. If there are faucets that are routinely running for hot or cold water, investigate whether there is a plumbing solution (e.g., recirculation pump) or appliance that could provide desired water temperature on demand
- Monitoring use (i.e., sub-metering) to identify leaks and excessive consumption (e.g., comparing usage data to similar labs)
- Consider water efficiency and use of rejected water when producing or purchasing purified water (reject water is water that doesn't make it into the final purified water).
- Create awareness campaigns to encourage water-saving behaviour among staff.
- Dishwashers, laundry machines and autoclaves should only be run when full to reduce the overall number of loads.
- Procure water-efficient equipment (e.g., Watersense and Energy Star appliances).

IMPROVE WASTEWATER QUALITY SENT FOR MUNICIPAL TREATMENT

Proper disposal of chemicals in clinical laboratories is critical for environmental safety. While clinical laboratories have liquid waste disposal guidelines to manage hazardous chemicals, there remain instances of improper disposal. For example, slide stainers utilize various chemical reagents, including eosin, thionin, and methanol, which should not go down the drain (75-77). Some laboratories dispose of this chemical waste down the drain, flushing it with tap water (also increasing water consumption).

The federally required minimum level of wastewater treatment is called secondary treatment, which breaks down organics to reduce the eutrophication potential of the wastewater and remove suspended solids (78).

Most municipal wastewater treatment plants in Canada do not focus on removal of chemicals from wastewater (78,79). Water-polluting industries are often required to pre-treat their wastewater for that reason. However, it does not appear to be common for hospitals to have pre-treatment systems (80-82). Research is only beginning to measure and evaluate the impacts of chemicals that make it through wastewater treatment systems into the environment 83,84).

Improve the quality of wastewater by ensuring lab staff follow existing chemical disposal guidelines and know to avoid disposing chemicals down the drain, even in small quantities. Some immediate actions are:

- Review liquid waste disposal guidelines to ensure they include recommendations for management of chemical waste in clinical laboratories.
- Run a 'Down the Drain' campaign to promote awareness of acceptable liquid waste disposal.

Figure 6 is a simple solution for chemical waste disposal: a catch basin for slide stainer waste that gets collected as needed by a liquid waste management vendor.

Figure 6: Slide stainer liquid waste collection system after two weeks worth of collection. Photo credit: Christine Henderson

USE LOWEST APPROPRIATE GRADE OF WATER

High grade water is needed in clinical laboratories, however the processes that use it should be reviewed to ensure it is a necessity rather than a habit or belief. There are different classification systems for water grades (i.e., ATSM, ISO 3696:1987, CSLI), with types or grades differentiated by quality indicator thresholds rather than production methods (e.g., distilled, reverse osmosis, etc.) (85). This, in addition to variation within production methods, makes generalizing water grades and their associated environmental impacts imprecise. However, in simplified terms, the levels of water quality are (86):

- Feed water (potable tap water or other)
- Reverse osmosis water (Type III)
- Deionized water (Type II)
- Ultrapure (Type I)

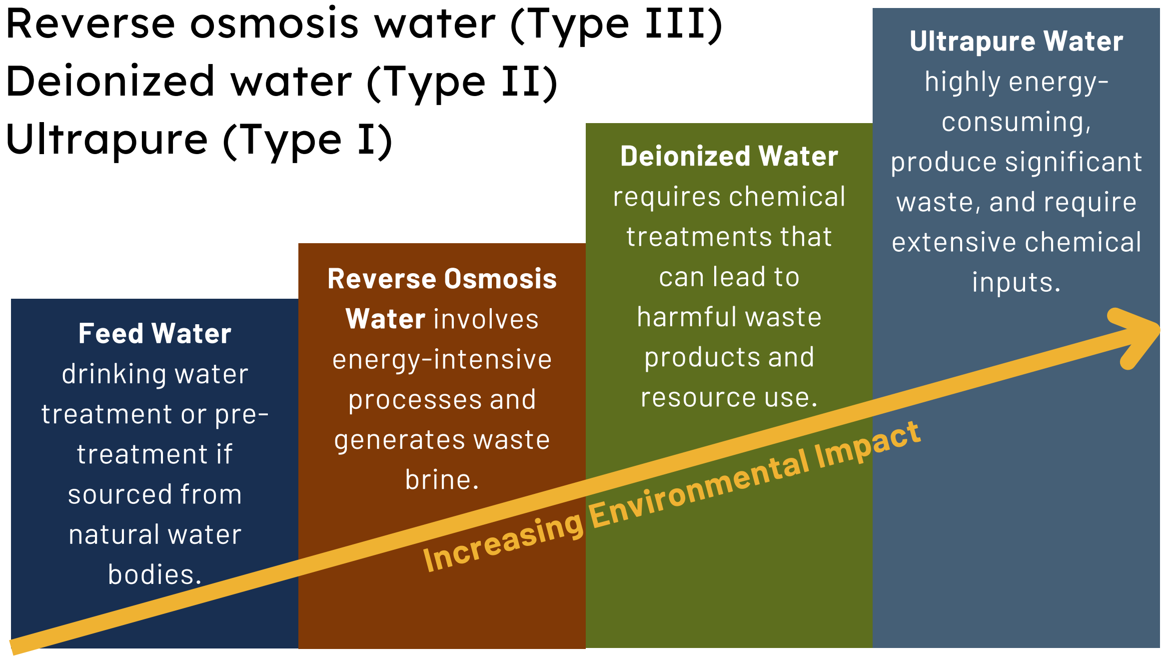


Figure 7: Grades of water purity in general order of environmental impact.

Sterile and distilled water is also used in some applications. Processing water to achieve these grades or sterility takes energy, among other resources, and often has an associated rejection rate (a waste stream that doesn't make it through).

Lower grade water may also be used as feed water to make higher grade water, compounding environmental impact. Generally, the higher grade the water, the greater its upstream environmental impact (Figure 7). The minimum grade required should be used to avoid excess cost and environmental impact.

REJECTION RATES

Reverse osmosis water may reject as much as 50-80% of the feed water used to make it; distilled water may reject 89% and also has relatively high energy requirements (86,87). Look for consideration of water efficiency and use of reject water when procuring graded water or selecting a purification system.

Rejected water commonly goes down the drain, where it adds to and becomes contaminated with wastewater. Reject water may be safe for use (especially if it came from a potable source), for instance for toilet flushing, irrigation or laundry.

RESOURCES:

- Top 9 Actions to Take in the Lab to Improve Water Efficiency, My Green Lab
- Balancing Lab Water Purity with Sustainability, Lab Manager
- Best Practices Guide Water Efficiency in Laboratories, I2SL & United States Environmental Protection Agency
- Make Every Drop Count, Lab Manager
- Water Module, My Green Lab Accredited Professional Course
- Lab Drain Disposal Guidance, The University of Alabama at Birmingham
- Water: page 27 of CASCADES' Sustainable Kidney Care playbook (includes links to resources about reuse of reject water)

Procurement and Supply Chains

PRACTICE SUSTAINABLE PROCUREMENT

Supply chains are estimated to be responsible for 50% to 75% of health care's greenhouse gas emissions, due to the life cycle impacts of purchased products and services (88). As a broad, complex area, sustainable procurement is not always straight forward. With the goal of minimizing harm to people and the planet in a financially sustainable way, the best path forward is situation dependent. Despite that, here are general principles for sustainable procurement:

ENSURE THE PURCHASE IS NECESSARY

Keeping good inventory of lab equipment and sharing resources across a hospital or health authority can reduce purchases. Ask around if it's something another site or department may have excess stock of, especially if it expires. Track and review expiry regularly.

PRIORITIZE QUALITY

The longer an item is in use, the fewer items need to be produced, which is better for the environment. Quality items can have higher upfront costs but may cost less to own, requiring less maintenance, fewer replacements, and/or fewer resources to operate. The laboratory can save money over time.

COLLABORATE WITH VENDORS

Ask suppliers about the sustainability of products already being purchased and inquire about more sustainable options. Asking about sustainability encourages the industry to change (89). Inform vendors of your organization's sustainability goals.

PACKAGING TAKEBACK PROGRAMS

Suppliers may be open to having their packaging materials returned to them for reuse.

MANAGE INVENTORY

Use the oldest product first and check the very back. Having one person responsible for ordering and receiving can reduce purchase duplications (88). Engage all lab members in keeping product inventory up to date.

REFILL

Empty product containers could be switched out and refilled instead of discarded. Explore whether local refilleries could fulfill contracts to refill soaps, isopropyl alcohol or other supplies to support local economies while reducing waste. Alternatively, establish refill programs with existing suppliers.

NO UNNECESSARY TECHNOLOGY

Mechanical equipment can be better than electronic from a sustainability and cost perspective, achieving the same job without electricity or electrical components, and likely with less maintenance and fewer replacements. For instance, faucets can be hands-free using a foot or knee pedal instead of a sensor (e.g., Tapmaster). Another example is paper towel dispensers, which can have each paper towel pull out the next, without electricity or microcontrollers.

CONSOLIDATE ORDERS FROM VENDORS

Restricting orders from a given vendor to one day per week department or facility-wide could reduce transportation emissions (89). If supplies are automatically ordered when a minimum threshold is reached, see if the system can identify other products near the threshold to include in the order to consolidate shipping.

BUY SECOND-HAND OR RECLAIMED

Purchasing used, refurbished equipment or products made from reclaimed materials (e.g., recycled solvents, products with recycled plastic content) reduces the demand for new materials.

PRIORITIZE RESOURCE EFFICIENT EQUIPMENT

This applies to any inputs required by equipment (e.g., energy, water, stains). Look for third party certifications for efficiency.

PURCHASE IN BULK

This consolidates shipping, reducing emissions and packing materials. Purchasing larger container volumes can also reduce plastic waste over time. Explore splitting bulk orders with other departments/sites to prevent expiry.

SHARE INSIGHTS

If you find a sustainable alternative for a product, let your colleagues know.

ECOLABELS

Ecolabels are badges that indicate desirable environmental or social performance for a product or company. The best Ecolabels are third party certified (unbiased) and have transparent criteria that the product must meet prior to using the label. Such trusted Ecolabels simplify sustainable procurement, as buyers can be sure that the product is preferable (Figure 8).

My Green Lab has a lab-specific ecolabel, ACT, which is an 'eco-nutrition label' for lab products. See the ACT label database for a list of certified products. The list of products is growing and includes three major categories: chemicals, consumables, and equipment.

Explore eco-labels
Click here

Figure 8: A reference guide to eco-labels

RESOURCES:

- Sample Generic Letter to Supplier, Canadian Coalition for Green Health Care
- CASCADES A Reusables First Approach to Sustainable Procurement Playbook
- Sustainable Procurement: A Guide to Ethical Purchasing course offered on Udemy
- Procurement module, My Green Lab Accredited Professional course
- ACT label database, My Green Lab
- Refilleries Across BC, Zero Waste BC
- Sustainable Procurement Toolkit, Sustainability Advantage
- Sustainable procurement guidelines, University of California
- Green Lab Supplies and Lab Equipment Guide, labconcious
  - Includes product recommendations for green chemistry, waste reduction, saving energy, water conservation and cleaning supplies
- The Canadian Collaboration for Sustainable Procurement (CCSP)
- Sustainable Purchasing Guidance: Laboratory Supplies and Services, Sustainable Purchasing Leadership Council
- Sustainable Procurement Factsheet - Laboratory Equipment, Western University

INTEGRATE SUSTAINABLE PROCUREMENT FROM THE TOP-DOWN

INCLUDE ENVIRONMENTAL SUSTAINABILITY IN THE RFP PROCESS

Often, companies go through a bidding process to become vendors, called the Request for Proposal (RFP) process. It is a standardized process with defined scoring criteria to fairly determine the best option for contracting services. Scoring criteria should include environmental sustainability considerations. England's National Health Service (NHS) has already done this. Their procurement scoring now includes a minimum of 10% net-zero and social value weighting (90).

Include environmental criteria in RFP scoring for:

- The sustainability of products themselves and their manufacturing and distribution processes.
- Suppliers' sustainability certifications, policies, and commitments (and progress).

PROMOTE PURCHASE OF SUSTAINABLE PRODUCTS IN EXISTING PROCUREMENT PLATFORMS

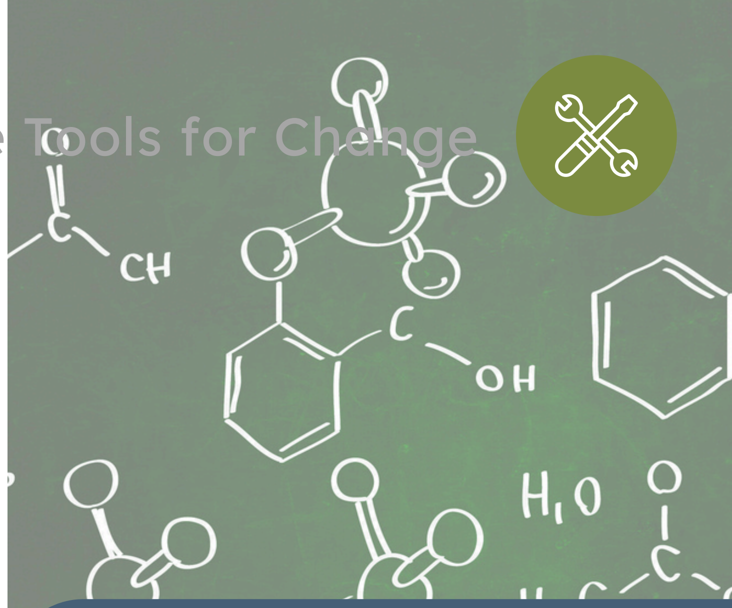
In alignment with existing procurement platforms, build internal resources or ways to promote environmentally preferred products:

- Indicate ecolabels of products or suppliers
- Indicate the sustainable option as the organization's preferred product
- Customize search results so that sustainable options are listed first
- Restrict options to the sustainable product only
- Auto-substitute equivalent products for the sustainable alternative upon purchase

CONSIDER LIFE CYCLE COSTS

Formalize the consideration of life cycle costs rather than purchase price alone for all products (e.g., equipment, consumables versus reusables, furniture) (92). Life cycle factors include: time duration product is expected to last, cost of use (e.g., energy or chemical input), and costs of maintenance and disposal. Highlight improvements to water, energy or other resource efficiency in the business case.

"Vendors should be selected based on considerations for material selection, manufacturing, processing, packaging, shipping and other factors that impact the carbon footprint of products and services." - Interior Health Climate Change and Sustainability Roadmap (91)



CONSIDER GREEN CHEMISTRY

Green chemistry is about finding chemical alternatives that perform just as well if not better, are cost competitive and are more sustainable (92).

Drs. Paul Anastas and John Warner developed the 12 Principles of Green Chemistry in 1998 (93).

Although these principles are mainly geared at research and chemical manufacturing laboratories, clinical laboratories can use them to evaluate chemicals purchased:

- labconcious lists green chemistry products with explanations of sustainable attributes
- Millipore Sigma has a product filter for green chemistry alternatives

1. **PREVENTION.**
   Waste prevention is efficient and cost effective.
2. **ATOM ECONOMY.**
   Goes beyond percent yield in synthesis reactions to optimize the amount of reactants converted into products.
3. **LESS HAZARDOUS CHEMICAL SYNTHESES.**
   Use and generate fewer hazardous chemicals.
4. **DESIGN SAFER CHEMICALS.**
   Design less toxic products with the same efficacy.
5. **SAFER SOLVENTS AND AUXILIARIES.**
   Minimize the amount of solvents or other chemicals needed and choose the least toxic alternatives.
6. **DESIGN FOR ENERGY EFFICIENCY.**
   Opt for reactions that occur at ambient temperature and pressure.
7. **USE OF RENEWABLE FEEDSTOCKS.**
   Where possible, synthesize chemicals from renewable (better yet, rapidly renewable (e.g., hemp or bamboo as compared to wood) or biowaste (e.g., sugarcane bagasse)) feedstocks instead of non-renewable feedstocks like petroleum.
8. **REDUCE DERIVATIVES.**
   Reduce need for derivatization (modifying chemical structure), especially through use of enzymes.
9. **CATALYSIS.**
   Use catalysts to improve environmental performance.
10. **DESIGN FOR DEGRADATION.**
    Use chemicals that break down at the end of their useful life into innocuous products.
11. **REAL-TIME ANALYSIS FOR POLLUTION PREVENTION.**
    Monitor reactions to enable adjustments as needed.
12. **INHERENTLY SAFER CHEMISTRY.**
    Minimize accident consequences through chemical choice.

RESOURCES

- Safety Data Sheets: Section 12 (Ecological Information) and 13 (Disposal Considerations) may contain insights on the sustainability of a chemical
- The US EPA's Safer Choice Ecolabel can be a good indicator for more sustainable products. Their website has a Safer Chemical Ingredients List
- Sustainable Chemistry, Millipore Sigma
- Green Chemistry Accredited Professional course module, My Green Lab
- Putting Innovation into Action for a Sustainable Future, ACS Green Chemistry Institute

HOW

The Strategy for Change

Staff Engagement → Collaboration → Quality Improvement → Leadership & Governance

Staff Engagement

Some staff concerned about sustainability are already making efforts in their clinical laboratories. However, they need organizational support to implement sustainable infrastructure (e.g., recycling). Where choice is involved, staff participation is also needed to make that infrastructure work (e.g., waste segregation).

Formalizing sustainability efforts and providing opportunities for staff to contribute maximizes the impact of new and existing sustainability efforts, while making staff feel heard and part of a team that is making a difference.

Creating sustainability engagement, collaboration, and training opportunities for laboratory staff across all levels can increase the uptake and acceptability of changes and generate solutions that work for everyone.

Ensure laboratory staff leaders, managers, procurement specialists, and physicians are aware of and supporting sustainability efforts. It is vital to ensure that those who oversee laboratory operations are well-informed about and approve sustainable changes. Having leadership on board clears barriers and helps ensure sustainable changes are done right the first time.

Examples of actions that leadership is uniquely positioned to facilitate are on the leadership-focused lab action checklist on page 40.

RESOURCES

- My Green Lab Freezer Challenge: promotes sustainable freezer maintenance
- Using Labs Wisely: national consortium that aims to make a measurable impact on reducing low-value lab testing in Canada
- My Green Lab Certification: assess baseline sustainability practices, implement recommended changes and re-evaluate performance

STAFF TRAINING, ROLES AND LAB PERFORMANCE

Fostering a sustainable laboratory environment begins with empowering staff to understand and prioritize sustainability in their daily work. By providing training opportunities, integrating sustainability into job descriptions, and incorporating environmental metrics into quality assessments, labs can align their operations with sustainable development goals. This approach not only builds awareness but also creates accountability and drives continuous improvement.

Training

Provide opportunities for lab staff to learn about sustainability. Awareness and interest can spread!

Roles

Integrating sustainability into job descriptions assures staff that they can spend time on sustainability (example here)

Lab performance

Integrate environmental sustainability metrics into annual lab quality improvement assessments to track progress and create accountability.

RESOURCES

- Reducing the Environmental Impact of Clinical Laboratories, LabCE: This $25 USD course guides evaluating environmental impact and creating an environmental management plan in clinical labs.
- My Green Lab Ambassador Program: A free online crash course in lab sustainability with an emphasis on behavioural changes that promote sustainable operations. It is designed to be a first step for laboratory professionals who are motivated to make their lab more sustainable.
- My Green Lab Accredited Professional Course: A six-module paid course for people who support or work in laboratories to dive deeper into lab sustainability. The modules are: waste, green chemistry, procurement, engagement, energy, and water.

Collaboration

SUSTAINABILITY AS AN ONGOING TOPIC

Provide opportunity to share sustainable practices in action - add sustainability to the agenda of recurring laboratory staff and leadership meetings to discuss questions, practices, changes, and opportunity areas to share and develop solutions.

COORDINATE EFFORTS

There are energy, procurement and facilities teams, and standards organizations, among others, in control of and working on upgrades to clinical laboratory buildings and workflows. Collaborating with these internal and external teams will accelerate sustainable change.

CREATE A LAB SUSTAINABILITY WORKING GROUP

A Laboratory Sustainability Working Group can connect those interested in sustainability across an organization. Coordinating sustainability efforts across a working group can:

- avoid reinventing the wheel
- ensure changes align with policies and requirements
- allow for collaborative problem solving
- accelerate spread of quick wins
- synchronize the asks of leadership

EXPERIENCE SPOTLIGHT:

INTERIOR HEALTH, BC

The Interior Health Laboratory Services department has formed a “Environmental Lab Sustainability Focus Group”, made up of interested Lab Services staff from across the health authority. They meet every other month to discuss and implement sustainable change and have representation from many different roles (e.g., Medical Laboratory Technologist and Assistant, Safety Officer, Business Consultant, Laboratory Information Systems, Environmental Sustainability, Laboratory Quality, Pathologist), which has been invaluable.

CREATE ACTION CHECKLISTS

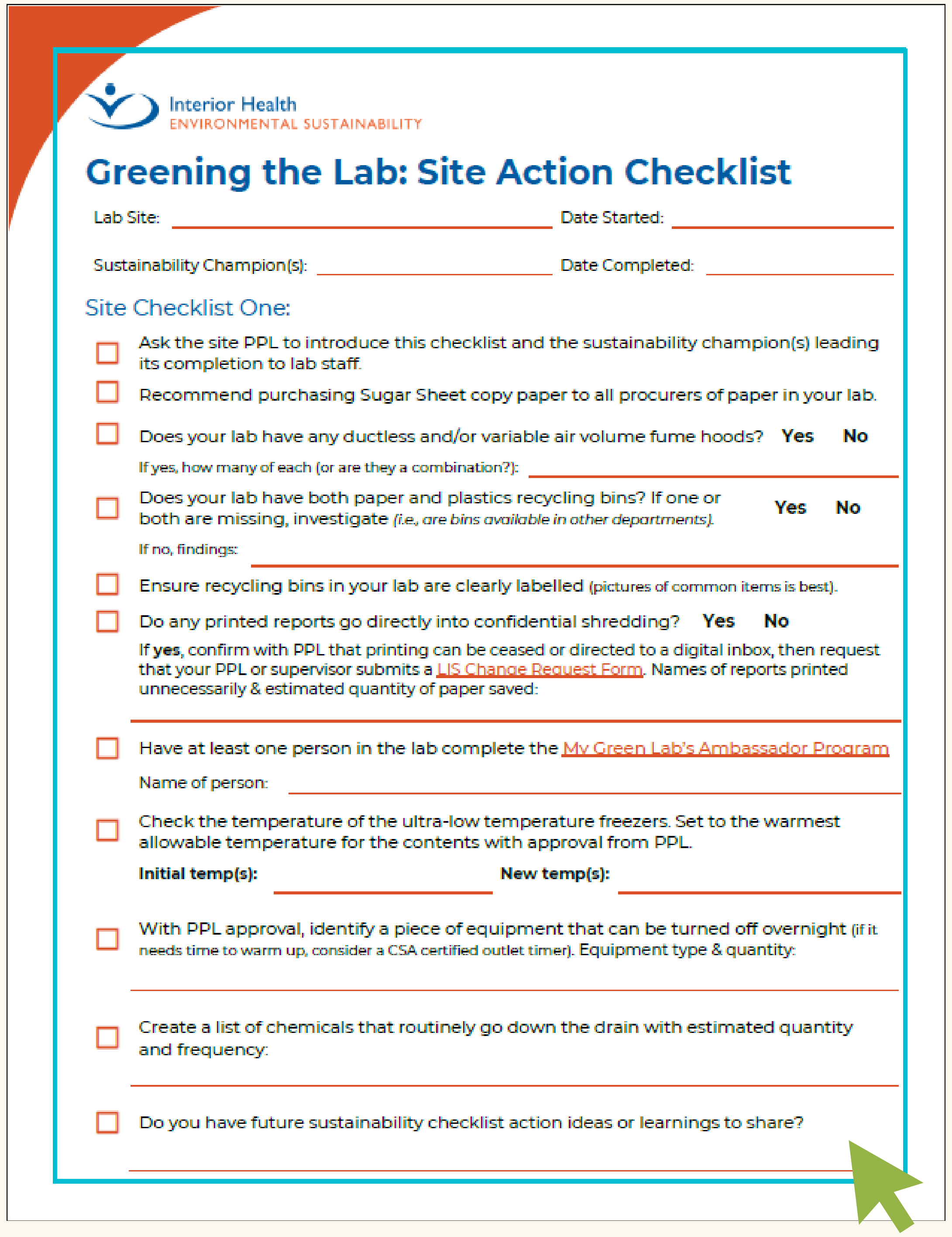
Checklists can function as tools to gather information, implement quick wins, and work toward more involved changes. Information gathering is a good way to start. Design checklists to be actionable, meaning that the checkbox is dependent on the action taken by staff rather than the outcome. Checklists for both the site and leadership level leverage different spheres of influence.

Due dates are helpful motivation and tracking who completed the checklist allows for follow-up questions. Designating a site Sustainability Champion, akin to a Health and Safety Lead, assigns responsibility for checklist completion.

EXPERIENCE SPOTLIGHT:

INTERIOR HEALTH, BC

As part of Interior Health's Greening the Lab initiative, members of the Environmental Lab Sustainability Focus Group serve as environmental champions at their home sites, completing checklists developed by the Environmental Sustainability team in collaboration with laboratory leaders, to move initiatives forward at the site level. They are also working towards completing a regional Laboratory Steering Committee (LSC) checklist to support actions requiring system-level change or larger projects.



Interior Health
ENVIRONMENTAL SUSTAINABILITY

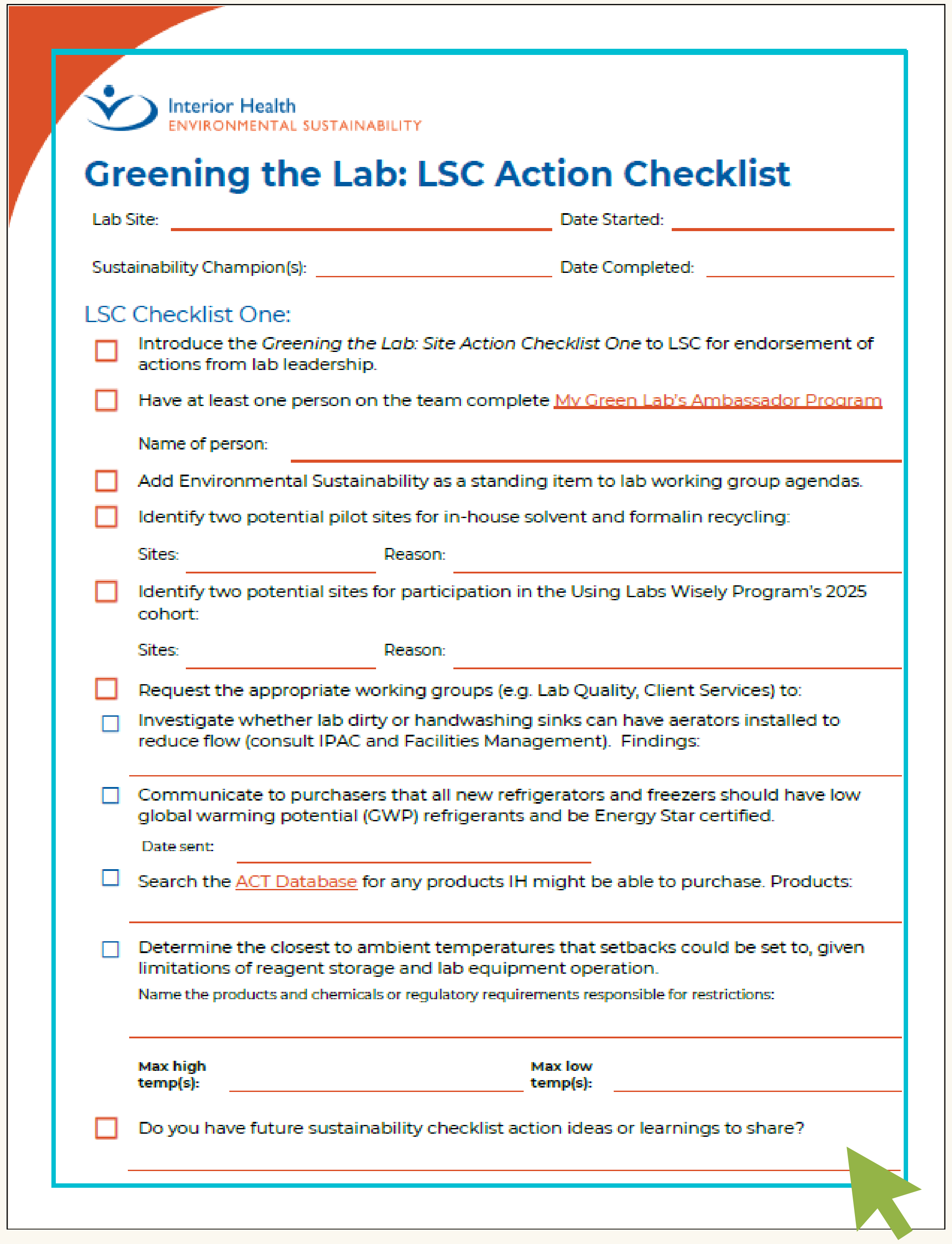
Greening the Lab: Site Action Checklist

Lab Site: ______ Date Started: ______

Sustainability Champion(s): ______ Date Completed: ______

Site Checklist One:

- ☐ Ask the site PPL to introduce this checklist and the sustainability champion(s) leading its completion to lab staff.
- ☐ Recommend purchasing Sugar Sheet copy paper to all procurers of paper in your lab.
- ☐ Does your lab have any ductless and/or variable air volume fume hoods? **Yes** **No**
  If yes, how many of each (or are they a combination?): ______
- ☐ Does your lab have both paper and plastics recycling bins? If one or both are missing, investigate *(i.e., are bins available in other departments).* **Yes** **No**
  If no, findings: ______
- ☐ Ensure recycling bins in your lab are clearly labelled (pictures of common items is best).
- ☐ Do any printed reports go directly into confidential shredding? **Yes** **No**
  If **yes**, confirm with PPL that printing can be ceased or directed to a digital inbox, then request that your PPL or supervisor submits a LIS Change Request Form. Names of reports printed unnecessarily & estimated quantity of paper saved: ______
- ☐ Have at least one person in the lab complete the My Green Lab's Ambassador Program
  Name of person: ______
- ☐ Check the temperature of the ultra-low temperature freezers. Set to the warmest allowable temperature for the contents with approval from PPL.
  Initial temp(s): ______ **New temp(s):** ______
- ☐ With PPL approval, identify a piece of equipment that can be turned off overnight (if it needs time to warm up, consider a CSA certified outlet timer). Equipment type & quantity: ______
- ☐ Create a list of chemicals that routinely go down the drain with estimated quantity and frequency: ______
- ☐ Do you have future sustainability checklist action ideas or learnings to share? ______



Interior Health
ENVIRONMENTAL SUSTAINABILITY

Greening the Lab: LSC Action Checklist

Lab Site: ______ Date Started: ______

Sustainability Champion(s): ______ Date Completed: ______

LSC Checklist One:

- ☐ Introduce the *Greening the Lab: Site Action Checklist One* to LSC for endorsement of actions from lab leadership.
- ☐ Have at least one person on the team complete My Green Lab's Ambassador Program
  Name of person: ______
- ☐ Add Environmental Sustainability as a standing item to lab working group agendas.
- ☐ Identify two potential pilot sites for in-house solvent and formalin recycling:
  Sites: ______ Reason: ______
- ☐ Identify two potential sites for participation in the Using Labs Wisely Program's 2025 cohort:
  Sites: ______ Reason: ______
- ☐ Request the appropriate working groups (e.g. Lab Quality, Client Services) to:
  - ☐ Investigate whether lab dirty or handwashing sinks can have aerators installed to reduce flow (consult IPAC and Facilities Management). Findings: ______
  - ☐ Communicate to purchasers that all new refrigerators and freezers should have low global warming potential (GWP) refrigerants and be Energy Star certified.
    Date sent: ______
  - ☐ Search the ACT Database for any products IH might be able to purchase. Products: ______
  - ☐ Determine the closest to ambient temperatures that setbacks could be set to, given limitations of reagent storage and lab equipment operation.
    Name the products and chemicals or regulatory requirements responsible for restrictions: ______
    Max high temp(s): ______ **Max low temp(s):** ______
- ☐ Do you have future sustainability checklist action ideas or learnings to share? ______

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Quality Improvement

The quality of health care and environmental sustainability are interconnected. Without considering the environmental impact of health systems, progress in improving health outcomes for individuals and communities is opposed, both in the present and over time. To deliver high-quality care, efforts to enhance quality must include a focus on sustainability.

A FRAMEWORK FOR SUSTAINABLE QUALITY IMPROVEMENT

The Sustainability in Quality Improvement (SusQI) approach holistically incorporates sustainability into existing quality improvement frameworks.

CASCADES has created a framework for considering the ways in which environmental sustainability permeates the six fundamental domains of quality in health care (safety, patient centredness, effectiveness, efficiency, equity and timeliness) (Figure 9). Rather than considering sustainability as a separate dimension, sustainability is positioned as an interconnected, cross-cutting theme across all dimensions of quality, making the case that environmental sustainability is a prerequisite, goal and outcome of high-quality care.
To read more about how to integrate sustainability into health-care quality, check out the playbook.

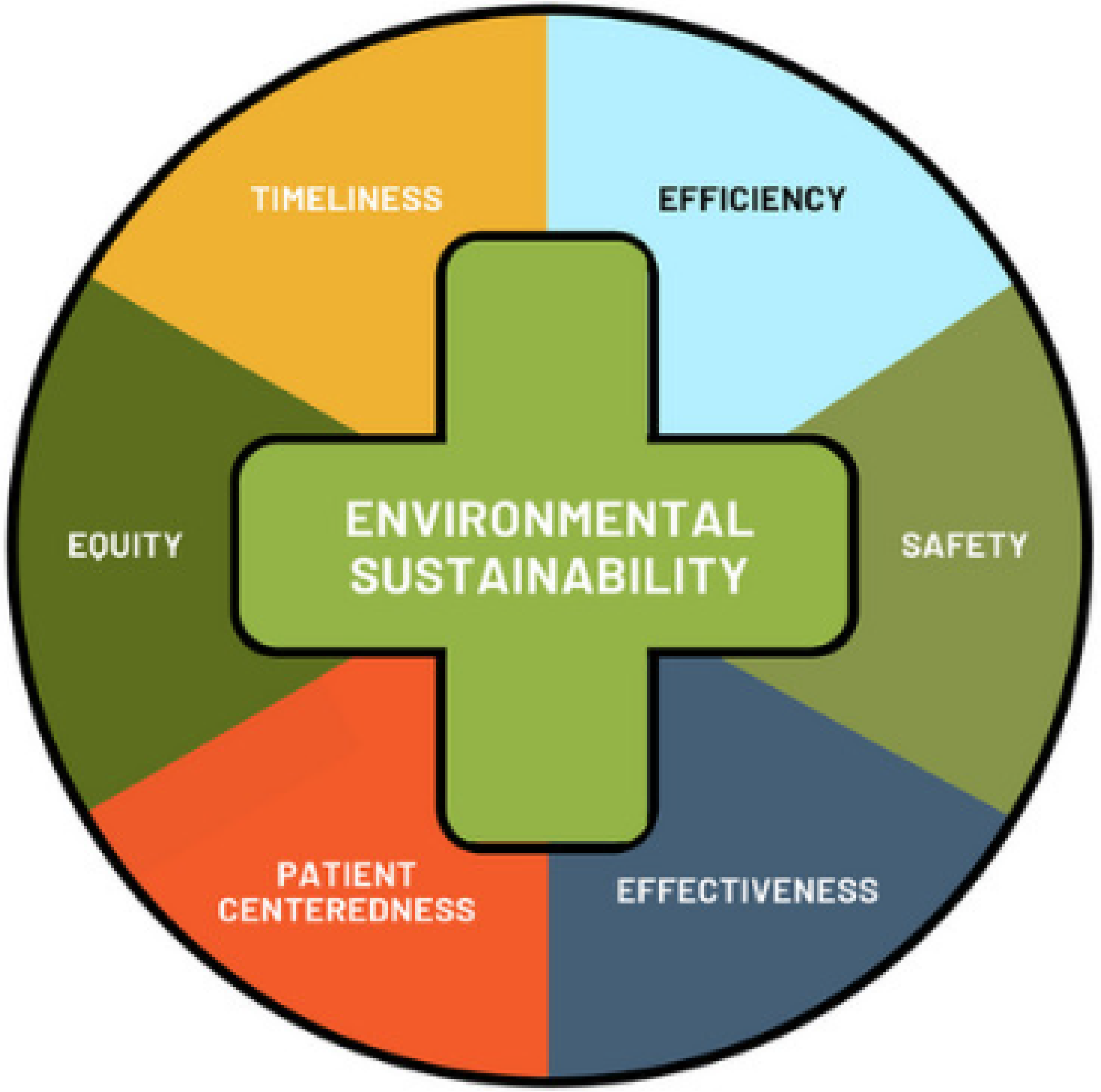

Figure 9: Integrating sustainability across the quality dimensions (CASCADES)

Leadership and Governance

Leadership and good governance are needed to develop and deliver effective climate and sustainability strategies.

Leaders and executives play a pivotal role in shaping health systems that are resilient and sustainable. Achieving this requires prioritizing key actions through thoughtful planning and collaboration:

ASSESS RISKS AND OPPORTUNITIES

Conduct detailed audits of resource use, energy consumption, and waste production to understand the environmental footprint. These findings should be used to target the most pressing challenges with effective sustainability measures.

BUILD ON EXISTING EXPERTISE

Evaluate successful initiatives, such as efforts to reduce greenhouse gas emissions and improve waste management. Sharing best practices across departments fosters a culture of continuous improvement and innovation.

ENGAGE TEAMS

Involving clinical and management teams early allows organizations to leverage their operational knowledge. Ensuring that proposed solutions are practical helps build buy-in and increases success.

FORM STRATEGIC PARTNERSHIPS

Early engagement with interested parties (e.g., Infection Prevention and Control) saves time in the long run. Collaborations with external organizations, including environmental groups, research institutions, and community organizations, can amplify impact. Partnerships might support renewable energy projects or enhance waste segregation programs.

ADVOCATE FOR POLICY CHANGE

Leaders should work to influence policy at local, regional, and national levels to secure regulations and funding that support sustainable health-care practices. Advocacy helps bridge the gap between ambitious goals and current restrictions.

EMBED SUSTAINABILITY IN STRATEGY

Sustainability should be integrated into strategic plans with measurable outcomes. Mechanisms for regular progress reporting must be established to ensure transparency and accountability.

COMMUNICATE PRIORITIES

Organizations should emphasize that environmental performance is a priority beyond cost reduction. Clearly communicating this commitment fosters a sense of shared purpose among staff and empowers them to contribute actively to sustainability goals.

RESOURCES:

- CASCADES, Strategic Planning for Sustainable Healthcare
- Environmental Stewardship: An Implementation Guide for Boards, Executive Leaders and Clinical Staff, Canadian Coalition for Green Health Care

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