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CADTH Horizon Scan

Reducing the Environmental Impact of Clinical Care

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Abbreviations

LCA	life cycle assessment
MDI	metered dose inhaler

Key Messages

- This report summarizes emerging activities that aim to improve the environmental sustainability of clinical care and help mitigate climate change. It signals to decision-makers opportunities to reduce health care's environmental impact, including ensuring the appropriate use of health care, reducing unnecessary health care, and rethinking and researching what and how health care is provided.
- This report describes initiatives identified in the literature across areas of health care, including operating rooms and surgical services, anesthetics services, dialysis, virtual care, and single-use medical supplies, among others, which are emerging to address environmental sustainability and climate change.
- The impact of health care on the environment and climate is significant. Many health systems, health facilities, and health care providers are working to reduce the environmental impact of clinical care. Striving to create environmentally sustainable health systems through activities such as the appropriate use of metered dose inhalers can achieve multiple goals, including cost savings, improving patient care, and reducing the environmental impact of care.
- Challenges such as the lack of data on the environmental impact of clinical interventions and devices remain. However, there are opportunities for engaging health care leadership, staff, and patients to develop and implement changes to make health care more environmentally sustainable. In the future, there may be greater opportunities to consider evidence on environmental impact alongside clinical and economic evidence, patient perspectives, social values, and ethics to support the delivery of clinically effective, cost-effective, and environmentally sustainable care.

Purpose and Scope

This Horizon Scanning report provides an overview of issues related to environmental sustainability and climate change in health care. It describes how clinical care is changing to mitigate climate change and become more environmentally sustainable by reducing the carbon and environmental footprint of health care, and orients decision-makers to emerging activities in this area. This report aims to provide an overview of activities across clinical care that aim to mitigate the environmental impact of health care by reducing the carbon and environmental footprint of health care systems. It is not a comprehensive or systematic review of all activities and initiatives that have been or are being undertaken, and does not address climate adaptation or resilience. It does not include a critical appraisal and is not intended to provide recommendations for or against a particular initiative or activity.

Pharmaceuticals are not a focus of this report; however, this report describes activities related to pharmaceuticals that were dominant in the literature (i.e., metered dose inhalers [MDIs]) or were related to a clinical intervention that was within scope (i.e., anesthetic services). Much of the activity of health care systems around reducing their environmental impact relates to infrastructure and systems that support direct clinical care. These include, for example, targeting direct sources of emissions such as energy consumption (e.g., making more energy-efficient buildings and reducing energy consumption), or changes

in food services (e.g., sourcing local foods to reduce travel distance, reducing food waste, and shifting to plant-based diets).[1] While these activities and sectors are beyond the scope of this report, they are important and highlight the diverse and multiple opportunities for climate mitigation activities in health care.

Methods

Literature Search Strategy

A limited literature search was conducted by an information specialist on key resources including MEDLINE, Embase, GreenFILE, the Cochrane Database of Systematic Reviews, the International HTA Database, and the websites of major health technology agencies in Canada and internationally, as well as a focused internet search. The search strategy comprised controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. The main search concepts were environmental sustainability and health care. No filters were applied to limit the retrieval by study type. Conference abstracts were removed from the search results. The search was completed on September 8, 2022, and was limited to English-language documents published since January 1, 2020. Regular alerts updated the search until project completion; only citations retrieved before December 9th, 2022, were incorporated into the analysis. Additional internet searching was used to identify activities and organizations relevant to jurisdictions in Canada.

Article Selection

One author reviewed the full text of all potentially relevant publications. Articles that described activities aimed at reducing the environmental impact of climate change, and that were about health care technologies and clinical interventions, were included as information sources in this scan. This project used CADTH's definition of health technologies, which focuses on medical devices and interventions that are patient-facing and that are intended to have a direct impact on patient outcomes. Articles about technologies such as information technology systems, energy and heating sources, and physical infrastructure, as well as articles that focused on health care systems adapting to climate change, were not included.

Peer Review

A draft version of this bulletin was reviewed by an expert in environmental sustainability in health care.

The Issue

Canada is warming at a rate 2 times faster than the global average, and the effects of climate change are having a tangible impact on the health of people living in Canada.[2] The Chief Public Health Officer's 2022 Annual Report outlines the many ways climate change is already affecting public health in Canada. Extreme weather events (e.g., flooding, landslides, wildfires), heat stress, reduced air quality, changes in the types and distribution of infectious diseases, threats to food and water quality, and safety and security are among the key climate hazards threatening human health.[2] Moreover, the health impact of climate change is not limited

to physical health. The impact of climate change on mental health is also growing, with people experiencing increased climate-related worry, grief, anxiety, and fear.[2]

The impact of climate change and the risks of climate affecting one's health are not equally distributed. In Canada, Indigenous Peoples are often at the front lines and experience the direct health effects of environmental degradation and climate change due to their close relationship to the land.[3] Influences on societal inequity, such as colonialism, poverty, and gender — and their intersections — can make people vulnerable to being exposed to, and at risk of being impacted by, climate impacts. Those experiencing societal inequities may be more sensitive to these impacts, with fewer resources and less capacity to adapt to them.[2]

As health care systems across Canada confront climate hazards such as wildfires and heat events, they are working toward adapting and becoming resilient to climate change. Health systems also contribute to climate change: health care, as a sector, is a significant source of greenhouse gases, air pollution, and waste.[4] Globally, Canada's health systems are the third most carbon-intensive system, after the US and Japan.[5] Within Canada, an estimated 4.6% of national greenhouse gas emissions can be attributed to health care.[6]

Major sources of emissions associated with health care systems include hospitals, drugs, and devices.[6] Hospitals and health care facilities are responsible for emissions in large part due to the electricity they consume, and account for an estimated 30% of the carbon (i.e., greenhouse gas) emissions attributable to the health care sector in Canada.[6] The next largest category of emissions includes those associated with the manufacture, delivery, and disposal of materials consumed by health care: it is estimated that the production of drugs and devices account for around 25% of the emissions attributable to health systems in Canada.[5,6] Beyond carbon emissions, drugs and devices also contribute to pollution and environmental contamination.[6]

Health systems stand to benefit from efforts to mitigate climate change as it will reduce their exposure to climate hazards and lessen the impact of climate change on people's health. Because they focus on people's well-being and health, health care systems are uniquely situated to take climate action and protect human and climate health.[3] In November 2021, Canada formally committed to the Health Program to build climate-resilient and sustainable low-carbon health systems at the United Nations Framework Convention on Climate Change Conference (COP26).[7] While activities related to adaptation and resilience of health systems are out of scope for this report, it is important to recognize that these areas are increasingly pressing given the intensity and frequency of climate hazards.

This report describes emerging activities that aim to transform clinical interventions and use of medical devices to mitigate climate change and reduce the environmental impact of health care. They highlight the diverse and multiple opportunities to design and deliver health care in a way that minimizes its environmental and climate impact.

Principles and Concepts Guiding Environmentally Sustainable Health Care

A variety of principles and concepts underpin initiatives to mitigate the impact of health care on climate change and the environment. Some concepts lend themselves toward system-wide thinking, while others toward a specific environmental impact (e.g., waste reduction), and many overlap or can be used concurrently. The principles and concepts described in this report are not comprehensive of all those available and in use and are presented as examples. Together they highlight the many opportunities to align health care design and delivery with environmental objectives.

One of the most common concepts employed at a health systems level is net zero emissions, which is focused on the carbon footprint of health care. Health care systems in several countries (e.g., the UK, Norway, and Spain) have signed onto Health Program goals of COP26 to make their health care systems net zero.[7] To be net zero typically involves ensuring that the amount of carbon emitted is no greater than the amount of carbon captured or sequestered. At its core, net zero is about a balanced carbon equation, where the carbon output is equal to carbon captured or removed. It requires identifying and measuring sources and amounts of carbon emissions, and can involve developing projects or initiatives (e.g., protecting nature against development, or reforestation) that offset carbon emissions.[8]

Another concept employed is planetary health which emphasizes the connections between human health and the planet. Its foundational premise is that human health and well-being over the long-term are dependent upon a healthy planet, which requires considering the planet as a system in which the health and well-being of living and nonliving systems are interdependent.[9] The concept has expanded into a field of study, but has also been used to develop a framework for sustainable health care systems.[10] This framework involves 3 principles, the first being to reduce the need and demand for health services by reducing the incidence and severity of disease. For example, an environmentally sustainable health system might leverage primary care's position to support disease prevention and health promotion.[3] The second principle is to ensure appropriate care and avoid unnecessary care. Reducing unnecessary care can include reducing unnecessary invasive testing when noninvasive techniques are indicated and available, or reducing unnecessary laboratory tests, and ordering and processing those that contribute to improved patient outcomes.[11,12] The third principle is to reduce health care emissions by addressing the environmental impact of health care itself. Most of the activities described in this report relate to ensuring appropriate care and reducing unnecessary care, and directly reducing the environmental impact of care itself.

Circular economy is a principle that brings the use and life cycle of resources into focus. Our current economy is largely linear, meaning that resources are extracted and used to make products, and are then disposed of as waste at the end of their life. In a circular economy, medical devices are designed to be reused and kept in circulation as long as possible, reducing waste and pollution.[13] Waste reduction is also the focus of the 5 Rs (reduce, reuse, recycle, rethink, and research), which adapted the 3 Rs (reduce, reuse, and recycle) for the operating room.[14] The principles of the 5 Rs are often cited as guiding changes in health care settings.[15] "Rethink and research" is similar to the circular economy, and support what care is delivered and how, including how natural resources are used in care.

Whether focused on carbon or waste reduction, these principles and concepts draw attention to the life cycle of medical devices beyond their point-of-use, including their manufacturing, shipping, storage, packaging, use, and disposal. They also highlight opportunities to align efforts to reduce the environmental impact of clinical care with other goals, including economic efficiencies and clinical effectiveness. Principles and concepts such as these can help inform what environmentally sustainable health care can look like and spark innovation in both medical devices and models of care.

Initiatives and Activities for Environmentally Sustainable Clinical Care

This section describes examples of activities designed to reduce the environmental impact and carbon footprint of clinical care. It highlights activities across clinical areas that are emerging within the published literature and is not exhaustive.

Inhaler Prescribing

Inhalers are frequently prescribed across care settings (e.g., primary care, tertiary care, and long-term care) for respiratory symptoms and illnesses, including asthma and chronic obstructive pulmonary disease. MDIs are most commonly prescribed and use hydrofluorocarbons, which are powerful greenhouse gases as propellants.[8] There are alternatives that have much lower greenhouse gas emissions, such as dry powder inhalers or soft mist inhalers.[16] While these alternatives are not suitable for all patients, limiting the use of MDIs to where they are absolutely necessary can substantially reduce greenhouse gas emissions. Evidence also suggests that switching away from MDIs can result in cost savings.[8,16]

Moreover, shifting from MDIs to alternatives provides an opportunity to improve patient care by focusing on appropriate prescribing. This can include ensuring that diagnoses are objectively confirmed (e.g., by spirometry or peak flow testing), and that the medications prescribed for continuous or maintenance use are necessary and appropriately indicated.[16] Additionally, teaching correct inhaler technique can improve the effectiveness of the medication being delivered and benefit patients.[17] Further, appropriate use can be part of a treatment plan that includes behavioural changes, which can help people to maintain their health (and reduce further health care usage).[8] Lastly, appropriate use includes disposal, and opportunities exist for inhaler disposal and recycling, which are particularly important for MDIs.[16] Hospitals and long-term care facilities can establish recycling programs, and for people living in the community, primary care centres and pharmacies can provide education and options for their proper disposal.[8]

Operating Rooms and Surgical Services

Surgical services are currently the most resource-intensive areas of clinical care,[18] and operating rooms represent 1 of the largest users of medical supplies and producers of medical waste.[19] Waste in the operating room largely consists of disposable products, such as gowns, gloves, surgical instruments and equipment, implants, and packaging.[20] Further, the use of anesthetic gases (described in the next section) is a major contributor to the carbon footprint of operating rooms and surgical services.

One way to reduce waste from operating rooms is to reduce the amount of surgical supplies that are prepared for surgical procedures but are not used and are therefore discarded. There are multiple ways to reformulate and streamline prepackaged kits and surgical packs to reduce waste; this can include preparing sets with the minimum required instruments for specific procedures, or removing items that are regularly thrown out and packaging them separately.[20-25] Prelabelled surgical trays can help reduce their unnecessary use, and for those surgical instruments that are reused and sterilized, reducing unnecessary use can avoid redundant sterilization and can increase their lifespan.[24]

Other options for reducing waste and emissions from energy consumption is to move less-complex procedures, where appropriate, from the high-resource use setting of the operating room to less-intensive settings such as outpatient surgery or clinics. Some evidence supports the observation that the same procedure produces less waste in other health care settings or venues than in the operating room.[21,25] This reduced resource use can also result in reduced health care expenditures and other health system benefits such as increased surgical capacity.[26]

Revisions to prepackaged kits and surgical packs or shifts in surgical settings will require careful planning and change management, and will need to consider care quality, efficiency, and capacity.

Anesthetic Services

Anesthetic services are a clinical area with direct carbon emissions. Anesthetic gases including nitrous oxide, sevoflurane, desflurane, and isoflurane are highly potent greenhouse gases, and their use in clinical care is a major direct source of greenhouse gas emissions.[22,27] As a result, they have been a target for reducing the environmental impact of health care.[22,27]

It is possible to substitute 1 type of gas for another to reduce the harm from emissions; for example, sevoflurane and desflurane can provide similar anesthetic effects, but desflurane is estimated to be 30 to 50 times more environmentally damaging in terms of its global warming potential.[21,27] Initiatives that have engaged anesthesiologists and their professional associations have led to substitution and reduced use of the most damaging anesthetic gases.[27,28] Some have suggested removing desflurane entirely from formularies.[21]

Similarly, there are technologies that capture anesthetic gases and reduce their release into the environment.[27,29] While in use at some hospitals in Canada, these technologies are in the early stages of development and adoption, and there remains uncertainty about how to process the gases that are captured.[27] This has led some to suggest they are likely to have less impact than avoiding or substituting the use of environmentally damaging anesthetic gases.[27]

Beyond shifting to anesthetic gases with a lower climate impact, there are opportunities to decrease or minimize the usage of volatile anesthetics and nitrous oxide, including considering which procedures can instead be done under local or regional rather than a general anesthetic. These alternative techniques have a much lower carbon footprint even though they use more consumables and can move clinical practice away from using greenhouse gases.[27] Clinical developments include the increasing use of local or regional anesthesia and total IV anesthesia and may offer patients quicker recovery time while reducing carbon

emissions.[22,27] For example, wide-awake local anesthesia with no tourniquet (WALANT) surgery has been found to lead to equal patient safety and satisfaction while reducing costs and environmental impact.[25] Developing best practices in anesthesia that are beneficial for patients and the planet can help improve the delivery of high-quality, lower environmental impact care.

Hemodialysis

Hemodialysis is another area where the environmental impact of clinical care is being identified and explored. The environmental impact of dialysis is largely due to the volume of water consumed and wastewater produced.[30] It has been estimated that water consumption in each session of hemodialysis may be as high as 500 litres.[30] This includes the dialysate used during the process of dialysis itself and the water that undergoes reverse osmosis filtration to remove contaminants before becoming dialysate. Many reverse osmosis systems currently in use are inefficient, with between 30% and 50% of the source water passing through the membrane, the remainder being rejected and going back into the water system as wastewater.[30,31] Newer systems have been developed where up to 80% of the source water passes through the membrane.[31] Some newer systems also have, as part of their design, a reduced number of single-use items to be disposed of.[31] Reducing the rate of dialysate flow, where clinically appropriate, can also lead to reduced water consumption and wastage.[15,28,32]

Recycling reverse osmosis reject water is the redirection of reject water to somewhere (e.g., storage tanks, grey water system) other than a wastewater drain. Reject water has been used, for example, for janitorial work, equipment sterilization, and landscape care.[30,32]

Home dialysis is not appropriate for all people requiring dialysis, but for those for whom it is a preference and appropriate, it is potentially an option for environmentally sustainable dialysis care. In addition to reducing emissions from travel to and from a dialysis centre, many home dialysis systems have a low rate of flow of dialysate, which reduces the amount of water being used.[31] However, these benefits may not be enough to make home dialysis a more environmentally sustainable treatment option depending on patients' dialysis routines, partly due to the large number of disposables used by currently available home systems.[30]

Virtual Care

Virtual care programs, which rapidly expanded due to the COVID-19 pandemic, offer a means to reduce carbon emissions by reducing patients' need for travel.[33,34] People seeking and receiving care can also experience direct economic benefit by not having to purchase parking, gas, and/or other transportation costs (e.g., public transit),[18,34] as well as not having to pay for or arrange child and/or elder care, time off work, and other life disruptions from the need to travel to medical appointments.[35] The reduced emissions associated with virtual care has been found to remain after accounting for increases in travel for staff and building energy consumption from the delivery of virtual care services.[33] While patient emissions may be reduced, to have a complete understanding of its environmental impact, a life cycle assessment of virtual care compared to in-person care is necessary to account for its environmental impact.[36,37]

Aside from reducing the need to travel for in-person visits, virtual care may be a model of care that supports the delivery of appropriate care and reduces unnecessary care and address environmental sustainability. For

example, teledermatology can reduce in-person visits and travel, but also improve access to those living in rural areas where dermatology services may not be available and travel costs may be significantly higher.[33] Further, it may also reduce unnecessary referrals to hospital specialists.[33] While virtual care may support reducing the carbon footprint of health care, there remains the need to assess the specific programs in terms of short- and long-term patient outcomes, and to ensure that they can serve equity-deserving populations.

Single-Use Medical Supplies and Devices

Many of the medical supplies and devices used in health systems are designed or approved for single use and are disposed of after that single use. This includes personal protective equipment such as gloves, masks, and gowns, which are often designed for single use, but it is a broad category of items and includes devices such as wound care products, cardiac catheters, and IV and blood transfusion bags and sets. In some settings, those items that are not used are disposed of if they are in a patient's room.[38] For example, many intensive care units (ICUs) in Canada require that all equipment brought into a patient's room, including unused equipment inside a nursing server cart, must be discarded after patient discharge.[38] In a survey of ICU policies and practices in Canada, staff reported a number of strategies used to reduce disposing of unused medical supplies such as tubes, dressings, and IV supplies. These included reducing stocking quotas in nursing server carts, bedside cabinets, and central supply rooms; moving supply carts and nursing server carts outside of rooms; and developing methods that allow for different levels of patient need. Some facilities engaged front-line staff and used group processes to determine minimum and maximum supply quotas and what should be stocked, while other facilities posted information on the cost of supplies with the hope of reducing their unnecessary usage.[38]

Personal protective equipment (PPE) is often single-use and used for infection control. However, there are opportunities to rethink its routine use, which sometimes includes settings or procedures where it may not provide a benefit. For example, nonsterile gloves are often not necessary and, because of their high volume of use, reducing their use can result in both cost savings and waste reduction.[17,39]

In many cases, switching from single-use to reusable devices has economic and environmental benefits.[40] This includes PPE such as surgical and isolation gowns;[41] clothes for clinical surface decontamination;[42] and operative supplies like applicators, packs, drapes, and reusable Vac-Lok patient immobilization systems.[43] Some health systems and settings are moving toward a preference for reusable devices over single-use devices or recycling,[8,43] as recycling is typically an energy-intensive process.[43] Similarly, sterilizing reusable instruments can be resource-intensive (using energy and water), highlighting the challenges of selecting alternative devices or processes.[20]

There are multiple regulatory processes that affect the reuse of medical devices, including the fact that most medical devices on the market are not approved for reuse. Once approved for reuse, there are additional regulatory approval and oversight processes for the reuse or reprocessing of medical devices.[44] Similarly, infection prevention and control policies can sometimes be seen as in tension with waste reduction.[38] Clinician perspectives on reusable devices can affect their uptake, and some clinicians have expressed a need for improved oversight of device reuse.[25] As a result of the complex cultural, practice, and policy environment, reducing the use of single-use devices (rather than reuse and/or reprocessing) may be a more

feasible and practical target for reducing their environmental impact. Many of the activities described in the section on operating rooms and surgical services are relevant to reducing the use of single-use medical devices. They also draw into focus the role for evidence-generation on clinical effectiveness and safety in tandem with measuring the environmental footprint of single-use versus reusable medical devices. A change in management approach will help with the implementation of initiatives and support successful shifts amongst all actors involved.

Procurement Opportunities for Environmental Sustainability in Clinical Care

Some health systems have developed procurement strategies to reduce the environmental impact and carbon footprint of their supply chains. While these activities typically go beyond the scope of medical supplies and devices used in clinical practice, there is an opportunity to use procurement processes to reduce the environmental impact of medical supplies and devices used directly in clinical care. Procurement can play a key role in influencing product selection and waste reduction. NHS Wales, for example, is prioritizing reusable products as the default over single-use products where clinically acceptable.[8] The NHS Wales strategy recognizes the complexity of doing so, and thus is proceeding on a case-by-case basis.[8] Procurement can also choose products with limited or no packaging, or those that have packaging that is recyclable or compostable.[43] Similarly, procurement processes are moving in line with extended consumer responsibility and can include requesting that manufacturers provide environmental information such as embodied carbon. Some have advocated that procurement work with manufacturers and suppliers have labelling or signage that makes the environmental impact of the device or product clear, as part of the purchasing process and as a way of ensuring appropriate use.[22]

Expanding the Recycling and Diversion of Medical Supplies and Devices

Many areas of health care generate waste during the delivery of clinical care. Improving waste sorting and recycling at point-of-use and disposal can reduce waste misclassification. This can be done through user-friendly collection bins, appropriate and consistent signage throughout a facility, and supporting education and training for staff.[15] Recycling programs can be expanded by collecting items such as paper or glass, items that are regularly put into waste but are not hazardous and can instead be recycled (e.g., pre-incision plastics),[15] or by developing procedures for handling multicomponent devices.[44]

Diverting waste from landfills or incineration can also reduce health care expenditures. An additional possibility for some medical equipment is the potential of donating it through established medical charities or other community organizations.[38] However, this can raise questions similar to those that arise in the landscape of single-use medical devices around safety and appropriateness. Nevertheless, it highlights opportunities to consider as ways of diverting waste and instead using products for their whole life cycle.

Rethinking and Research

Rethinking and research present opportunities to improve and tailor clinical care with the aim of reducing environmental impact while providing clinically effective care. It can involve exploring whether protocols can safely be shifted, or if there are alternative procedures or interventions that are equally beneficial for patient outcomes, costs, and reduce environmental impact. For instance, in research on alternative

radiation protocols, hypofractionated treatments that require fewer treatment days and visits compared with conventional fractionated treatments, have a lower environmental impact in part due to reduced emissions from patient travel.[43] Reducing the number of visits can have a positive impact on people receiving cancer care by requiring less support and less time to travel to care.

Waste reduction and diversion is another area ripe for research and redesign. There are opportunities to understand the hazards of waste and explore possibilities for recycling, including developing novel processes for products that currently lack recycling options.[28] By collaborating with manufacturers, health care providers and facilities can, for instance, revise the contents of disposable packs, reduce extraneous items to reduce waste,[23,31] and send signals that environmental considerations, including a life cycle view, are of value. This can include reduced packaging as well as improved product design.[23]

Challenges and Opportunities

Scaling up and Spreading Environmentally Sustainable Care Initiatives

There are opportunities to scale up and spread environmentally sustainable health care initiatives by engaging and educating health care staff. When designing and implementing initiatives, having representation from all types of health care staff (e.g., pharmacy, management, and sanitation services) can help to assure legitimacy and buy-in from all participants.[15,25,38] Education is important for the adoption of initiatives, and needs to be regularly updated to ensure new staff is trained and existing staff can refresh their training.[45] Lack of time for training and education is a significant barrier to environmentally sustainable care initiatives.[15]

Knowledge and training in environmental sustainability are important not only for those already working in the health care system but also for medical school faculty.[15] There may be benefits to environmental sustainability becoming embedded into medical school curricula.[46] Some specialties and medical schools have established sustainability fellowships to create champions who are able to develop initiatives to reduce the environmental impact of care.[17,47] Further collaborations across medical schools, research institutions, manufacturers, journals, and clinical associations can help create a network to support ongoing knowledge generation and translations.[28] The creation of forums for interdisciplinary collaborations with and integration of environmental scientists and sustainability management experts can harness expertise in environmental systems thinking.

Within Canada, most of the activities around environmentally sustainable clinical care are driven by champions and teams located within regional health authorities, hospitals, and clinics.[5] In general, few policies at the provincial and territorial level guide the health care systems toward reducing the environmental impact of health care.[5] Health care providers often cite having top-down mandates and policies for reducing the environmental impact of clinical care as motivating and supporting environmentally sustainable care initiatives.[15,48]

Aligning environmentally sustainable care initiatives with reduced costs and increased efficiency in resource use has been cited as a major motivator and facilitator of successful implementation.[38] This highlights the benefits and opportunities of positioning environmentally sustainable care initiatives consistent with and supportive of other values and objectives of health systems (e.g., resource efficiencies, quality care, and patient-centredness).[5] However, environmentally sustainable care activities can, at times, seem to conflict with the practical demands of health systems to adapt to climate change.[1] Synergizing health care activities and systems to align with all climate-related goals (i.e., mitigating climate change, adaptation to climate change, and becoming resilient) can require a process of iterative learning and collaboration across parts of a health system.[1]

Defining and Measuring Impact

One of the challenges in addressing the environmental impact of health care is measuring the effect of clinical interventions on the environmental footprint, both before and after environmental initiatives. Understanding the environmental impact of a clinical intervention or medical device typically requires considering its life cycle (i.e., from resource extraction through to disposal) across different metrics (e.g., water use, energy use, pollution, and carbon emissions). This information can then be compared across different clinical interventions or devices. There are several methods for evaluating the environmental impact of health care, including life cycle assessment (LCA), environmentally extended input-output analyses, and comprehensive environmental assessments, each with their respective strengths and limitations.[37,49] CASCADES Canada, Dalhousie University, and Brighton and Sussex Medical School have partnered to develop HealthcareLCA, a publicly accessible database designed to collect and share completed LCA environmental impact studies related to health care. The goal is to support the development of an evidence base around the environmental impact of health care that is accessible to researchers, health care providers, and decision-makers.[50] It is often not enough to look at 1 device or component within a clinical intervention (e.g., PPE). Instead, these assessments must be integrated with other data to create a full profile for alternative interventions. For example, comparing minimally invasive surgeries (i.e., laparoscopic, robot-assisted) and conventional methods requires accounting for more than the environmental impact of, for example, disposables, but also energy consumption, hospital stay, and travel time (among others).[18] Initiatives like HealthcareLCA are expected to identify knowledge gaps and research opportunities.[50] There is currently no topic-specific journal or annual conference, and there remain opportunities to build communities of scholars and health care planners for ongoing knowledge sharing and discussion.[51]

Waste audits are another tool that can be used to identify areas for waste diversion or waste management improvement.[20] They involve collecting and weighing the materials disposed after a procedure and how much is sent to each waste stream (e.g., landfilling, incineration, recycling, and composting).[20] This is another way of gathering information to support the planning and design of activities aimed at reducing the environmental impact of clinical care. Additionally, there are opportunities to use a quality improvement approach even with missing or incomplete evidence on environmental impact. Embedding environmental sustainability into ongoing quality improvement efforts can help monitor change.[22] Moreover, tracking change provides feedback to leadership and clinician teams and can encourage people to further engage with the activities and support the adoption and spread of initiatives.[23]

Final Remarks

The activities described in this report illustrate the breadth of clinical areas engaged and initiatives being explored to mitigate the effects of climate change and make health care more environmentally sustainable. Not all clinical areas or interventions are equal in their ability to reduce health care's environmental impact. Currently, activities to make clinical care environmentally sustainable are largely pursued and developed based on opportunities identified by champions and front-line staff, which are reinforced by facility or organizational policies. What is certain is that this is an area where momentum continues to build as health care acts to mitigate climate change. Productive dialogues across stakeholders involved in clinical interventions and devices can point to and advance shared goals, and deliver cost-effective, clinically effective, and environmentally sustainable health care. This includes opportunities — like those identified in the earlier section on rethinking and research — to rethink how and where clinical care is delivered, and rethink the design of medical devices to become more environmentally sustainable. While the initiatives here are those found in the clinical literature, drawing on the expertise of environmental scientists, sustainability management professionals, and others is likely to provide greater insight into and opportunities for environmentally sustainable health care. As the evidence base around the environmental footprint of clinical interventions and devices grows, there is an opportunity for health technology assessment agencies and health care decision-makers to adopt clinical interventions and devices based on patient, clinical, economic, ethics, and social values, as well as environmental considerations.[24] Increased investment and support from multidisciplinary research communities to assess the environmental impact of clinical care will help support future decision-making to meet these goals.

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