Module 6

Climate Change Toolkit for Health Professionals

Taking Action on Climate Change at Health Facilities

April 2019

ACME CAPE

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Preface

This toolkit consists of eight modules which have been prepared as stand-alone documents that can be read by themselves, but they have also been prepared to complement one another. It has been designed as a tool for health professionals and students in the health care and public health sectors who want to engage more directly on the issue of climate change as educators with their patients, peers and communities, and/or as advocates for the policies, programs and practices needed to mitigate climate change and/or prepare for climate change in their workplaces and communities.

Module 1 – Climate Change – Science, Drivers & Global Response provides an introduction to climate science and discusses the human activities that are contributing to climate change, the international commitments that have been made to address it, and where we are in terms of complying with those commitments.

Module 2 – Global Health Impacts of Climate Change summarizes the direct and indirect health impacts that are occurring, and are predicted to result from, climate change, on a global scale.

Module 3 – Climate Change Health Impacts across Canada summarizes the direct and indirect health impacts that are occurring, and that are predicted to occur, in the different regions of Canada.

Module 4 – Greenhouse Gas Emissions in Canada by Sector and Region discusses the volume of greenhouse gases emitted, and the trends in those emissions, from different sectors in Canada at a national, provincial and territorial scale.

Module 5 – Climate Change Solutions with Immediate Health Benefits discusses climate solutions that can produce fairly immediate health co-benefits for the jurisdictions that implement them.

Module 6 – Taking Action on Climate Change at Health Care Facilities discusses the climate mitigation and adaptation policies, programs and practices that can be adopted and implemented by health care institutions to reduce their greenhouse gas emissions and prepare for climate change.

Module 7 – Preparing for Climate Change in our Communities discusses the climate adaptation policies and programs that can be developed by public health units or municipalities to minimize the health impacts associated with climate change.

Module 8 – Engaging in Climate Change as Health Professionals discusses the different ways in which health professionals can educate and engage their patients, the public, their peers, and their communities on the health impacts of climate change, and the policies and programs needed to mitigate climate change and prepare for it.

Module 6 – Taking Action on Climate Change at Health Facilities

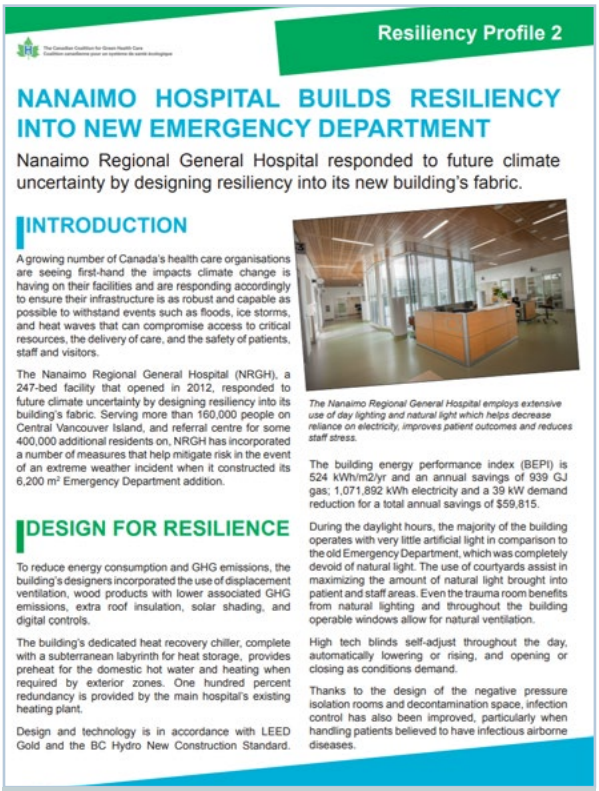
Introduction

This module is intended for health care professionals such as doctors, nurses, administrators, emergency responders, and other front-line health workers who are interested in learning more about how climate change will impact health care organizations and their facilities. Information is included on strengthening the health care facilities to be better prepared for climate change as well as reducing greenhouse gases (GHGs). Within this module are examples of initiatives, projects, policies and programs which can be promoted and implemented to help health care facilities become more sustainable and resilient as they adapt to anticipated climate-related impacts.

Support for Health Care Facility Action on Climate Change

While recognizing the important and vital link between health and climate change in general, the World Health Organization (WHO) and the Pan-American Health Organization (PAHO) are calling for health care facilities (HCFs) specifically to be more engaged in several specific ways (PAHO, 2017):

- Developing initiatives to become more resilient;
- Leading by example through reducing health systems' emissions of GHGs while promoting change in the entire health system supply chain;
- Making HCFs safer and more environmentally-sustainable;
- Focusing on making policies and processes adaptable to the changing climate;
- Training health personnel to recognize and understand the effects of climate



Resiliency Profile 2

NANAIMO HOSPITAL BUILDS RESILIENCY INTO NEW EMERGENCY DEPARTMENT

Nanaimo Regional General Hospital responded to future climate uncertainty by designing resiliency into its new building's fabric.

INTRODUCTION

A growing number of Canada's health care organisations are seeing first-hand the impacts climate change is having on their facilities and are responding accordingly to ensure their infrastructure is as robust and capable as possible to withstand events such as floods, ice storms, and heat waves that can compromise access to critical resources, the delivery of care, and the safety of patients, staff and visitors.

The Nanaimo Regional General Hospital (NRGH), a 247-bed facility that opened in 2012, responded to future climate uncertainty by designing resiliency into its building's fabric. Serving more than 160,000 people on Central Vancouver Island, and referral centre for some 400,000 additional residents on, NRGH has incorporated a number of measures that help mitigate risk in the event of an extreme weather incident when it constructed its 6,200 m² Emergency Department addition.

The Nanaimo Regional General Hospital employs extensive use of day lighting and natural light which helps decrease reliance on electricity, improves patient outcomes and reduces staff stress.

The building energy performance index (BEPI) is 524 kWh/m2/yr and an annual savings of 939 GJ gas; 1,071,892 kWh electricity and a 39 kW demand reduction for a total annual savings of $59,815.

DESIGN FOR RESILIENCE

To reduce energy consumption and GHG emissions, the building's designers incorporated the use of displacement ventilation, wood products with lower associated GHG emissions, extra roof insulation, solar shading, and digital controls.

The building's dedicated heat recovery chiller, complete with a subterranean labyrinth for heat storage, provides preheat for the domestic hot water and heating when required by exterior zones. One hundred percent redundancy is provided by the main hospital's existing heating plant.

Design and technology is in accordance with LEED Gold and the BC Hydro New Construction Standard.

During the daylight hours, the majority of the building operates with very little artificial light in comparison to the old Emergency Department, which was completely devoid of natural light. The use of courtyards assist in maximizing the amount of natural light brought into patient and staff areas. Even the trauma room benefits from natural lighting and throughout the building operable windows allow for natural ventilation.

High tech blinds self-adjust throughout the day, automatically lowering or rising, and opening or closing as conditions demand.

Thanks to the design of the negative pressure isolation rooms and decontamination space, infection control has also been improved, particularly when handling patients believed to have infectious airborne diseases.

Resliency profile #2 of Healthcare Energy Leaders Canada (HELC). Photo provided by Canadian Coalition for Green Healthcare.

change, and

- Using health personnel to advocate and act to reduce the climate footprint.

The Lancet Countdown on health and climate change report (Watts et al., 2018) states that "The public and the health systems they depend on are clearly unprepared to manage the health impacts of climate change" and calls on countries to increase the climate resilience of health infrastructure. At the same time, the Lancet authors call for health care sector emissions reporting and monitoring to "ensure a full transition to a healthier, more sustainable model of climate-smart and increasingly carbon-neutral health care".

In Canada, both the Canadian Medical Association (CMA) (CMA, 2010) and the Canadian Nurses Association (CNA) (CNA, 2017) have policy statements on climate change and call on their members to be advocates and champions. Canadian health-related organizations such as the CMA, CNA, CAPE, Canadian Public Health Association (CPHA), Canadian College of Health Leaders, Canadian Pharmacists Association, and the Canadian Coalition for Green Health Care (CCGHC), also support actions for an environmentally-responsible health sector, including carbon reduction, through signing on to the 2009 Joint Position Statement (JPS) (JPS, 2009).

St. Peter's Hospital in Melville SK. Photo by Derek Keller.

The JPS also calls for action by governments (to understand and address links between health and the environment and to incorporate these links into policy through legislation and budgetary actions), health care organisations (to take action by minimizing the negative impact on the environment and seek solutions to existing barriers), and those who work in the health sector (to both model and advocate for environmentally responsible approaches to delivering health care without compromising patient safety and care).

Climate-related Impacts on Canadian Health Care Facilities

Climate-related events are already impacting health care facilities (HCFs) in Canada (Waddington et al. 2013). The frequency and magnitude of severe weather events such as extreme heat, cold, rain,

ice, snow, winds and storms are multiplying, as forecast with climate change. Increasing, global temperatures will also result in rising sea levels, melting permafrost and droughts and dry conditions which will spur on wildfires. While some climate-related events may be smaller or incremental events experienced at the level of HCFs, others may have the potential to impact entire communities.

HCFs in the provinces of British Columbia (BC), Saskatchewan, Manitoba, Quebec, New Brunswick and the cities of Toronto and Windsor in Ontario, have all experienced the impact of flooding within their HCFs causing major disruption to health services delivery (CCGHC, 2019). The 2013 southern Alberta floods were one of the largest natural disasters in Canadian history, resulting in HCF closures, evacuations and infrastructure damage (MNP, 2013 and Roles, 2013).

Toronto's Hospital for Sick Children - a view of the atrium. Photo by Dhodges.

Another climate-related event with the potential to disrupt HCF operations is melting permafrost. Melting permafrost in Canada's far north means HCFs in those regions will need thermosyphons to maintain cooler ground temperatures that prevent the building from sinking (Holubec, 2008). Wildfires are an additional concern for public health and HCFs. In addition to "Very High Health Risk" air quality impacts due to smoke felt all the way into Alberta, the BC wildfires in 2017 and 2018 resulted in HCF closures, patient transfers, and health services disruptions (Legassic, 2018).

Other examples of Canadian HCFs that have been impacted by climate-related events have been documented in the CCGHC's Resiliency Profiles available on their website.

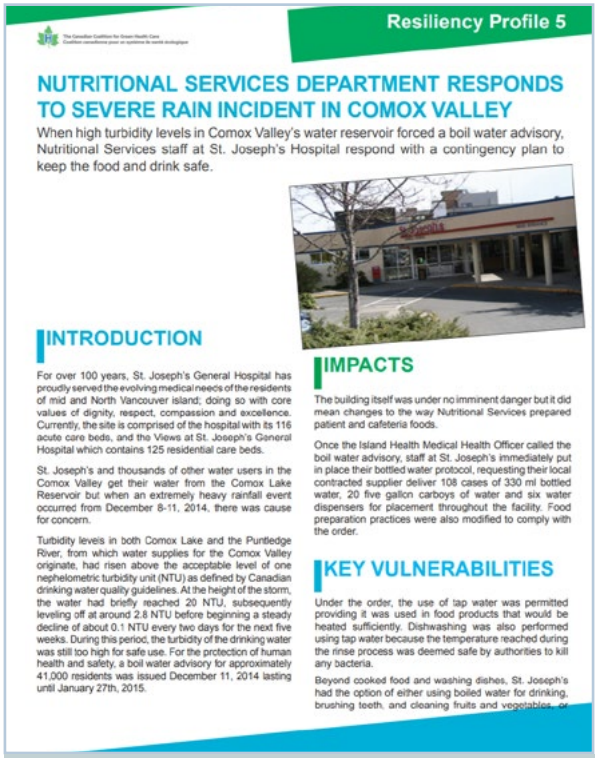
Impact on Delivery of Health Care Services

Climate-related events can affect the delivery of health care services at HCFs in many ways. Multiple impacts often can occur simultaneously. These impacts include, but are not limited to:

1. Physical, emotional and mental health impacts among health care workers;
2. Damage to the building envelope, internal infrastructure, electrical and mechanical systems (including heat-

ing, ventilation and air conditioning (HVAC) systems);

3. Reduced access to critical support services including transportation, power, water supply, and tele-communications;
4. Reduced access to non-medical supplies and services such as food, linen and site cleaning, waste disposal storage and services, data management and patient record systems, and sterilization services;
5. Reduced access to medical supplies and products including local sources of products including blood services, and global manufactured medical products sourced from areas affected by climate-related events;
6. Reduced access to health and clinical services during temporary closure periods, delays in treatment such as surgical treatment and delayed access to outpatient services such as dialysis;
7. Increase in emergency room visits and hospital admissions as the result of climate-related events, including heat stress or frostbite, respiratory distress, exposure to climate-sensitive diseases, physical and psychological trauma due to extreme weather events and rapid weather alteration and patient transfers from other HCFs experiencing service disruptions;
8. Activation of the HCF emergency plan; and
9. Increased costs.



Resiliency Profile 5

NUTRITIONAL SERVICES DEPARTMENT RESPONDS TO SEVERE RAIN INCIDENT IN COMOX VALLEY

When high turbidity levels in Comox Valley's water reservoir forced a boil water advisory, Nutritional Services staff at St. Joseph's Hospital respond with a contingency plan to keep the food and drink safe.

INTRODUCTION

For over 100 years, St. Joseph's General Hospital has proudly served the evolving medical needs of the residents of mid and North Vancouver island; doing so with core values of dignity, respect, compassion and excellence. Currently, the site is comprised of the hospital with its 116 acute care beds, and the Views at St. Joseph's General Hospital which contains 125 residential care beds.

St. Joseph's and thousands of other water users in the Comox Valley get their water from the Comox Lake Reservoir but when an extremely heavy rainfall event occurred from December 8-11, 2014, there was cause for concern.

Turbidity levels in both Comox Lake and the Puntledge River, from which water supplies for the Comox Valley originate, had risen above the acceptable level of one nephelometric turbidity unit (NTU) as defined by Canadian drinking water quality guidelines. At the height of the storm, the water had briefly reached 20 NTU, subsequently leveling off at around 2.8 NTU before beginning a steady decline of about 0.1 NTU every two days for the next five weeks. During this period, the turbidity of the drinking water was still too high for safe use. For the protection of human health and safety, a boil water advisory for approximately 41,000 residents was issued December 11, 2014 lasting until January 27th, 2015.

IMPACTS

The building itself was under no imminent danger but it did mean changes to the way Nutritional Services prepared patient and cafeteria foods.

Once the Island Health Medical Health Officer called the boil water advisory, staff at St. Joseph's immediately put in place their bottled water protocol, requesting their local contracted supplier deliver 108 cases of 330 ml bottled water, 20 five gallon carboys of water and six water dispensers for placement throughout the facility. Food preparation practices were also modified to comply with the order.

KEY VULNERABILITIES

Under the order, the use of tap water was permitted providing it was used in food products that would be heated sufficiently. Dishwashing was also performed using tap water because the temperature reached during the rinse process was deemed safe by authorities to kill any bacteria.

Beyond cooked food and washing dishes, St. Joseph's had the option of either using boiled water for drinking, brushing teeth, and cleaning fruits and vegetables, or

Resliency profile #5 of Healthcare Energy Leaders Canada (HELC). Photo provided by Canadian Coalition for Green Healthcare.

The Health Sector

The sheer scale of Canada's commitment to the health care sector highlights its potential importance in efforts to address and respond to climate change. The health sector is a significant contributor to the Canadian economy representing a 11.3 % of the gross domestic product (GDP) in 2018 (CIHI, 2018), and a health and social services workforce of 1.9 million people in 2017 (SC, 2019). Across Canada, health sector spending represents the largest budgetary outlay for each of the provincial and territorial governments. An estimated total of $253.5 billion was allocated to the health sector in 2018. Hospital costs were the largest component of this

expenditure ($71.7/28.3%), followed by pharmaceuticals (15.7%), and physician fees for services (15.1%) (CIHI, 2018a).

Notably, growth in hospital spending has slowed over the last several years to an annual rate of 1.9% in 2016-2017. One of the ways hospitals have responded to limited funding is by changing how care is delivered, with more people treated as outpatients to reduce high costs associated with inpatient treatment. In terms of extent and capacity, there were 798 hospitals across Canada with approximately 90,000 hospital beds according to 2014 figures (CIHI, 2018b). HCFs like hospitals are often one of the largest employers in a community and employ trusted community members with the potential to provide leadership on climate-related concerns.

Canadian Health Sector GHG Emissions

GHG emissions from the Canadian health sector were reported in a study (Eckelman et al. 2018) that linked economic-environmental-epidemiological modeling framework to quantify emissions based on Canadian national healthcare expenditures over the period 2009–2015. The researchers found that GHGs emitted from Canada's health care sector life-cycle, which includes direct emissions from HCFs and indirect emissions from their supply chain, represented an estimated 4.6% of the total national GHG emissions in 2015 or 0.0330 Gigatonnes (GT) CO^2 eq.

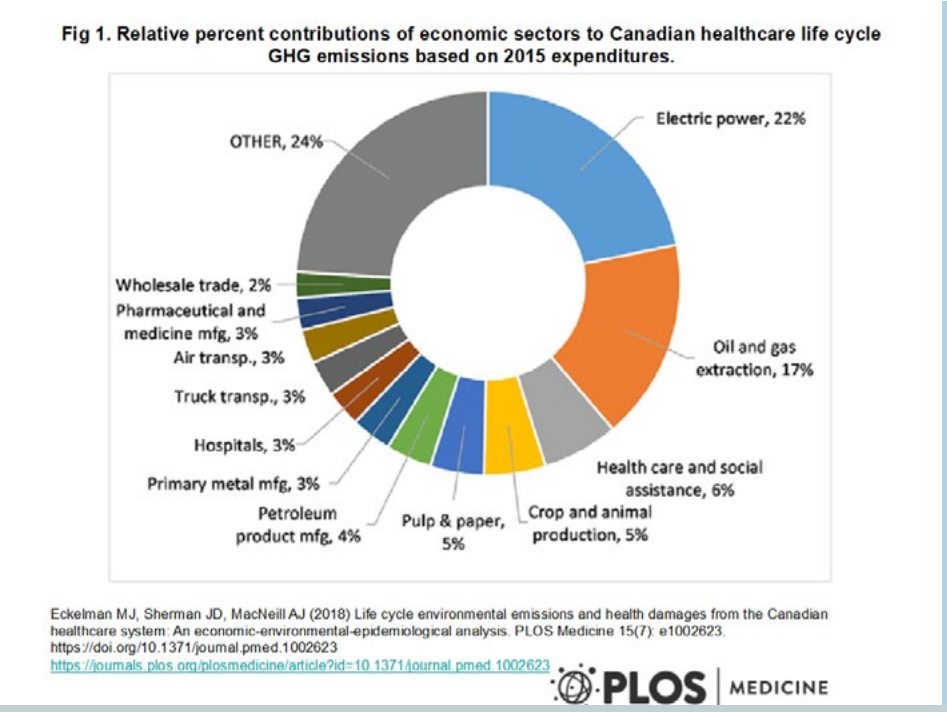


Figure 1: Relative percent contributions of economic sectors to Canadian healthcare life cycle GHG emissions based on 2015 expenditures. Provided by PLOS Medicine.

Medical supplies are a contributor to GHG emissions. Photo by Photo by Marcelo Leal on Unsplash.

However, GHG emissions in the health sector are increasing at double the rate of the national average; 10% compared to 5% between the years 2009 to 2015. Given its increasing annual contribution to Canada's total GHG output, targeted support programs to reduce emissions in the health sector could play an important role in national climate change mitigation efforts. The most significant GHG emissions in the health sector are: prescribed and non-prescribed pharmaceuticals (25%); hospitals (24%); and physician services (13%).

In the same study, Eckelman's team further identified each of the economic sectors contributing to Canada's health care life-cycle total GHG emissions. Hospitals as an economic sector represented 3.1% of the health care life-cycle's GHG emissions - together with health care and social assistance (6.4%) and nursing and residential care (0.4%) comprising only 10% of the total. This means that 90% of health care life-cycle GHG emissions are generated upstream by non-health economic sectors. Energy was shown to be the largest contributor comprised of electricity (22%) and oil and gas (17%). Other key economic sectors as potential targets for mitigation efforts included crop and animal agriculture (5%), pulp and paper industries (5%), and petroleum product manufacturing (4%) representing materials employed within the health system. **Figure 1** provides an illustration of this data (from Eckelman et al., 2018).

As part of its life-cycle emissions, Canada's health care system is further responsible for generating more than 210,000 metric tonnes of non-GHG pollution into air, water, and soils. Amongst the largest emissions to the atmosphere are ammonia, carbon monoxide, methanol, nitrogen oxides, non-methane volatile organic compounds, particulate matter, and sulfur dioxide. As service providers with a leadership capacity in Canadian society, the health sector needs to step up and take responsibility for the health effects related to these pollutants (Eckelman et al., 2018).

From Canada's national reporting on GHG emissions, the transportation sector and oil and gas sector combined represent 50% of the national GHG emissions, and

Climate-related Risks:

1. *Extreme heat, including extended heat periods*
2. *Extreme cold*
3. *Extreme rain and floods*
4. *Extreme snow*
5. *Extreme winds*
6. *Ice storms*
7. *Droughts*
8. *Wildfires*
9. *Tornados*
10. *Extreme storms; thunderstorms, lightening*
11. *Hurricanes and related storms*
12. *Avalanches, rock/mud/land-slides, debris flows*
13. *Rising sea levels; coastal flooding, storm surges*
14. *Permafrost melt*
15. *New and emerging climate-related diseases*

are the ones that have increased the most since 1990 (ECCC, 2017). The health sector relies heavily on these two sectors.

The health sector and HCFs use significant resources across numerous supply chains that are contributing to climate change, and are already being impacted by climate-related events. These next sections describe initiatives that help identify climate-related vulnerabilities, prepare HCFs for future impacts, and describe initiatives to address and help mitigate climate change that health care professionals can advocate for implementation at HCFs.

Resilience, Vulnerability & Adaptation Assessments

HCFs personnel will need to identify what impacts their facility will likely experience, understand the current strength or vulnerability of their facility, and work with their stakeholder community to implement initiatives that will make them more sustainable and resilient, and allow them to adapt to expected climate-related conditions. HCF initiatives can help lessen climate change impacts both by advancing the development of low-carbon facilities, and by changing behaviours around the extensive use of products and services contributing to GHG emissions.

Climate-related Risks

Many types of climate-related risks have been identified across Canada, requiring the health sector to assess which of these risks will potentially apply to each HCF. There are many reliable sources of climate-related risk information available in assessing local risk, including information from public health departments, municipal governments, and provincial/territorial or regional climate strategies and plans. A key online tool is the Climate Atlas of Canada which presents information tailored to identifying the spe-

HCF Resiliency Checklist used at Children's Hospital of Eastern Ontario:

Dr. Curtis Lavoie is an Emergency Room Physician at the Children's Hospital of Eastern Ontario (CHEO), Chair of the Hospital Green Team, and a member of CAPE.

Working with CHEO's Facility Manager Kim Greenwood, Dr. Lavoie took part in the Climate Change Resiliency Mentoring Program, obtaining the services of a summer student to help complete the Health Care Facility Climate Change Resiliency Checklist.

Through this physician's leadership initiative, CHEO now has the baseline information it needs to understand its particular climate-related challenges, enabling this HCF to move forward and take the necessary steps to become more resilient.

cific climate-related risks facing many communities across Canada. Examples of how some HCFs have summarized their climate-related risks can be found in the Ontario HCF Climate Change Factsheets available on the Canadian Coalition for Green Health Care (CCGHC) website.

HCF Resiliency Assessment

The CCGHC in partnership with Health Canada developed the Health Care Facility Climate Change Resiliency Checklist (CCGHC, 2014; Patterson et al. 2014) to assist HCFs assess their resilience to climate change. Guidance on how to complete the resiliency checklist for a HCF is available through The Climate Change Resiliency Mentoring Program which offers an online learning resources, including webinar recordings. The checklist includes questions in areas such as emergency management, facilities management, health care services, and supply chain management.

Officials with knowledge and experience in these subject areas can complete HCF assessments using the checklist, in order to increase awareness and inform resiliency activities. By entering the HCF resiliency checklist assessment results online, a score can be generated that then can be used as a baseline to compare with results obtained in future years. Other HCF resiliency toolkits that have been developed include The Sustainable and Climate Resilient Health Care Facilities Toolkit in the United States, and the Smart Hospital Toolkit, developed by PAHO for HCFs in the Pan-American regions (Balbus et al. 2016 and Velislava et al. 2015).

Other ways in which HCFs can increase their resiliency is by engaging in broader community discussions and initiatives around climate-related issues, considering climate change during the development of strategic plans and activities, and mainstreaming climate change considerations into ongoing risk assessments.

Risks can be greatly reduced through

Interior Health, BC Vulnerability Assessment:

After experiencing major wildfire events for two summers in a row, the Strategy and Risk Management Council of the Interior Health region in BC endorsed a pilot climate change vulnerability assessment to understand potential impacts and resulting risks and opportunities at their Golden and District Hospital.

"Our ability to support health services over time is dependent on our facilities being able to operate under 'new normal' climate conditions," said Tanja Stockmann, Manager of Sustainability who is taking the lead on the pilot.

Information gleaned from this vulnerability assessment will help senior leadership, capital project managers, and operational staff make better-informed decisions on how to prepare for the climate-related events Interior Health is already experiencing, as well as to plan for expected and unanticipated impacts during the lifespan of its facilities.

proper management of critical resources (e.g. pharmaceuticals, food, energy, transportation, medical supplies, and equipment) that consistently incorporates climate change considerations.

Another aspect of HCF resilience is its level of commitment to sustainable practices, including water and energy conservation, promoting active transportation, and local food procurement. By making a commitment to promoting these and other practices, HCFs can reduce their operating costs, and increase awareness of the need for climate change resilience in the broader community. Examples of how HCFs have taken these steps can be found in the resources below – Safe haven in the storm, and, Protecting lives and margins with climate-smart health care, Climate-smart healthcare: low carbon and resilience strategies for the health sector.

Resources:

- Health Care Facility Climate Change Resiliency Checklist
- Climate Change Resiliency Mentoring Program web page/ other resources/presentations
- Sustainable and Climate Resilient Health Care Facilities Toolkit (U.S.)
- Smart Hospital Toolkit, PAHO
- Safe haven in the storm: Protecting lives and margins with climate-smart health care
- Climate-smart healthcare: low-carbon and resilience strategies for the health sector.

HCF Vulnerability Assessments

The purpose of HCF vulnerability assessments is to identify any infrastructure that will be potentially vulnerable as a result of climate-related impacts. Engineers Canada and Natural Resources Canada supported development of the Public Infrastructure, Engineering

Health Canada – Capacity Building:

Health Canada has a new multi-year program to support the health sector to prepare for and adapt to the impacts of climate change in order to protect the health of Canadians and increase climate resiliency of the health system. Approximately $3 million will be provided to 10 health authorities across Canada, in which health care facilities are partners, to assess climate change vulnerabilities, establish adaptation plans and evaluation strategies.

Vulnerability Committee (PIEVC) protocol, which is a tool that reviews historical climate information in order to projects the nature, severity, and probability of future climate change events.

The PIEVC protocol includes an estimate of the severity of climate impacts on specific components of infrastructure in terms of their deterioration, damage, or destruction to enable identification of higher risk components. This information can be used to make informed engineering judgments to prioritize components requiring adaptation, as well as for understanding the best ways of adapting them - whether through design adjustments, or changes to operational and/or maintenance procedures.

As one example for its use in HCFs, the PIEVC protocol was applied to conduct a vulnerability assessment of the Nanaimo Regional General Hospital in BC. (Please see the Climate Change Vulnerability Assessment Report referenced below for further details.) Other examples of characterizing vulnerable Canadian health care infrastructure are available from Procyk and Dhariwal (2010).

Resources:

- PIEVC Engineering Protocol
- Nanaimo Regional General Hospital, Climate Change Vulnerability Assessment Report

Vulnerability and Adaptation (V&A) Assessments

From a public health perspective, vulnerability and adaptation (V&A) assessments can further examine population-level vulnerabilities to climate change in the community. These vulnerability assessments can be used to identify vulnerable populations and map the location of potential health risks, employing climate data to inform adaptation and planning (Ebi et al. 2016).

Undertaken from local to national levels, V&A assessments can help prepare health systems for the impacts of climate change by informing the need for development of tailored policies and programs to enhance resilience and adaptation (Bell, 2011). Ford et al. (2010) describe the climate change vulnerability of

the Aboriginal health systems in Canada. Guidance in performing V&A assessments is provided in the Ontario Climate Change and Health Toolkit referenced below.

At the local level, V&A assessments should be conducted with high levels of engagement and participation from stakeholders in the community including representatives from the HCF, critical infrastructure and emergency management and response, patient populations, and the general public. Information provided by HCFs to the V&A assessment should include the current and future resiliency of buildings and clinical services to climate-related events, as well as patient admission data, in order to ensure that critical health care services will be available even during disaster periods. The HCF representation within V&A assessment processes will help to ensure that community climate adaptation plans include this critically important perspective, especially as HCFs rely heavily on municipal infrastructure with the potential to be impacted during climate-related events, particularly transportation, power, and water and wastewater services.

Resources:

- Ontario Climate Change and Health Toolkit.

HCF Adaptation Assessments and Plans

The National Health Service (NHS) in England has shown remarkable leadership in requiring HCFs (known as 'Trusts') to develop climate change adaptation assessments and plans, known as 'Sustainable Development Management Plans' (SDMP), for their organizations.

The required assessments and plans summarize the set of adaptation actions specific to the individual circumstances and locations of each Trust. Examples of adaptation actions contained in the assessments and plans include training health care professionals on climate-related impacts, increasing levels of urban greening and green infrastructure, building retaining walls to keep flood waters out, and developing redundancies to ensure ongoing access to transportation, power, and water and wastewater services in the event of an emergency.

Some of the Trusts' plans and assessments have been developed in partnership with local governments to help build community-wide adaptation strategies. Some NHS Trusts combine their climate change adaptation assessments and plans with their Environmental Sustainability Plans, which are described in greater detail in below. NHS England and Public Health England jointly fund the Sustainable Development Unit which provides guidance to the Trusts to embed and pro-

mote the three elements of sustainable development - environmental, social and financial - to ensure that the health and care system fulfils its potential as a leading sustainable and low carbon service. Examples of the support provided by the Sustainable Development Unit includes planning guidance and sample plans. Examples of how nurses and physicians have engaged in climate change and specific examples of green infrastructure and the role of these in climate change and health are provided in the Resources below.

Resources:

- Adaptation to Climate Change – Planning guidance for health and social service organisations, and sample plans
- Nurses Climate Challenge
- A Physician's Guide to Climate Change, Health and Equity
- Climate Action for Healthy People, Healthy Places, Healthy Planet: Urban Greening & Green Infrastructure, Climate Change and Health

Stress Testing

Climate and health "stress tests" can be undertaken to gain further information on potentially disruptive climate-related shocks and stresses that might otherwise be missed in a V&A assessment. Stress testing uses the development of hypothetical scenarios to understand cases where

Stranded Ambulance. Photo by Alec Perkins from Hoboken, USA.

the health system would be stressed to such a degree that it might not be able to provide services to the public. Understanding this state and how it could come about provides an opportunity to evaluate and consider vulnerability and adaptation from a new perspective (Ebi et al. 2018).

Low Carbon Sustainability & Resiliency Measures at HCFs and their Supply Chain

Sustainability and resiliency measures are highly linked. For example, by using less energy, a facility can remain operational longer should power outages occur because of the finite amount of energy available once stand-by energy sourc-

es are activated. A new energy-efficient boiler should not be placed in any location where it would subject to flooding in a changing climate. An operational decision to size a heat recovery ventilation unit (HRV) on the basis of outdated weather data may mean earlier, higher cost, replacement in the event of longer, hotter periods due to climate change. Employing fewer toxic chemicals and reducing the level of waste in a facility would reduce the hazards that could be realized during clean up after a climate-related disaster results in potential disruption or damage to waste storage areas. Purchasing locally-sourced, sustainable foods would help to build capacity and resilience in local agricultural communities, which could further ensure a stable food supply in the event of climate-related disruption to global supply chains providing imported foodstuffs to the facility. Examples of how hospitals in Europe are addressing sustainability and resiliency can be found in the resources document Reducing healthcare's climate footprint. Opportunities for European hospitals and health systems.

Sustainability Support for HCFs

Having adequate support to implement new initiatives is critical, since health care professionals have limited time and resources to consider priorities outside of their stated responsibilities. Fiscal restraint is a constant concern, as the overall level of resources available for attaining non-priority objectives is low. New initiatives have to compete with other pressing matters within health systems on a periodic basis, such as influx of patients during the flu season. Factors that enable the success of new initiatives include existence of a regulatory backdrop, leadership making it a priority, having an action plan, the availability of resources, and co-benefits for the health system.

Support for HCF sustainability initiatives can be located at many levels, including a facility-led green committee, the regional health system, provincial /territorial government departments or programs, national-level frameworks, and international agencies. Trusted organizations located outside the HCFs and even the health system can provide complementary support through their own initiatives.

One example is the Green office toolkit for clinicians and office managers, created through the joint efforts of the Canadian Coalition for Green Health Care, Canadian Association of Physicians for the Environment (CAPE), Synergie Santé Environnement (SSE), McMaster University Department of Family Medicine, and Women's College Hospital in Toronto.

Sinai's Health's Green Committee:

The Toronto based Sinai Health System's Green Committee was formed in the mid 90's. One of its integral members was Hilda Swirsky, a nurse in Antenatal who has been on the committee for the past eight years. Today, Sinai Health has its first full-time Manager of Infrastructure and Sustainability, Mark Reynolds, and first Environmental Sustainability Coordinator, Tracey Clatworthy, who co-chairs the Green Sinai Health Committee with nurse Brenda O'Connor. The committee is comprised of several departments. The sustainability priorities of Sinai Health are reducing resource consumption and impacts on the environment, especially its carbon footprint. Focus areas for these priorities include waste diversion, energy and water conservation, as well as sustainable construction and procurement practices. Importantly, reducing utility consumption saves dollars that can go right back into providing patient care – the heart of their mission. The 30 members of Sinai Health's Green Committee engage frontline staff by championing environmentally-friendly behaviour changes, and ask all staff to sign a Green Pledge stating that they will try to power-down computers, unplug electronics and equipment, and turn off lights in empty rooms. The Green Sinai Health Committee further engages employees through outreach events like Smart Commute Month, encouraging employees to start thinking about sustainable ways to travel to work. In 2017, notable successes included halving water consumption, and increasing waste diversion from 30% to 45%, resulting in Sinai Health receiving a silver ranking on the Canadian Coalition for Green Healthcare's Green Hospital Scorecard.
(Yardley, 2018)

HCF Green Committees and Champions

Facility-led green committees can be their most effective when they are made up of staff from a broad range of backgrounds and incorporate the insights and efforts of personnel with a strong interest in seeing their facility become more 'green'.

Directly involving staff in the development of initiatives that reflect the unique interests of a facility can produce greater buy-in and increase participation for initiatives like waste reduction and recycling or changing energy use behaviours. In some cases, green committee initiatives have led to the creation of new staff positions, as the value of these activities becomes apparent to leadership.

Fostering the developing of internal "Green Champions" throughout an HCF can help extend a green committee's presence facility-wide. The Green+Leaders Network is one such example of an initiative to foster environmental stewardship by providing training and resources for

success to over 400 volunteer champions across BC's Lower Mainland Health Organizations (LMHO), calling itself a "collection of engaged staff volunteers who help create healthy workplaces on a healthy planet by improving environmental performance of health care operations".

Regional Sustainability Support Programs

Regional sustainability support programs can be embedded within a group of HCFs to take advantage of economies of scale by compiling information and sharing resources. The GreenCare program in BC's LMHO is one example of such a program, overseeing environmental sustainability initiatives which include Smart Energy and Water, Zero Waste and Toxicity, Regenerative Design, Active and Clean Transportation, and Culture Change programming. Each of these program categories outline corresponding areas of focus, key performance indicators, and targets to help smoothly implement initiatives between LMHO facilities.

Province-wide and National Support

Alberta Health Services (AHS) is the provincial health organisation in Alberta responsible for HCFs across the province. As one example of a centralized provincial sustainability support, a new Office of Sustainability has been developed and is currently being launched in Alberta, with staffing and resources provided from AHS funding.

While there is no national funding support for such a program in Canada, the NHS and Public Health in England, which is the publicly funded national healthcare system, created the Sustainable Development Unit in 2008 as described in the section on HCF Adaptation Assessments and Plans above. Another example of a national sustainability support program for hospitals is Practice Green Health in the USA,

CAPE Alberta Committee, Alberta Health Services:

Alberta Health Services (AHS) is the provincial overseer of a $14.7 billion health care operation encompassing more than 400 hospitals and 100,000+ employees.

With such a large organization and knowing that the health care sector has a significant impact on the environment through energy and water use, products used, and air and water emissions among other impacts, it only made sense to Dr. Joe Vipond and the CAPE-Alberta Committee of 50 doctors, nurse, medical students and academics to advocate for a Sustainability Office at AHS.

The new office at AHS will focus on decreasing GHG emissions for heating and cooling and electricity, waste management and recycling and employee engagement and education.

which is described in the section below.

Many benefits can flow from sustainability support program being embedded within health systems, including secure funding for staff, access to health system data and information, guidance from health system experts, ability to require reporting under health regulations, and the credibility associated with working with funders of the public health system.

External Sustainability Support from Trusted Organisations

External health care-related organisations can help provide expertise and manpower to support the sustainability efforts in HCFs, as needed. This support can take the form of partnerships on programs, consultation contracts for energy management services or special projects,

Cover of Green Office Toolkit for Clinicians & Office Managers. Cover Design by Louis Aubin.

and providing training and education services. Some examples of external sustainability support that have been provided to HCFs in Canada include:

Québec: Synergie Santé Environnement (SSE) is a not-for profit organisation formed by Quebéçois health care professionals in 2006 to help health care organisations reduce their negative impacts on the environment and health. SSE provides environmental health and sustainable development consulting services to health and social service institutions in Quebec with a focus on waste management, responsible procurement, policy and action plan development, and implementation of action plans, committee support, training, situation reports, and sustainable development report writing. SSE currently has 20 members representing 53 hospitals, 176 long-term care facilities, and more than 250 other types of health care buildings.

Canada-wide: The Canadian Coalition for Green Health Care (CCGHC) was established by CAPE members and several health care facilities and organizations in 2000, with a focus on promoting environmental health and addressing environmental sustainability in the health sector. CCGHC develops toolkits, offers

workshops and training, and undertakes projects with members, with a focus on the areas of climate change, energy and water, safer chemicals, green purchasing, sustainable food, and waste management and benchmarks these initiatives through the Green Hospital Scorecard and offers an awards program. CCGHC also developed a social enterprise platform (HealthCare Energy Leaders Canada) providing energy management services to CCGHC members at reduced rates. A key area of engagement for the CCGHG is the Green Health Leaders Initiative, which was developed to engage health care senior leadership on environmental sustainability and climate change. Membership includes health care organisations representing approximately 40% of hospital beds in Canada.

Outside of Canada sustainability support organisations include:

France: Comité pour le Développement Durable en Santé (C2DS) is a health care support organisation based in France with offices in Germany. It was set up by a group of hospitals in order to establish a healthcare community committed to environmentally responsible healthcare. C2DS is endorsed by the French Ministry of Health and has around 500 hospitals in their network. C2DS is associated with a private company with expertise in GHG audits and when members use this company they are eligible for cost savings. C2DS offers training, workshops, sustainability toolkits, and best practices.

United States of America (USA): Practice Green Health (PGH) is a non-profit and the USA's leading membership and networking organization for institutions in the healthcare community that have made a commitment to sustainable and eco-friendly practices. It was established in 1998 through a memorandum of understanding between the American Hospital Association and the US Environmental Protection Agency and was first known as Hospitals for a Health Environment (H2E). in 2006 Health Care Without Harm took a leadership role in helping H2E become an independent not-for-profit and formed PGH. PGH provides practical and cost-effective guidance, tools, resources and expertise to its members, and also has an awards program and an annual conference known as CleanMed.

Global: Health Care Without Harm (HCWH) and the Global Green Healthy Hospitals (GGHH) networks

seeks to transform health care worldwide so that it reduces its environmental footprint, becomes a community anchor for sustainability and a leader in the global movement for environmental health and justice without compromising patient safety or care. HCWH leads programs in Latin America, Europe, Asia and leads projects and initiatives around the world. GGHH, a program of HCWH, is an international network of hospitals, health systems and health organizations dedicated to reducing their environmental footprint and promoting public and environmental health by providing online platforms, awards, and networking opportunities.

Resources:

- Reducing healthcare's climate footprint. Opportunities for European hospitals and health systems.
- Green office toolkit for clinicians and office managers
- Green+Leaders Network
- Sustainable Health Care – The BC GreenCare Community website
- Sustainable Development Unit (SDU), National Health Service (NHS) England
- Synergie Santé Environnement (SSE)
- The Canadian Coalition for Green Health Care (CCGHC)
- Comité pour le Développement Durable en Santé (C2DS)
- Practice Green Health (PGH)
- Health Care Without Harm (HCWH)
- Global Green Healthy Hospitals (GGHH)

Environmental Sustainability Plans for HCFs

In England's National Health Service (NHS), HCFs are required to complete a Sustainable Development Management Plan (SDMP). The SDMP initiative was a joint effort between the SDU national sustainability support program and NHS England Sustainable Improvement Team, aiming to integrate other health care priorities with sustainability ones.

In their SDMP, HCFs address issues such as air pollution, energy use, green spaces, carbon emissions, and climate change adaptation. Organisations are required to consider both their potential for direct impacts and indirect influences on their supply chains, as well as local communities. The HCFs are provided with key mes-

Carbon Footprint. Photo by Louisa Potter on Unsplash.

sages to help shape an understanding of the importance of these plans for their employees and community stakeholders, with an example being: "SDMPs form a key part of sustainable health care delivery to ensure services remain fit for purpose today and for the future". The SDMP also asks that HCF organisations incorporate ideas about prevention and improving the wider determinants of health in the community they serve and ways of achieving financial savings.

Carbon Footprints

England was the first country to undertake a detailed carbon footprint of their health system in 2009. The NHS England and the SDU (its national sustainability support program) established standardized measurement systems and identified carbon 'hotspots', so that HCFs could implement GHG emissions reduction initiatives that then could be re-evaluated every few years. Notably, even though system utilization increased by 18% between 2007 and 2015, GHG emissions dropped by 11% during these years. The emission reductions were achieved by improving procurement activities for a 16% reduction, realizing a 5% reduction in transportation emissions, and obtaining a 4% reduction in energy emissions (NHS SDU, 2016).

In Canada, without a similar commitment from the government and without a national program to support HCF sustainability, health care sector emissions increased 10% between 2009 and 2015 (Eckelman et al. 2018). A comparable level of detail on Canadian carbon emissions is lacking; however, the designation of 'hotspots' as in the English system could be used as a guide for initiatives to address HCF carbon emissions in Canada. Carbon 'hotspots' for goods and services identified at NHS acute care sites included building energy, medical instruments, and business services. Other less GHG-intensive but still significant contributors included construction, food and catering, manufactured chemicals and gases, pharmaceuticals, and travel.

For additional consideration, further carbon footprints of interest in the health care sector as identified by research studies include operating rooms (MacNeil et al. 2017), renal services (Connor et al. 2010), laparoscopic surgery (Theil et al. 2018), and emergency services systems (Blanchard et al. 2010). Supply chains are also significant GHGs emission contributors in these studies, as are the anesthetic gases employed during surgical operations.

Resources:

- Sustainable Development Management Plan (NHS)
- Good and services carbon hotspots, NHS SDU

Energy

Out of all the commercial and institutional buildings in Canada, HCFs have the highest energy use intensity (2.45 Gigajoules [GJ] per m2), particularly hospital campuses. Despite accounting for only 0.2% of commercial and institutional buildings, hospitals account for 4.1% of total energy used by the building sector in Canada. In 2014, the total energy used by all hospital buildings was 38.8 petajoules (PJ) with a 40% to 60% electricity to natural gas split. Notably, over 40% of HCF buildings are older than 50 years, presenting a great deal of potential for improving the energy efficiency of Canada's health care building stock, even though older buildings can often pose challenges with retrofitting (NRCan, 2014).

Energy Reporting

In BC, the Carbon Neutral Government Regulation requires that health authorities submit an annual 'Carbon Neutral Action Report' to document and summarize actions they have taken to combat their identified carbon footprint, which is defined as the fuel used in both their buildings and transportation fleets, as well as GHG emissions related to paper use. In Ontario, HCFs must complete an En-

Snow at Sunnybrook Hospital, Toronto. Photo by Laura Berndt.

Vancouver Coastal Health passive house for hospital staff:

The staff housing complex at the RW Large Memorial Hospital in Bella Bella, BC burnt down in 2014 requiring a replacement facility. Vancouver Coastal Health (VCH) took advantage of new building technology by building a modular structure to the Passive House standard which requires about 80% less heating and cooling energy than an average building.

The modular building was built off-site and installed in 2016. On the coldest day of the year, each unit in this complex has a peak heating load of about 600 watts, which is equivalent to the heat generated from six 100-watt light bulbs. No additional heating (such as a furnace or boiler) is required. On a long-term basis, this building will use 75% less energy and produce 80% fewer GHG emissions than a similar sized standard construction building, thereby saving VCH significant operational costs for this location (Greencare Community).

ergy Conservation Demand Management plan every five years, which consists of a description for previous, current, and proposed measures to conserve energy and manage energy demand. In addition, Ontario HCFs must submit their facilities' energy and water data onto Natural Resources Canada's ENERGY STAR® Portfolio Manager platform annually.

Setting Targets

Setting targets for GHG emission reductions will help to achieve results, especially targets which are supported by the senior leadership, and made public. This has been demonstrated by GHG emission reduction targets for carbon neutral and net energy generating systems that have been announced by health systems in the United States. Some examples include:

- Kaiser Permanente, the largest non-profit integrated health care system in the US will achieve its goal of being carbon neutral in 2020. Kaiser Permanente's power purchase agreement for 180 megawatts (MW) of clean energy — enough to power 27 of its 39 hospitals — will enable the construction of utility-scale solar and wind farms, as well as one of the country's largest battery-energy storage systems. Kaiser Permanente has publicly pledged to become carbon net positive by 2025 (Kaiser Permanente, 2018).
- Advocate Aurora Health intends to operate its facilities in Wisconsin and Illinois with fully renewable energy sources by 2030. Reaching this goal would reduce its carbon emissions by 392,657 metric tons

annually, or the equivalent to removing 84,000 cars from the road each year (Advocate Aurora Health, 2019).

- Gunderson Health System in Wisconsin achieved the first energy-independent hospital in the US. Its $30 million system uses wind turbines, dairy farm methane digesters, and a facility that captures biogases released from a nearby county landfill. They expect that their investment will have an eight-year payback (Gunderson Health, 2019).

Benchmarking Tools

Many HCFs in Canada and the US voluntarily submit their energy and water usage data to the ENERGY STAR® Portfolio Manager program every year. These HCFs are the provided with a score that allows them to benchmark their results to compare with similar facilities, or to their own past performance. The United States Environmental Protection Agency (US EPA) reports in over 20 years, Portfolio Manager users have saved more than $192 billion in energy costs. The ENERGY STAR Certification can also be attained for high performing buildings in Canada.

The Canadian Coalition for Green Health Care's Green Hospital Scorecard (GHS) is the only health care-specific environmental benchmarking tool developed in Canada. Originally focused on energy, GHG emissions, water, waste, pollution, and leadership indicators, the GHS program has expanded to include climate change, transportation, food, and energy behaviours. One half of Ontario HCFs participate in the GHS program, alongside organisations in other provinces and from outside of Canada. Based on their Scorecards, program participants are designated as gold, silver, or bronze. The average GHS score attained by participants across all indicators has been increasing over the past five years.

Energy Managers and Energy Efficiency Support

There are several examples of programs in Canada that are helping to enable HCFs to become more energy efficient. Energy manager programs funded by the utility providers in BC and Ontario have helped HCFs to embed dedicated staff focused on energy savings within their organisation. Efficiency Nova Scotia is the first energy efficiency utility in Canada and also works with HCFs to help them become more energy efficient.

Greening Health Care, with the Toronto and Region Conservation Authority based in Ontario, helps hospitals to become leaders in energy efficiency to reduce their impact on the envi-

ronment and contribute to mitigating climate change. Since 2004, Greening Health Care has helped to conserve 1.5 million gigajoules of energy, saving $28 million, and reducing GHG emissions by 85,000 tonnes.

HealthCare Energy Leaders Canada (HELC) and Ontario (HELO) was developed by the CCGHC in partnership with the Ontario Chapter of the Canadian Healthcare Engineering Society. HELC aids HCFs with conducting energy consumption audits, identifying energy efficiency opportunities, preparing business case content to secure buy-in from senior management for project formulation and execution, and providing guidance for completing energy incentive forms to receive potential funding assistance.

Resources:

- Sample Carbon Neutral Plan, BC: Fraser Health Carbon Neutral Action Report
- Sample Conservation Demand Management (CDM) plan, Ontario: University Health Network
- Portfolio Manager US
- ENERGY STAR® Portfolio Manager: Canada
- BC Energy Mangers Ontario Energy Managers
- Efficiency Nova Scotia
- HealthCare Energy Leaders Canada
- Green Hospital Scorecard

GHG Emission Audits

Auditing GHG emissions should be undertaken using the GHG Protocol (www.ghgprotocol.org) as one of the most globally recognized accounting standards in this area. The GHG Protocol divides HCFs GHG emissions into three scopes, based on how the nature of those emissions. Scope 1 emissions include onsite energy, fleet vehicles, waste anesthetic cases, and refrigerants. Scope 2 emissions include purchased electricity and purchased steam. Scope 3 emissions include GHGs emitted along the supply chain and incorporate transportation and distribution (emissions from staff, freight, and business travel), waste disposal, food-related commodities (i.e. meat), pharmaceuticals, and medical devices and equipment.

In France, the private company Primum Non Nocere, which is associated with the non-profit Comité pour le Développement Durable en Santé (C2DS), has been conducting GHG emission audits with HCFs for the past 5 years, as required by French reporting regulations. Primum Non Nocere's work indicates that 90% of the GHG contribution made by HCFs come from scope 3 emissions, that is, indirectly from supply chains. Their audit reports contain action plans to reduce these GHG emissions tailored to the spe-

cifics of each audit. By implementing these action plans, some HCFs have been able to reduce their GHG emissions by more than 20% over a 3-year period, even though the number of patients increased and new buildings were added (Personal communications, Primum Non Nocere).

One of the benefits of taking this tailored action plan approach is that over the course of working collaboratively with their employees, partners, and suppliers to achieve highly relevant GHG reductions, these HCFs transform into climate leaders armed with pertinent information for their communities. Having more site-specific information on the areas where emissions are generated permits the customization of GHG reduction plans for each HCF. It can also reveal shifting patterns of GHG emissions at sites, such as moving from direct to indirect sources of emissions.

Dr. François Reeves, interventional cardiologist at the Cité-de-la-Santé in Laval, is the founder of the Day of Tree Health, which is an event in Québec combining health and the environment through tree planting activities conducted primarily on the grounds of health facilities, as part of the Montréal urban forest action plan.

A total of 8,275 trees has been planted over six years, in Montreal alone. The Francophone Doctors of Canada group is also involved in the Day of Tree Health and have created a kit to help orient new participants, including a draft invitation to employees, a press release, and an organization guide for leadership.

Dr. Myles Sergeant is a family physician, CAPE supporter, and founding member of the charitable organization Trees for Hamilton who has planted trees at several health care sites in Hamilton, Ontario. In his words, "We believe that trees are important to human health. The closer trees are to people the better. It can be challenging to find places downtown to plant trees so we're grateful to have hospitals to partner with."

Carbon Offsets and Tree Planting

In BC, public sector facilities such as HCFs are required to purchase carbon offsets from the provincial government in order to maintain carbon neutral facilities. There are other voluntary carbon offset programs in Canada, such as the 'Carbone boreal' greenhouse gas offset program, which is both a tree planting initiative and research project housed by researchers at the Université du Québec à Chicoutimi in Québec.

Tree planting initiatives have taken

root within various health care systems. The Centre for Sustainable Healthcare in England coordinates the National Health Service (NHS) Forest program, which aims to build a long-term legacy of forests for health by engaging people with their immediate environment and forested space that will be used and continually improved by staff, patients and the local community.

Doctors in both Montreal, QC and Hamilton, ON have taken the initiative to plant trees at HCF locations in Canada. Studies have shown that trees have numerous benefits besides absorbing carbon dioxide and reducing GHGs including health benefits such as improved respiratory health by cleaning the air, helping to reduce stress, creating a sense of calm, and providing shade during hot sunny days, as well as increasing resilience of the HCF by assisting with controlling floods. For a bibliography of evidenced based research see the NHS Forests resource below.

Resources:

- Greenhouse Gas Emissions Offset Projects BC
- Carbone boreal
- NHS Forests: Bibliography of research evidence of the benefits of green spaces and trees
- Trees for Hamilton
- Day of Tree Health kit

Approximately 25% of hospitals in Ontario voluntarily use some kind of waste anesthetic gas collection and recovery system. Sunnybrook Hospital in Toronto, Ontario has participated in a waste anesthetic gas collection program for 13 years. Staff estimate that approximately 780 tonnes of waste anesthetic gases are collected annually, representing an estimated 4% of GHG emissions from their facility (Carss, 2018)

Inhalation Anesthetic Gases

The primary inhalation anesthetic gases used in HCFs are Desflurane, Isoflurane, Sevoflurane, and nitrous oxide, which also acts as a carrier gas. These anesthetics are potent GHGs, with over 95% of the gas that is administered to patients being directly vented into the environment during use, owing to their low metabolization rates and some of them remain in the atmosphere for years (Sulbaek-Andersen et al. 2010). The 2014 global release of anesthetic gases totaled 3 million tonnes of CO_2e, 80% of which were Desflurane and of the total global nitrous oxide emissions, 1% is reported from medical sources (Charlesworth, 2017).

In Canada, inhalation anesthetic gases are not included in reporting

requirements, even though these are direct emissions from HCFs; as a result, total emission quantities are unknown. Studies from the Sustainable Development Unit at the NHS in England (SDU, 2013) have determined that anesthetic gases represent 5% of the carbon footprint of acute care organizations, equivalent to approximately 50% of GHG emissions from heating buildings and water. Nitrous oxide represents the highest volume gas of all the anesthetics that are used, and therefore is the largest component of GHG emissions from anesthetics, making it a prime target for tracking and reduction.

Recommendations from an anesthetic gas life-cycle study by Sherman et al. to reduce GHG emissions include: utilizing low fresh gas flows; avoiding high impact inhaled anesthetics like Desflurane and nitrous oxide; considering the use of intravenous and regional techniques; investing in Waste Anesthetic Gas (WAG) trapping technology for volatiles only and WAG destroying technology for all inhaled anesthetics including nitrous oxide by updating anesthesia machines.

The American Society of Anesthesiologists have launched the Inhaled Anesthetic 2020 Challenge program to reduce inhaled anesthetic greenhouse gas emissions 50% by 2020. The Royal Society of Anaesthetists and researchers in the Department of Anesthesiology at Yale University have developed carbon calculators that can help HCF staff calculate the GHG equivalents of the anesthetic gases used in their facilities. See resources below.

Personnel in the Anaesthetic Department at Western Health in Melbourne Australia voluntarily reduced their Desflurane and nitrous oxide use, aiming to use lower flows of gases in general. These efforts lowered annual costs by $22,500 USD, and reduced greenhouse gas emissions by 140 tons per year (Hospital and Healthcare, 2018).

Resources:

- SDU Carbon Calculator – anesthetic gases
- Inhaled Anesthesia Climate Initiative: Inhaled Anesthetic 2020 Challenge and Calculator

Sustainable Procurement

In Canada, the large majority (90%) of GHGs in the health sector originate upstream from the HCFs (Eckelman et al. 2018). Although there is no comprehensive sustainable procurement initiative in

Canada, some HCFs have developed their own green purchasing policies, while others are beginning to ask about the sustainability of products in their requests for proposals.

With the majority of GHG emissions coming from supply chain sources, waste recycling will not significantly reduce a facility's carbon footprint, so waste reduction approaches will need to take precedence. Programs to address the operating room, as the most product intensive area of in HCFs, should be considered (Kagoma et al. 2012). By adopting sustainable procurement policies, strategies, and practices, the health sector and HCFs have an opportunity to spearhead a significant shift in the manufacturing sector to develop greener products throughout their lifecycles.

Sustainable procurement program references can be found in the resources below, and include those in the US and Europe which support HCF participation:

- The Greenhealth Exchange is an environmental purchasing catalogue and exchange for health care facilities in the United States owned by Practice Green Health and includes health care organisations as members, aiming to accelerate the development and adoption of new, more environmentally-friendly products. As a first step, the Exchange lists products that would enable hospitals to meet purchasing targets outlined in the Healthier Hospital Challenges, a program that identifies key activities which HCFs can undertake, and which if undertaken by many HCFs, will result in shifts in the health care sector supply chain.
- The Sustainable Health in Procurement Project (SHiPP) is a program developed by the United Nations Development Programme in collaboration with Health Care Without Harm,

Students can be empowered to take direct actions that will improve sustainability at health care facilities. After winning a social innovation contest that provided seed funding, Alec, a second-year medical student at the University of British Columbia and his colleague Iman, a biology and anthropology student at Simon Fraser University, have been conducting research and quality improvement work on medical waste and sustainability at a BC Hospital over the past two years.

Their work has included both developing a methodology for waste quantification and conducting a national survey of environmental sustainability in critical care units. Next steps include helping the hospital implement changes in their intensive care unit. The team sees significant potential in helping to reduce waste and lower costs at hospitals via greater emphasis on purchasing and stocking processes that take waste volumes and associated costs into consideration. By reducing the quantity of medical devices purchased, the hospital will also be able to reduce its GHG emissions.

and funded by the Swedish International Development Agency. The SHiPP program is designed to reduce the harm to people and the environment caused by the manufacture, use, and disposal of medical products and by the implementation of health programs, mainly targeting lower and middle-income countries.

- The EKU Swedish tool is for ecologically sustainable procurement that supports public organisations.
- The Procuring for Carbon Reduction tool, developed by the SDU national sustainability support program in England, bases purchasing on a hierarchy of interventions including (from highest to lowest) reduce demand, reduce in-use emissions, substitution and innovations, and supply chain management.

Resources:

- Greenhealth Exchange
- The Sustainable Health in Procurement Project (SHiPP)
- EKU Swedish Tool
- Procurement for Carbon Reduction

Pharmaceutcals & Medical Devices

The Eckelman et al. (2018) research team study of the Canadian health sector identified pharmaceuticals as a primary source of GHG emissions, although Canada will need to look abroad for examples of strategies in this area. In England, the NHS Sustainable Development Unit (SDU) carbon footprint reporting identified pharmaceuticals (21%) and medical devices (11%) both to be 'hotspots' (NHS SDU 2012).

The SDU national sustainability support program has engaged with these sectors to establish greater uniformity in GHG emissions accounting and reporting across pharmaceutical and medical device 'life-cycles' from manufacturing through usage to disposal. As part of this engagement, the SDU created a list of the top 20 pharmaceuticals with high GHG emissions accounting for 60% of their carbon footprint, which then have been targeted for reductions. Optimization of medical device use can begin with an examination of where large volumes of unused medical devices are being discarded, often in

operating rooms and surgical theatres, and explore opportunities for medical device reprocessing (Kagoma et al. 2012).

Resources:

- Carbon footprinting pharmaceuticals and medical devices from SDU
- Guidelines for the procurement of safer medical devices from SDU

Transportation

Transport systems are key resources for HCFs, which rely heavily on these networks to move supplies, contractors, patients, staff, laboratory samples, and wastes. For some facilities, transportation systems are required for offsite services such as laundry, sterilization, and the preparation of food. Climate-related events such as floods, severe storms, and wildfires can restrict access to transportation services, with the potential to disrupt the delivery of critical health care.

Notably, the transportation sector is the second largest source of GHG emissions in Canada, accounting for 25% (173 Mt CO^2 eq) of the national total. Transportation GHG emissions grew by 42% between 1990 and 2016, largely due to an increase in freight trucks and passenger light trucks. In addition to carbon dioxide, transportation sector activity produces other air pollutants like nitrogen oxides that convert into atmospheric ozone and contribute to the greenhouse effect, as well as particulate matter, volatile organic compounds, and other substances known to be harmful to health (ECCC. 2018).

Seattle Children's Hospital has been leading sustainable transportation efforts in the area of its workforce commuting by reducing drive-alone trips among staff traveling to and from the facility from 73% to 38% between 1995 and 2015.

This achievement was accomplished by charging daily parking rates, offering generous subsidies and incentives to use lower-impact commuting options, working with the city and county on local bicycling, pedestrian, and transit improvements, and providing personalized commute planning to every new employee.

There are many simple transportation initiatives that health care workers can support to be implemented at HCFs, including anti-idling initiatives, ride-share programs, and hospital-sponsored public transit incentives.

Active Travel

Active travel in the context of HCFs refers to using public transit and physically active modes of transportation like walking and bicycling to reduce the frequency of single-occupancy vehicle commuting. Supporting active travel can have many co-benefits for HCFs, including reduced need for staff parking areas, reduced traffic congestion allow-

ing for easier emergency vehicle access, improved local air quality, and more physically fit and healthy staff.

Active travel initiatives undertaken by HCFs could include surveying staff about their current commuting habits and interest in alternatives, offering bicycle repair workshops and providing bicycle racks, parking cages, and shower areas for cyclists, developing incentives and/or subsidies for staff to use lower-impact options such as transit, charging daily parking rates, providing shuttle buses between campuses, and supporting car-pooling initiatives. CAPE's Active Travel toolkit found in the resources below, provides additional information on these types of programs.

Cleaner Transportation and Fleets

Electric vehicles, or 'low emission' vehicles, can contribute to lowering overall GHG emissions. These vehicles can be encouraged at HCF sites by educating staff on the benefits of electric vehicles, installing electric vehicle charging stations, and providing preferred parking areas for these types of vehicles. Greening HCF fleets by switching to electric and/or hybrid vehicles could further contribute to lowering GHG emissions.

> ***Energy saving ambulances:*** *The Peterborough County-City Paramedics will be the first emergency responders in North America to use custom-designed, eco-friendly ambulances which mimic models used in Europe. Peterborough County-City Paramedics purchased three New Era ambulances in 2018 that have solar panels on the roof and a mechanism that puts the vehicle to sleep when its idling and monitors battery systems, reviving it up when needed (Nyznik, 2018).*

Support Suppliers who are committed to Green Transportation

The US EPA's SmartWay program helps companies apply sustainability to their supply chains by measuring, benchmarking, and improving freight transportation efficiency. This American-based program also collaborates with organizations in Canada to help reduce their emissions for a more sustainable freight transportation supply chain throughout North America, overall.

In England, the Sustainable Development Unit (SDU's) Health Outcomes of Travel Tool (HOTT) helps HCF organisations to measure the impact of their travel and transportation in environmental, financial, and health terms. The HOTT facilitates the quantification of impacts, including air and noise pollution, road traffic incidents, and greenhouse trav-

Garden on Hospital Grounds, Halifax, Nova Scotia. Photo by Kim Perrotta.

el and transportation impacts from different travel modalities to help develop a plan and targeted initiatives that reduce the health sector's impact from travel and transport.

Telemedicine and Tele-health

In studies by Holmner et al.(2014), and Masino et al.(2010), telemedicine and tele-health were seen as excellent opportunities to reduce GHG emissions from health sector travel. For distances over a few kilometers, telemedicine appointments can result in a 40- to 70-fold decrease in carbon emissions compared to alternative transportation by single-occupancy vehicle. In comparison, GHG emissions produced for the energy used in videoconference units were minor.

Persuading and training potential users to adopt telemedicine and tele-health as tools to be integrated into their regular practices was identified by the researchers as an important next step. Co-benefits of this approach include increased efficiency and reduced system costs. Advancing the uptake of telemedicine also presents an opportunity to improve delivery of care in areas where access and transportation can be challenging, such as remote communities and regions in northern Canada. Accordingly, the Lancet Countdown Report Briefing for Canadian Policy Makers identified Telemedicine as a nationally-relevant opportunity for Canada to reduce its GHG emissions (Howard et al. 2017).

The Ontario Telemedicine Network (OTN) is one of the largest tele-health organizations in the world, with the mission to 'develop and support telemedicine solutions that enhance access and quality of health care in Ontario, and inspire adop-

Resources:

- Seattle Children's Hospital Comprehensive Transportation Plan
- Prescribing Active Travel for Healthy People and Planet: A Toolkit for Healthcare Professionals. CAPE, March 2017
- SmartWay, U.S. EPA's Sustainable Transportation Tool
- HOTT, SDU's sustainable transportation tool
- Ontario Telemedicine Network

tion by health care providers, organizations, and the public'. Funded by the Ontario Government, OTN has extensive telemedicine networks, and has been working to mainstream virtual access for health care delivery and education over the past decade. On a smaller scale, tele-networking systems such as audio, video, and web conferencing can be effective tools for holding virtual meetings.

Food

Canadian HCFs spend more than $4 billion on food annually, and are thought to be discarding up to 50% of the food served (Nourish Infographic). The agricultural sector (defined as non-energy crop and animal production) contributes approximately 5% of total health care GHG emissions, primarily from nitrous oxide emissions from fertilizers and methane from ruminant animals, underscoring the interlinkages between the healthcare system and the food system (Eckleman et al. 2018). Broken down further, agricultural production accounted for 30% of national methane emissions, and 77% of national nitrogen oxide emissions, with livestock and fertilizers as the main contributors (Eckleman et al. 2018).

Canada's new food guide and the EAT-Lancet Commission on Food, Planet and Health (see resources below) both stress a need to reduce the consumption of meat in our diets, to support our personal health and the health of our planet, while reducing GHG emissions. As such, HCFs have an opportunity to design menus that model sustainable, more plant-based diets which could enable a shift to low-carbon foods and healthier sourcing for people and the planet. As one example, a two-year initiative known as Nourish, which supported 25 health care food innovators across Canada up to 2019 to explore how specific sustainable food initiatives could be implemented to leverage food budgets and the reputational credibility of the health care sector in order to improve health outcomes (Nourish website).

Resources:

- Nourish Health Care Food infographic
- Canadian Coalition for Green Health Care – Food Waste Resources
- The EAT-Lancet Commission on Food, Planet, Health
- Canada's new food guide

Leadership

A report by Miller et al. (2018) concluded that health system leaders are at least somewhat aware of climate change, but very few regard it as an important factor affecting their work or patients' health. This

lack of awareness presents an opportunity for action to raise awareness and build climate leadership within the health system in Canada.

A new initiative by the CCGHC to address this leadership deficit is the Green Health Leaders program, which seeks to engage and support leaders to move their organization toward new levels of stewardship in climate change and environmental sustainability. In other countries, health care leaders have already assumed a leadership role, and become advocates for climate change as a health issue. One example is the Health Care Climate Council in the United States, which was established by Health Care Without Harm in 2014 as a leadership body to coordinate health systems committed to protecting their patients and employees from the health impacts of climate change. The Council recognizes their organizations as anchors for resilience in their communities. Mitigation, resilience, and adaptation are important priorities for the Council. With respect to leadership, Council members agree to act as critical messengers in communicating the health impacts of climate change, and to advocate for climate-smart policies at all levels of government.

Resources:

- Green Health Leaders Initiative, a project of the Canadian Coalition for Green Health Care
- Health Care Climate Council
- Climate Action, a playbook for hospitals

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