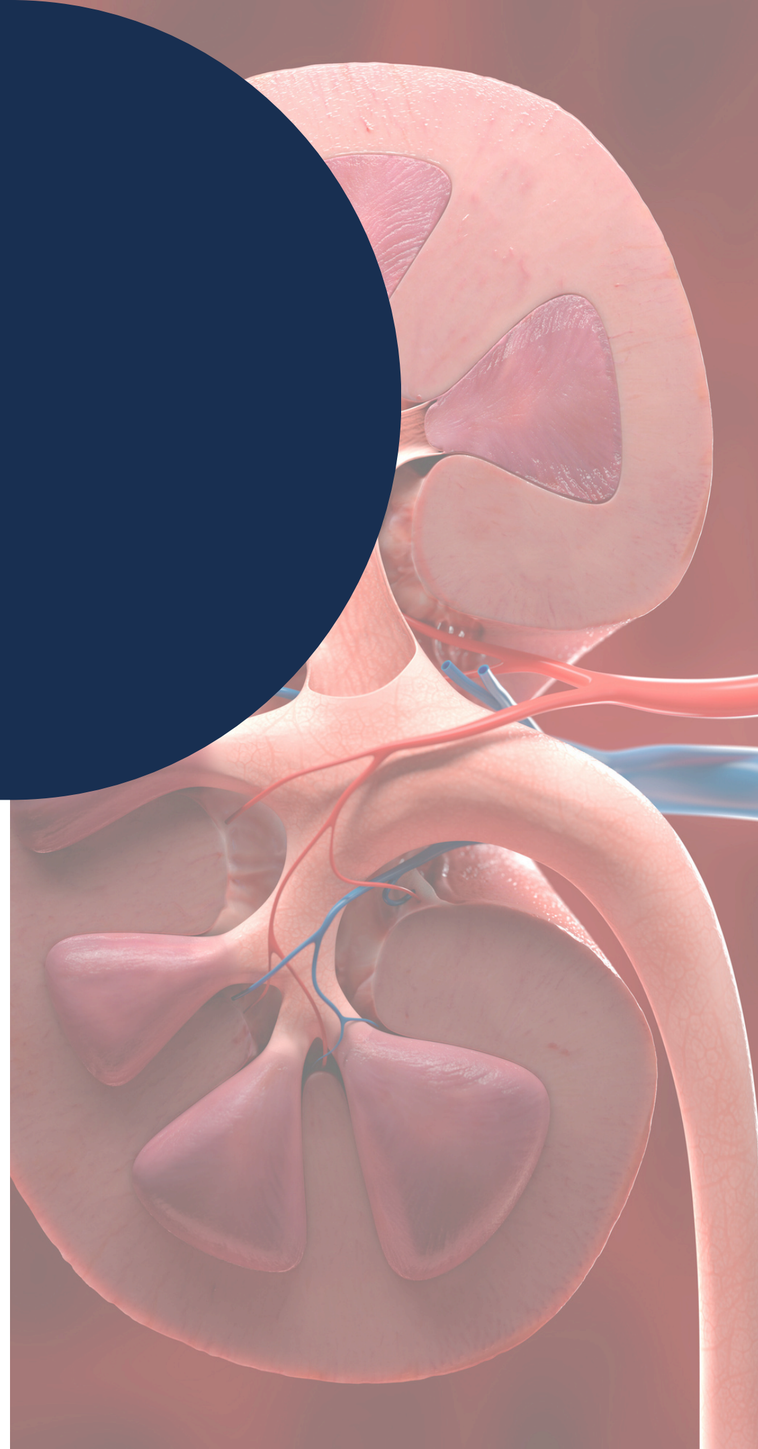
SUSTAINABLE KIDNEY CARE

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



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Canada

CASCADES

SNAP
Sustainable Nephrology Action Planning

Canadian Society of Nephrology/
Société canadienne de néphrologie
CSN/SCN

NAVIGATION

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

INTRODUCTION

This playbook is intended for all kidney health professionals and advocates. Patients, technicians, nurses, dieticians, pharmacists, administrators, nephrologists and industry partners all have important roles to play in providing quality kidney care while mitigating the impact of climate change and fostering responsible resource use.

The playbook intends to:

1. Inform of the reciprocal relationship between climate change and kidney health.
2. Provide knowledge and tools to guide implementation and practice of environmentally sustainable kidney care (ESKC).
3. Inspire action using examples from Canadian settings and practitioners of ESKC.

Suggested citation

Stigant C, Nour S, Finkle N, Devitt K. Sustainable Kidney Care version 2.0 (2024) [Internet]. CASCADES (Creating a Sustainable Canadian Health System in a Climate Crisis). [Cited DATE]. Available from https://cascadescanada.ca/resources/sustainable-kidney-care-playbook/

PLAYBOOK STRUCTURE

WHY
The Case for Change

WHAT
The Tools for Change

HOW
Strategy and Partnerships

WHY

The Case for Change

1. Impact of Kidney Disease on Climate Change
2. Impact of Climate Change on Kidney Disease
3. Kidney Care Requires Extensive and Uninterrupted Resources

A Call to Action

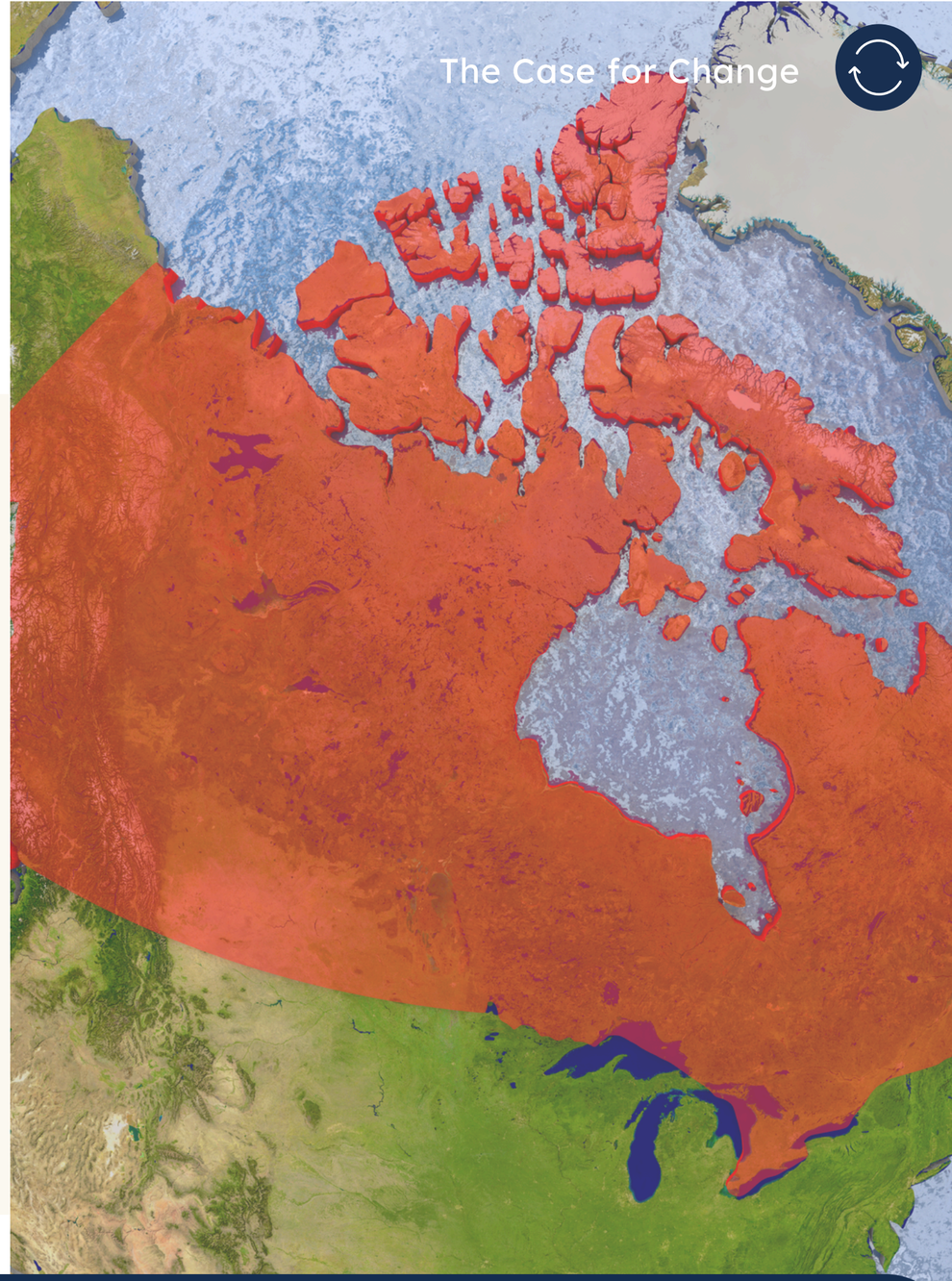
Chronic kidney disease (CKD) is recognized as a major global health concern; the prevalence of CKD has increased by 33% from 1990 to 2017 globally (1) and it is recognized that climate change is contributing to the prevalence of CKD. (2) Canada is vulnerable to the effects of climate change including increased temperatures and an increase in extreme climate events, wildfires, flooding and heat waves. (3-5) Yet, the Canadian healthcare system contributes significantly to the high levels of greenhouse gas (GHG) emissions, being responsible for 4.6% of Canada's total emissions. (6)

As a progressive disease, CKD has disproportionately high economic and environmental impact on healthcare systems. (7) In the treatment of kidney disease, kidney therapies, such as medications, hemodialysis (HD) and peritoneal dialysis (PD) require significant resources that have disproportionately high environmental impact. (2,8)

Fine Particulate Matter (PM2.5) Air Pollution: A Driver of CKD Nationally and Globally

Fine particulate matter (PM2.5) are airborne particles the diameter of up to 2.5 micrometer. The small size of the PM2.5 can easily penetrate through the lungs and enter the bloodstream (9), increasing risk for respiratory and cardiovascular diseases and other adverse health outcomes. (10)

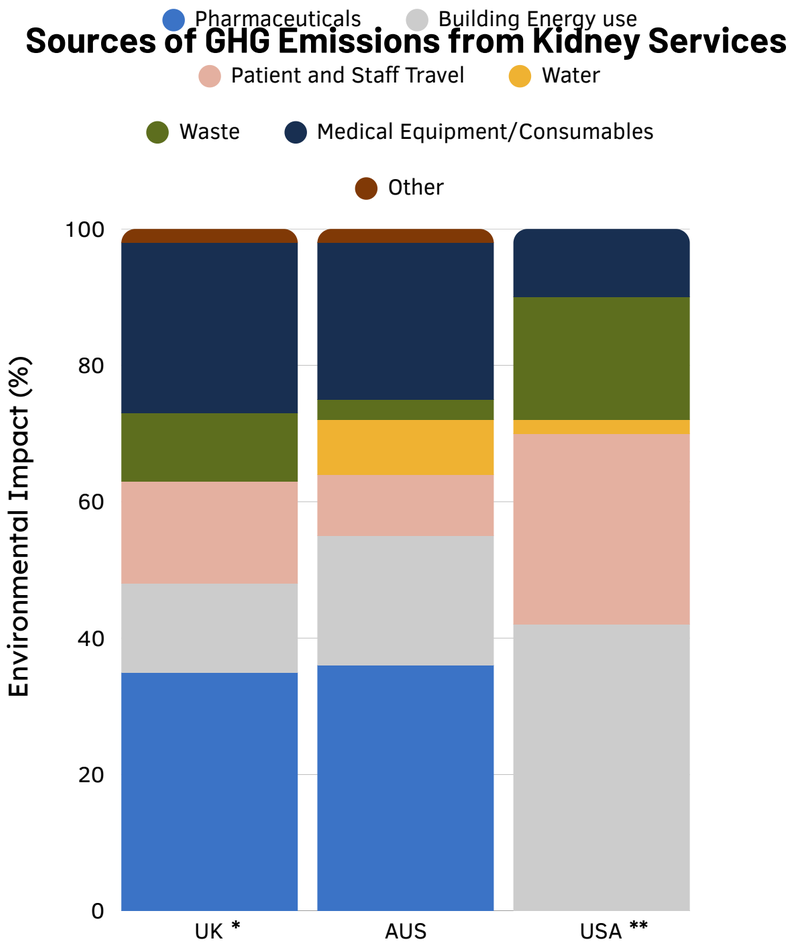
PM2.5 air pollution is associated with 3.2 million cases of CKD globally per year, including between 64 000 to 106 000 prevalent CKD cases in Canada. (11) The link between PM2.5 and kidney disease warrants urgent action to address air quality and sources of air pollution.



ENVIRONMENTAL IMPACT OF KIDNEY CARE SERVICES: OVERVIEW

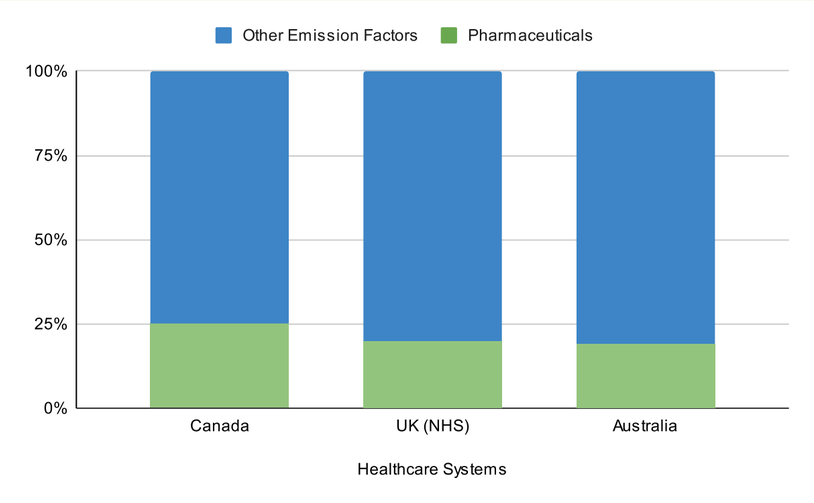
Sectors and resources involved in the operation and provision of kidney care, including procurement, pharmaceuticals, water, electricity, transportation and waste management (12, 13) – are all well known to be carbon intensive hence resultant GHG emissions are expected to intensify as ESKD prevalence increases in Canada. (14)

The Canadian healthcare system is confronted with the challenges of implementing climate adaptation strategies. Mitigating the environmental impact of kidney care also requires a robust multi-sector approach involving primary care to enhance CKD prevention, early detection and delayed progression. A shift towards sustainable kidney care requires health systems to prioritize low carbon interventions and invest in sustainable infrastructure to reduce its environmental burden at each stage of CKD.



*Water contributed to 0.20% of GHG emissions, although 22 million litres of water was used annually for HD treatments. (Connor, 2010)
**Pharmaceuticals were not included. (Sehgal, 2022)

PHARMACEUTICALS



The emissions from pharmaceuticals in kidney care services are comparable between health systems of high income countries, contributing as much as 25% of Canada's healthcare GHG emissions. Within kidney care, pharmaceutical sourced emissions account for approximately 35% of total GHG emissions due to polypharmacy and significant use of single-use, prepackaged medications. (6, 12, 13)

Impact of Kidney Disease on Climate Change

KIDNEY CARE SERVICES HAVE SIGNIFICANT ENVIRONMENTAL IMPACT

Dialysis therapies for people living with kidney failure have disproportionately large environmental impact across the spectrum of care, requiring large amounts of water, electricity, and consumables, while generating significant waste. (2)
The magnitude of emissions related to operating dialysis facilities encompasses both direct and indirect sources, ranging from heating/cooling buildings, lighting, powering electronics such as dialysis machines and reverse osmosis systems, and travel to and from facilities (8). The anticipated increase in people living with kidney failure is expected to intensify the environmental impacts of kidney therapies (2).

Emissions factor for pharmaceuticals from a UK renal service: **0.80 kg CO2 per £** * (12)
This is equivalent to 0.45 kg CO2 per CAD**

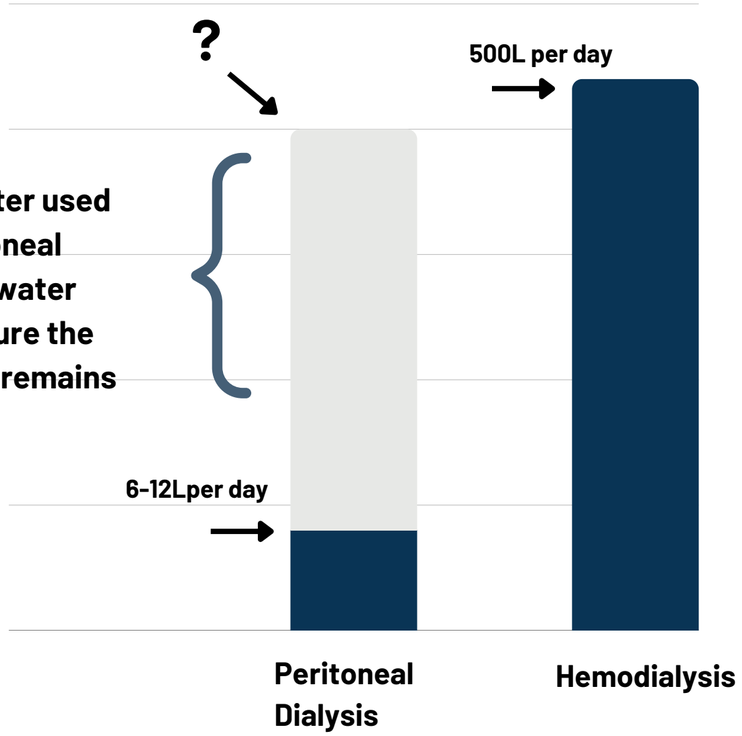
SOURCE	HEMODIALYSIS	PERITONEAL DIALYSIS
Water	• Up to 500 L used per 4 hour therapy (2, 15) • Cumulative water use per patient per year: up to 80,000 L (16) • Hemodiafiltration uses 10-30% more water than conventional HD (17)	• 6-12 L of fluids used per patient per day (depending on dialysis prescription)* (2, 15)
Electricity	Electricity use from dialysis related equipment: ◦ 4 kWh per 4 hour home HD therapy (18) ◦ 5.2 kWh per 4 hour therapy at Home HD training unit (19) • 25.9kWh per 3.8 hour session (includes dialysis equipment and building energy use) (8)	Electricity use from PD related equipment: ◦ 18.3 kWh for 70 hours of automated PD per week - this includes running the machine, automated PD machine preparation and warmer (20)
Plastic Use and Waste Production	• One facility audit reported 2.5 kg of total clinical waste generated per treatment (21) • Polyvinyl chloride (PVC) plastics made up 0.65kg (26%) of total waste (21) • Cumulative waste production per patient per year: 390kg (21)	• One facility audit reported 1.69 kg of total clinical waste generated per 24 hour of therapy* (21) • PVC plastics made up 0.94 kg (56%) of total waste per day (21) • Cumulative waste production per patient per year: 617 kg (21)

*Expenditure data based from Connor et al., 2010
**Reflects current market value as of July 26, 2024

*Based on performing 4 exchanges per day by continuous ambulatory PD.

PERITONEAL DIALYSIS ENVIRONMENTAL IMPACT: WATER CONSUMPTION

It is assumed that PD uses less water than HD. However, when direct and indirect sources of water consumption are measured, the assumption that PD uses significantly less water compared with HD is challenged. Water is a finite, and in some regions a scarce resource hence sustainable dialysis may include innovative technologies that address water consumption and waste. (2, 15)



Hidden Sources of Water Consumption in PD

Water required to produce PD dialysate

Data have remained proprietary to date, however, it is estimated that 1 L of PD dialysate requires several litres of water. (2, 15)

PD plastic packaging

An empty 2L PD dialysate bag requires 28L of water to manufacture. (2, 16)

Impact of Climate Change on Kidney Disease

CLIMATE CHANGE IS ASSOCIATED WITH INCREASED INCIDENCE OF KIDNEY DISEASE

Extreme heat, particle pollution, and other climate change effects are linked to an increased incidence of CKD globally. (11, 22) This results in greater need for kidney care services including medications, consumables, energy use, waste management and transportation. The high resource of these inputs contributes to health care's significant environmental impact. (2, 8)

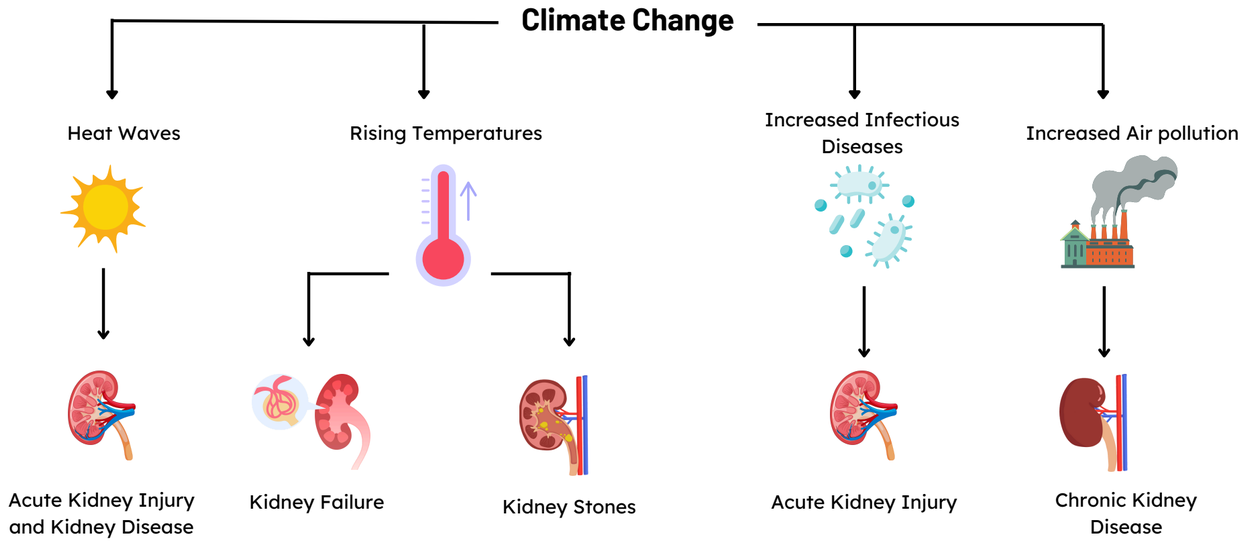


Figure 1. Climate change and their effect on the incidence and distribution of kidney disease. Adapted from Young et al. (2023)

KIDNEY DISEASE AND CLIMATE CHANGE EACH WORSEN THE OTHER

As the number of ESKD patients continue to rise across Canada, so does the need for kidney replacement therapies. The prevalence of Canadians either requiring dialysis or receiving a kidney transplant has increased by 24% in the last 10 years. (23)

Although there are no studies that directly link climate change to the rise in ESKD in Canada, one study showed a strong link between particle pollution exposure and risk of CKD globally. (11) Higher global temperatures and extreme weather events are expected to contribute to increases in both acute and CKD. (14, 24)

Kidney Care Requires Extensive and Uninterrupted Resources

PEOPLE LIVING WITH KIDNEY DISEASE ARE VULNERABLE TO CLIMATE CHANGE

Kidney patients, even those with a transplant, require uninterrupted supply chains for access to vital therapies. People who rely on dialysis therapies need reliable access to consistently operating dialysis infrastructure.

Kidney therapies depend on robust infrastructure to reliably provide water and electricity and to supply consumable products and pharmaceuticals. (2, 25). Climate change is already impacting infrastructure and access to kidney care in vulnerable zones in Canada. These extreme weather events such as heat waves, floods and fires are expected to increase in Canada in both frequency and intensity, thereby further straining healthcare resources. (3-5, 26)

WHY SHOULD KIDNEY CARE PROVIDERS CARE ABOUT CLIMATE CHANGE?

- Climate Change is increasing kidney disease rates, and therapies for patients with kidney disease are contributing to the climate crisis. (27)
- Life sustaining therapies for patients with ESKD are associated with poor outcomes and significant symptom and financial burdens. (28) Increasing efforts in primary and preventative care, especially in high-risk populations can reduce the volume of patients needing life sustaining therapies and mitigate the burden of kidney disease for patients, the healthcare system and the climate. (29)
- Extreme weather events associated with climate change can harm dialysis infrastructure and threaten patient access to care. (25)

'If I don't get dialysis, I drop dead': Chilliwack dialysis patients cut off by flooding flown to care

As tourists flock to Montreal for F1 race, Cree dialysis patients who fled fires are on the move again

AHS assisting NWT evacuee patients

Evacuated Williams Lake patients receiving dialysis in Prince George

WHAT

The Tools for Change

1. Build Individual and Organizational Capacity
2. Reduce End-Stage Kidney Disease and Optimize use of Non-Dialysis Therapies
3. Prescribe Optimally
4. Explore Climate Conscious Infrastructure

Overview of Action Areas

Build Individual and Organizational Capacity	Reduce End-Stage Kidney Disease and Optimize use of Non-Dialysis Therapies	Prescribe Optimally	Explore Climate Conscious Infrastructure
Action 1: Understand the Connections Between Kidney Disease and Climate Change	Action 3: Promote Early Recognition of CKD Risk Factors and Timely Diagnosis, and Optimal Uptake of Preventative Therapies	Action 6: Engage in Medication Stewardship	Action 8: Incorporate Sustainable Hemodialysis Technologies
Action 2: Establish a Sustainability Role or Team within Every Kidney Care Program	Action 4: Optimize Uptake of Kidney Transplantation	Action 7: Consider Clinically Appropriate Prescription Modifications for End-Stage Disease Therapies	Action 9: Advocate for Low Carbon Transportation
	Action 5: Consider Conservative Management of ESKD when appropriate		Action 10: Build Climate Resilient Infrastructure

Build Individual and Organizational Capacity

ACTION 1: UNDERSTAND THE CONNECTIONS BETWEEN KIDNEY DISEASE AND CLIMATE CHANGE

Climate change and kidney disease can be illustrated in a circular relationship. Kidney care therapies are contributing to climate change and climate change is contributing to a rise in climate-related kidney disease globally. (30, 31)

Kidney care providers should understand local patient and care system vulnerabilities to climate change and plan accordingly. (32-34)

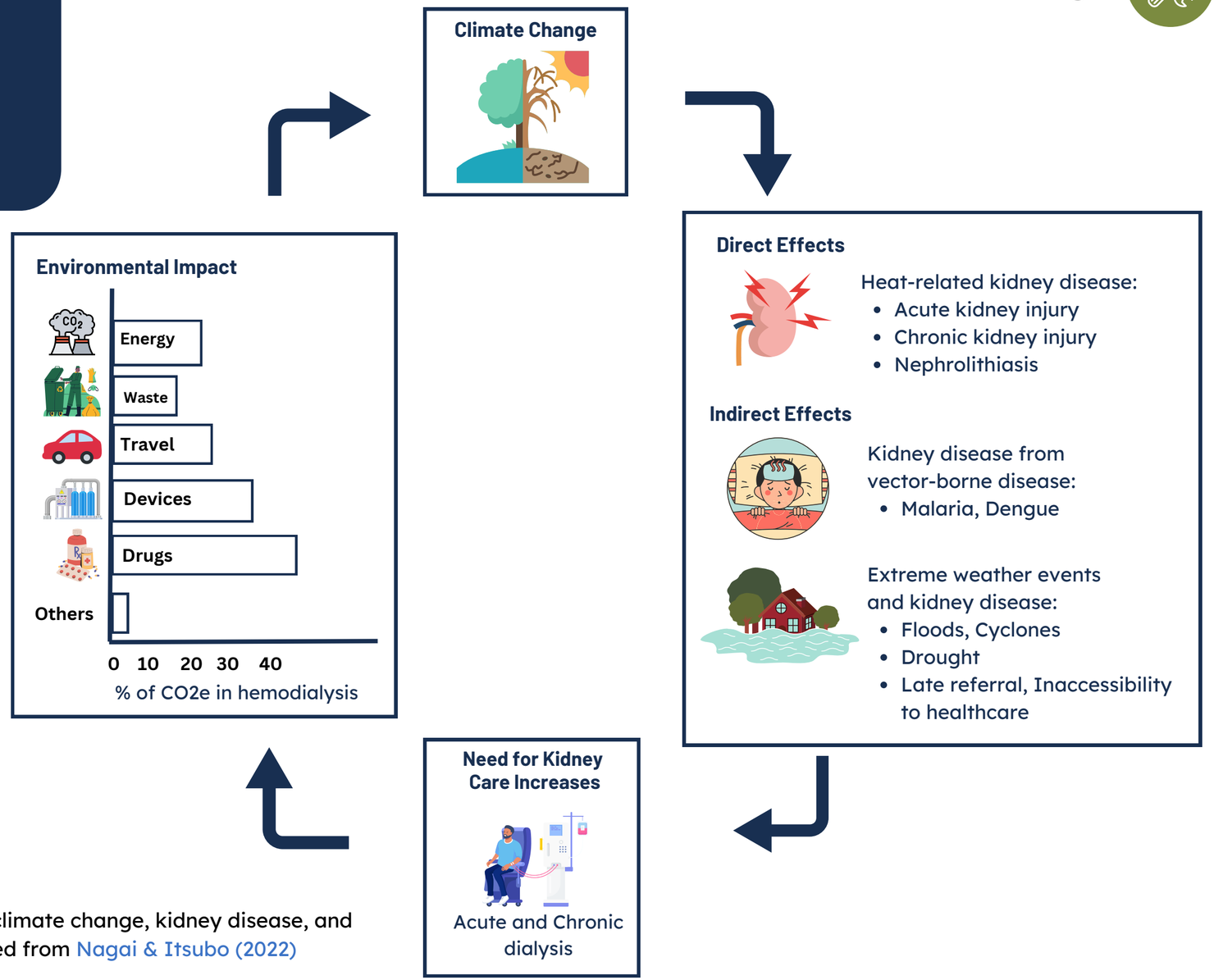


Figure 2. Cycle of climate change, kidney disease, and healthcare. Adapted from Nagai & Itsubo (2022)

Many nephrologists and professional societies have acknowledged the impact of kidney therapies on the environment and have taken action to educate, advocate or implement practice changes. Stigant et al. designed a framework of environmentally sustainable quality kidney care that prioritizes health promotion, early disease recognition, and effective therapies to slow disease progression and prevent hospital visits. This framework is relevant to all aspects of kidney care. Situating kidney care actions by stage of kidney function can help providers develop appropriate ESKC policies and practice change. (27)

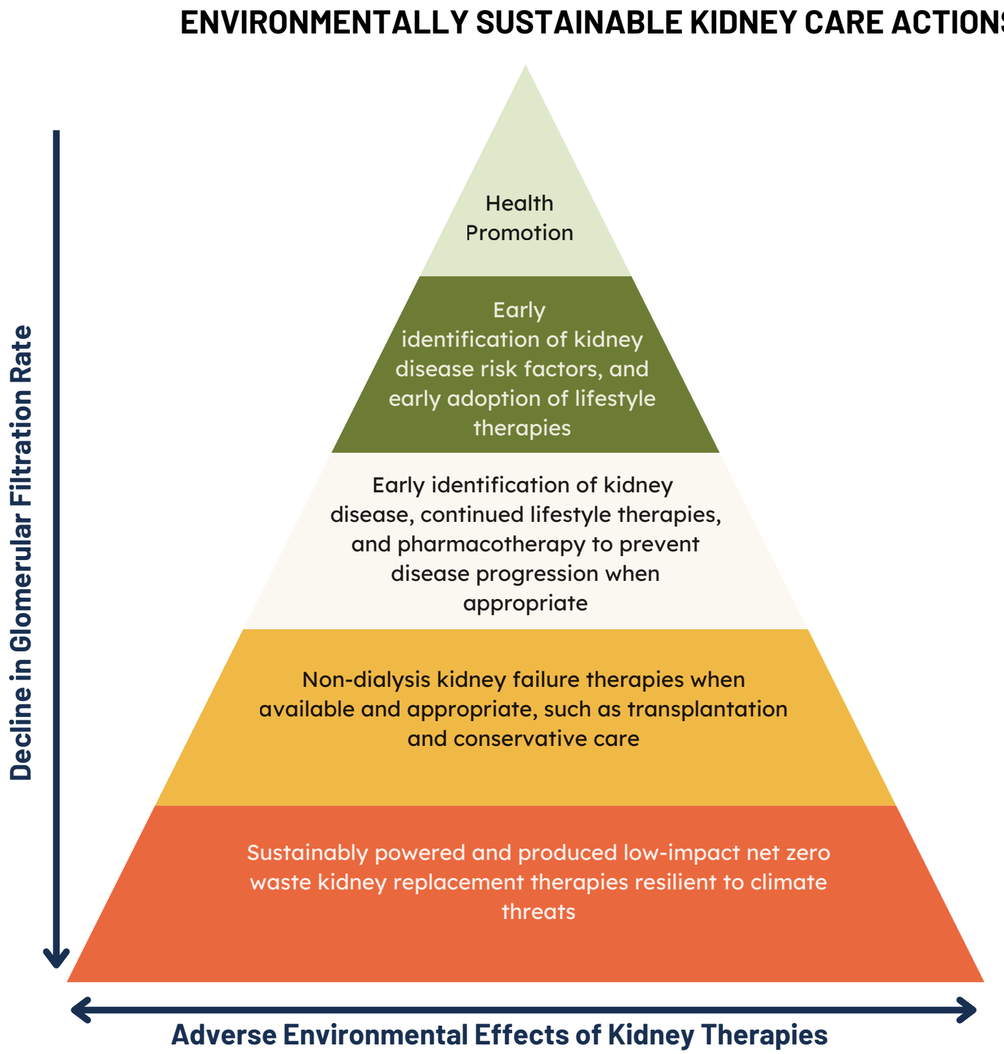


Figure 3. Framework of environmentally sustainable quality kidney care. Adapted from Stigant et al. (2023)

RESOURCES

- Sustainable Kidney Care Infographic, CASCADES
- Sustainable Nephrology Action Planning (SNAP)
  - mission is to educate, innovate and advocate for sustainable kidney care.
- "The Necessity of Environmentally Sustainable Kidney Care"
  - highlights the importance of integrating ESKC in the Canadian setting.
- International Society of Nephrology GREEN-K initiative
  - outlines the field of ESKC and calls for the global kidney care community to collaborate in the evolution towards low-carbon kidney care.
- UK Kidney Association - Sustainable Kidney Care Committee
  - aims to reduce UK's kidney care climate impact, through education, partnership, and advocacy.

ACTION 2: ESTABLISH A SUSTAINABILITY ROLE OR TEAM WITHIN EVERY KIDNEY CARE PROGRAM

"Embedding environmental sustainability into health care quality supports its inclusion as a pre-requisite, goal, and overall outcome of high-quality care." (35)

Embed a Culture of Sustainability in the organization by:

- Scanning or surveying clinical and non-clinical care areas to evaluate where potential sustainable interventions could be implemented
- Assessing existing policies and practices to establish metrics and goals for sustainability projects
- Auditing impact of practice change through iterative data collection and analysis
- Identifying barriers and developing strategies to overcome them
- Performing ongoing assessments to ensure sustainability initiatives' efficiencies in patient care and unit operation (36, 37)

Sustainability Team in Kidney Care

'Green Team' Committee → **ESKC Goals and Projects** → **Evaluate Improvement Projects**

RESOURCES

- Strategic Planning for Planetary Health and Sustainable Care
  - Readiness Assessment Tool
- Organizational Readiness for Sustainability, CASCADES
  - Playbook
  - Infographic
- Training for Better Health Outcomes: Integrating Sustainability into Healthcare Quality Improvement Educations Project, CASCADES
- Planetary Health for Primary Care, CASCADES
- Project Charter, CASCADES
  - A tool to help structure your sustainability goals
- Sustainability in Quality Improvement (SusQI), Centre for Sustainable Healthcare
- Sustainability Series: Green Nephrology Guides, Centre for Sustainable Healthcare
- Green Excellence in Dialysis: Recommendations for Sustainable Kidney Care (European Dialysis and Transplant Nurses Association/European Renal Care Association)
- Green Workplaces Opportunities Guide, BC Green Care
- Green Office Toolkit, Canadian Coalition for Green Healthcare
- In-centre Haemodialysis Carbon Calculator

Reduce End-Stage Kidney Disease and Optimize use of Dialysis Therapies

ACTION 3: PROMOTE EARLY RECOGNITION OF CKD RISK FACTORS, TIMELY DIAGNOSIS, AND OPTIMAL UPTAKE OF PREVENTATIVE THERAPIES

Screening for CKD in high-risk populations (i.e., hypertension, diabetes and cardiovascular disease) can improve early detection of CKD and enable timely initiation of treatment.

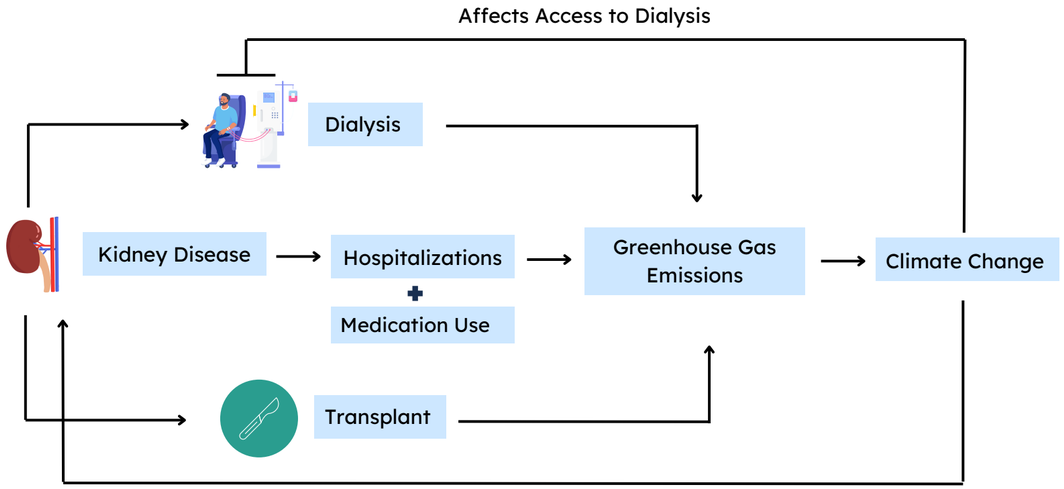


Figure 4. Increased incidence of kidney disease leads to increased medication use, hospitalizations, dialysis and transplant. Adapted from Young et al. (2023) and Kitzler & Chun (2023)

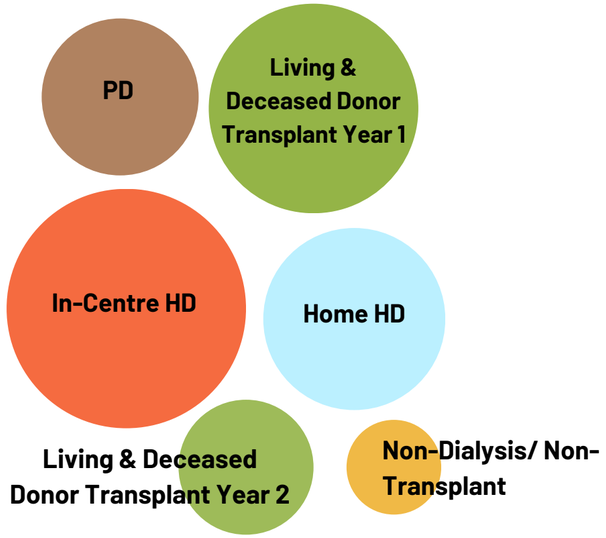
A robust primary care system can work upstream of and with kidney care programs to prevent CKD, slow its progression and reduce incidence of ESKD; all are sustainable approaches to reduce the burden of CKD on patients and healthcare systems. (29, 39)

Despite insufficient data, carbon emissions associated with pre-dialysis CKD care are presumed to be significantly less compared to ESKD therapies due to lower treatment related costs and resource use. (25)

In Canada, it is estimated that the annual cost of care for non-dialysis or non-transplant CKD patients (including their other attributable co-morbidities) is $32 billion. Canadians on dialysis represent 0.06% of the total population, yet the cost of care in Canada is about $2.5 billion annually. (40, 41) As CKD progresses, healthcare costs and resource-intensive treatments rise. Interventions that slow or prevent ESKD and optimize early CKD management is key to reducing kidney care's environmental impact and cost-savings for healthcare systems. (42)

In Canada, the estimated annual per patient cost of CKD (non-dialysis/non-transplant) care is about $14 600, whereas for ESKD treatment, it can significantly vary depending on the care modality. (42) These differences are mainly attributed to resource use and setting. Increasing efforts to slow CKD progression, extending the non-dialysis/non-transplant time and optimizing uptake of lower cost-lower impact modalities are strategies that can improve the overall environmental impact of kidney care.

Average Annual Cost of Care for CKD/ESKD Modalities



In-Centre HD:
- $95 000 to $107 000

Home HD:
- $71 000 to $90 000

PD:
- $56 000

Living & Deceased Donor Transplant Year 1*:
- $76 000 to $80 000

Living & Deceased Donor Transplant Year 2**:
- $20 000 to $22 000

(43, 44)

*This estimate represents the cost associated with the recipient and does not include the additional costs associated with the live and deceased donor, such as pre-transplant work up, graft removal/surgery and post-surgery follow-up (live donor). The added costs from the donor is about $21 000 to $37 000.

**Represents costs for maintaining the transplant; mainly attributed to the use of medications such as immunosuppressants.

CKD Risk Factors	Management Strategies for Prevention and Treatment of Early CKD
• Hypertension • Diabetes • Cardiovascular disease • Family history of CKD • Prior acute kidney injury • Genetic risk factors • Other system diseases that impact kidney function • Older age • Environmental exposure (45)	• Smoking cessation • Regular exercise • Balanced diet (low sodium intake; adequate dietary vegetable and potassium intake) • Management of pre- existing chronic conditions • Limiting alcohol intake • Pharmacotherapies (45,46)

RESOURCES

- International Society of Nephrology (ISN) & Kidney Disease Improving Global Outcomes (KDIGO)
  - CKD Early Identification & Intervention Toolkit
- Patient Pamphlet - Chronic Kidney Disease: Making Hard Choices, Choosing Wisely Canada
- Nephrology: Five Tests and Treatments to Question, Choosing Wisely Canada
- KidneyWise Toolkit, Ontario Renal Network (ORN)
  - Provides Ontario care recommendations for nephrologist referral (exact referral patterns vary across Canada).
- National Smoking Cessation Program, QuitNow
- Canadian Task Force on Preventive Healthcare

ACTION 4: OPTIMIZE UPTAKE OF KIDNEY TRANSPLANTATION

Transplantation improves survival and offers patients a better quality of life. The 5-year survival rate for a kidney transplant is 92% for a living donor transplant whereas the 5-year survival rate for patients on dialysis is 43.9%. (47)

While studies are ongoing, early evidence suggests that the environmental impact of kidney transplantation may have 90-95% lower GHG emissions compared to dialysis therapies. (48, 49) Improving access to kidney transplant programs can save water, energy, and waste generated from dialysis therapies. Carbon footprint measurements for kidney transplant care are needed.

Benefits of Kidney Transplantation

- Improved quality of life
- Lower healthcare costs
- Lower therapy-associated emissions

(43, 49-51)

Spotlight: *Transplant First*

Transplant First is a joint initiative by the BC Renal's Kidney Care Clinic (KCC) Committee and BC Transplant to promote uptake of pre-emptive kidney transplantation and promote live donation by streamlining and standardizing the screening and consultation process for both the donor and recipient. CKD patients with eGFR below 25ml/min are given education and the choice of transplant as a treatment option, appropriate testing is efficiently undertaken, and potential donor and recipient are supported throughout the pre-transplant process. (52, 53)

In Canada, it takes an average of 1.1 years to receive a living donor kidney transplant and 3.3 years for a deceased donor kidney transplant. (54)

CURRENT CHALLENGES IN KIDNEY TRANSPLANTATION

- Kidney transplantation can be difficult to access due to insufficient organ supply and lengthy recipient/donor evaluation process. (54)
- In 2021, 2% of Canadians with kidney failure received a pre-emptive transplant. (54)
- Increasing uptake is needed for expansion of both live donor and deceased donor programs. (27)
- There is a lack of standard practice guidelines at the national level for primary care physicians and nephrologists in implementing pre-emptive transplantation care as patients transition from CKD to ESKD prior to starting dialysis.

Robust efforts targeting CKD patients prior to ESKD can allow earlier access to kidney transplant evaluation and potentially enhance uptake of transplantation, thus minimizing need for dialysis.

RESOURCES

- Living Donor Kidney Transplant, BC Renal
- Transplant First: Workflow Review & Consultation, BC Renal
- "Protocol for a Process Evaluation of the Quality Improvement Intervention to Enhance Access to Kidney Transplantation and Living Kidney Donation (EnAKT LKD) Cluster-Randomized Clinical Trial."
  - This is an area of active research in Canada to help increase CKD patient access to kidney transplantation.

ACTION 5: CONSIDER CONSERVATIVE MANAGEMENT OF CKD WHEN APPROPRIATE

Choosing conservative management over dialysis or transplantation should involve a comprehensive discussion between a patient, their family, caregiver and their healthcare team.

CKD patients approaching kidney failure are faced with choosing conservative kidney management or a kidney replacement therapy. When appropriate, the kidney care team may initiate conversations on conservative kidney management with sensitivity, providing patients time and resources to determine if conservative care aligns with their goals of care.

In some cases, kidney replacement therapies may not be beneficial, as they may not improve health outcomes or quality of life. Patients who choose conservative kidney management may therefore be spared unnecessary treatments and/or hospitalizations. For chronic dialysis patients, the kidney care team could also support a patient's choice to discontinue treatment. (55)

Conservative Management Care Pathway

- Ongoing supportive care and discussion of advanced care plan
- Pain and symptom management
- Referral to palliative care team
- Bereavement support for family

(56)

RESOURCES

- Conservative Care Pathway, BC Renal
- Care Team Guide: Transition from Dialysis Treatment to Palliative Care, BC Renal
- Key Elements of Conservative Renal Care, Ontario Renal Network (ORN)
- Conservative Renal Care: Resource for Healthcare Providers, Ontario Renal Network (ORN)
- Palliative Care Tools, Ontario Renal Network (ORN)

Prescribe Optimally

ACTION 6: ENGAGE IN MEDICATION STEWARDSHIP

MEDICATION STEWARDSHIP PRACTICES IN KIDNEY CARE CAN PROMOTE SAFER PRESCRIBING WHILE REDUCING PHARMACEUTICAL RELATED CARBON EMISSIONS

Increased symptom burden from ESKD and dialysis is associated with polypharmacy in HD and PD patients. In one study, 25% of medications prescribed to patients on either dialysis modality are considered potentially inappropriate medications. (57)

Medication stewardship involves sustainable, safe and appropriate use of medications by prescribers and all other healthcare staff. This practice prioritizes prescribing clinically necessary medications, discontinuing their use when of no benefit, and prescription renewal or extension only if reasonable benefit and/or ongoing clinical indication. Medication stewardship can also reduce costs and resources associated with administering certain drugs. For example, the use of intravenous medications are associated with hidden costs such as increased use of single-use plastic materials and increased healthcare staff time to prepare, deliver the medication and monitor its effects. (58, 59)

Case Study: Fraser Health (BC) Transitions to Iron Sucrose IV Push in HD Clinics

2000 doses of Iron sucrose were given monthly at Fraser Health HD clinics which are delivered via 50ml to 100ml normal saline (NS) bags, hence over 2000 IV tubing sets and 2000 NS bags were also consumed.

Fraser Health HD clinics then switched to IV push practice:

- Initial roll out - 490 doses given in the first month, saving 36kg of medical waste associated with IV tubing sets and NS bags (vs one syringe and one vial for IV push)
- Prevents unnecessary excess fluid delivery to patients via NS bags
- Adverse events from IV push was low, similar to the rates of IV Iron Sucrose
- Staff reported that workload was not affected.

MEDICATION STEWARDSHIP CAN BE ESTABLISHED BY:

- Ensuring medications that slow CKD progression are optimally used
- Regular review of patient's medication history to ensure it is up to date and deprescribe potentially inappropriate medications
- Substitute intravenous medications with oral alternative when appropriate, thereby reducing single-use materials (i.e., diluents, needles, syringes, tubing, saline bags)
- Avoid Non-steroidal anti-inflammatory drugs (NSAIDS) in CKD patients
- Avoid concurrent use of angiotensin-converting enzyme (ACE) inhibitors and Angiotensin receptor blockers (ARBs) due to higher risk of acute kidney failure and hyperkalemia
- Prescribe Erythropoietin Stimulating Agents (ESAs) ONLY when clinically indicated (58-60)

STOPMed-HD

STrategic Optimization of Prescription Medication Use in Patients on HemoDialysis.

On average, patients on HD take 12 pills per day.*

STOPMed-HD is a Canadian initiative established by a network of expert nephrologists, healthcare providers, researchers and patients to address polypharmacy in HD via deprescribing tools. (61)

*Another report observed dialysis patients taking up to 19 pills per day; which included 10-12 prescribed medications and the remainder over the counter medications. (62)

RESOURCES

- Climate Resilient, Low Carbon Sustainable Pharmacy Playbook, CASCADES
- Climate Conscious Inhaler Practices in Inpatient Care Playbook, CASCADES
- Climate Conscious Inhaler Prescribing in Outpatient Care Playbook, CASCADES
- Sustainable Inhaler Alternatives, CASCADES
- Inhaler Guide: A clinical guide to inhalers in Canada, CASCADES
- Nephrology: Five Tests and Treatments to Question, Choosing Wisely Canada
- Pharmacists: Six Tests and Treatments to Question, Choosing Wisely Canada
- CKD Early Identification & Intervention Toolkit, International Society of Nephrology (ISN) & Kidney Disease Improving Global Outcomes (KDIGO)
- BC Renal Medication Reconciliation
- STOPMed-HD, Can-SOLVE CKD

ACTION 7: CONSIDER CLINICALLY APPROPRIATE PRESCRIPTION MODIFICATIONS FOR END-STAGE DISEASE THERAPIES

Every patient's kidney care treatment plan should be individualized. Adjusting prescriptions where clinically appropriate may yield modest carbon reductions.

Opportunities to Incorporate Green Dialysis Prescribing

Hemodialysis	Peritoneal Dialysis
• Carefully consider the clinical indications for Hemodiafiltration over HD. (17, 63) • Consider dialysate flow (Qd) reduction when there is no potential negative impact on treatment outcomes and optimize blood-dialysate flow ratio (Qb/Qd ratio). (64-68) • Consider incremental/ decremental prescribing, based on clinical parameters. (69, 70) • Use of NxStage for home dialysis patients when clinical equivalency exists between differing home HD systems. (71) • Consider lowering dialysate temperature by 0.5 C below patient's body temperature, when appropriate. (63, 72)	• Consider continuous ambulatory PD (CAPD) over automated PD (APD) when patient preference and clinical equipoise exist for PD prescription.* (73, 74) • Consider incremental/ decremental prescribing, based on clinical parameters. (76)

*CAPD involves manual exchanges whereas APD uses a cycler requiring additional consumables and power usage for operation. APD is also associated with higher costs compared to CAPD. (50, 75)

Choosing Wisely Canada:
Dialysis Initiation

- Under close supervision of the kidney care team, dialysis can be safely deferred in patients with Stage 5 CKD in the absence of significant symptoms.
- The Canadian Society of Nephrology recommends initiating dialysis in patients with Stage 5 CKD only in the presence of uremic symptoms and/or other clinical indicators. (58)

RESOURCES

- Nephrology: Five Tests and Treatments to Question, Choosing Wisely Canada
- Dialysis Initiation, Modality Choice, Access, and Prescription: Conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference
- Green Excellence in Dialysis: Recommendations for Sustainable Kidney Care, European Dialysis and Transplant Nurses Association/European Renal Care Association
- Systematic Review of Dialysis Prescriptions (Use of Dialysate Autoflow Facility), Centre for Sustainable Healthcare

Explore Climate Conscious Infrastructure

ACTION 8: INCORPORATE SUSTAINABLE HEMODIALYSIS TECHNOLOGIES

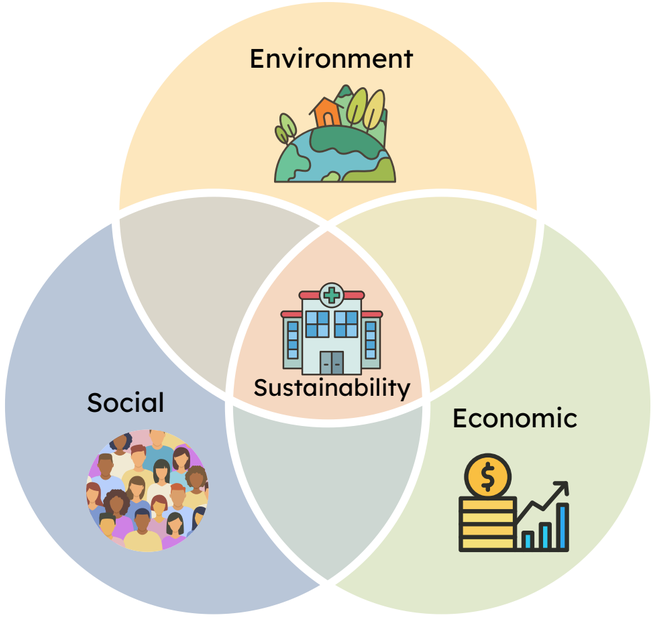
Kidney care has an evolving list of sustainable technologies

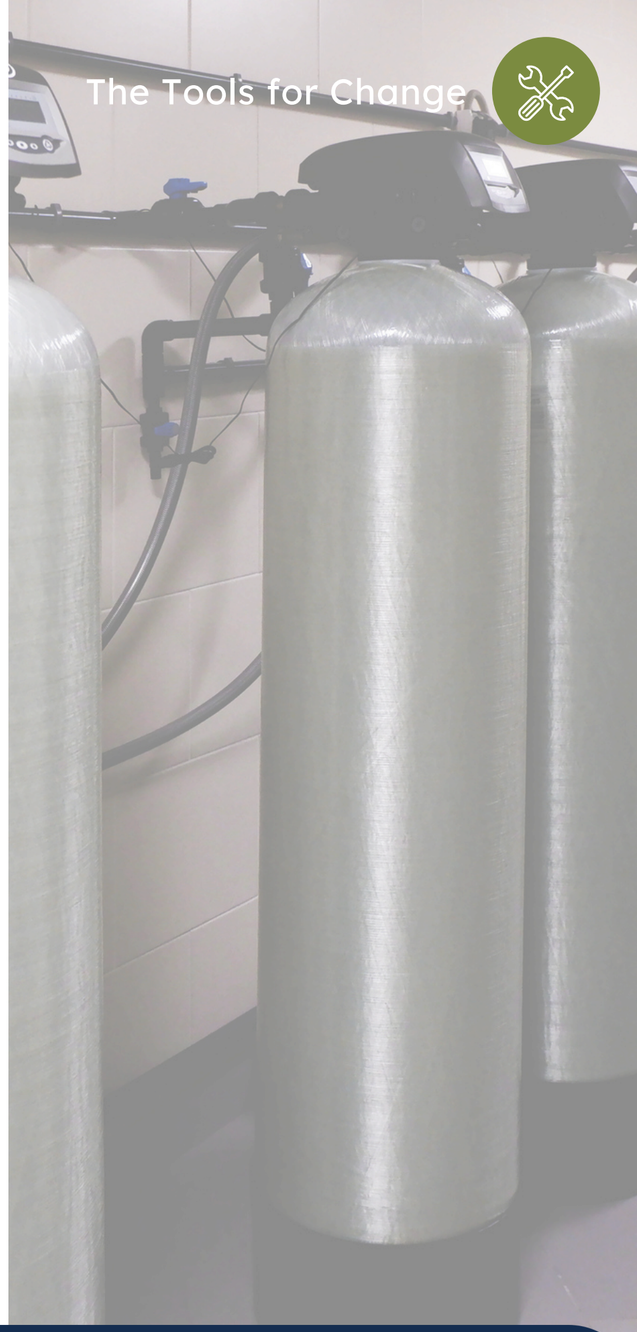
There are many opportunities to implement sustainable technologies, both small and large. Based on the health institution's capacity, some investments are suitable as part of new facility builds; others can be implemented as retrofits to existing infrastructure. (16, 17, 77)

Environmentally considered procurement, ongoing research and innovation in new sustainable kidney care technologies can help address areas with significant environmental impact:

- Water usage
- Energy consumption
- Waste generation

Implementing sustainable technologies are associated with long-term cost savings and carbon savings.



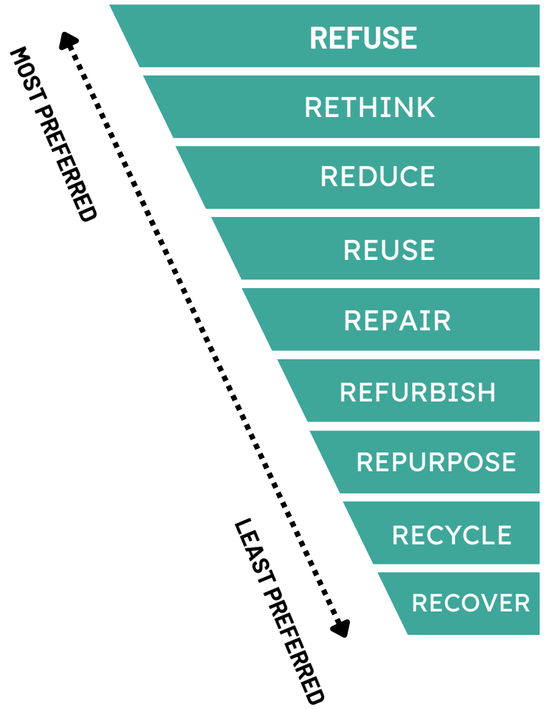


AREAS FOR CHANGE	SUSTAINABILITY OPPORTUNITIES
Water Consider implementing water saving measures including upgrading water treatment systems and/or implement water waste conservation projects.	**Water efficient reverse osmosis systems. New generation water treatment system decreases water use in dialysis.** • Example from France: Haemodialysis therapy and sustainable growth: a corporate experience in France • Example from United Kingdom: Upgrade of water treatment systems in the dialysis unit
	Consider installing reverse osmosis waste water capture system to divert waste water for 'grey use' (i.e., flush toilets, laundry, garden and other uses). **International examples:** • Australia: Reusing and recycling dialysis reverse osmosis system reject water • Australia: Handbook for reusing or recycling reverse osmosis reject water from haemodialysis in healthcare facilities. • France: Toward green dialysis: Focus on water savings • Malaysia: Reuse of dialysis reverse osmosis reject water for aquaponics and horticulture • Morocco: Recycling wastewater after hemodialysis: An environmental analysis for alternative water sources in arid regions • United Kingdom: Toward greener dialysis: A case study to illustrate and encourage the salvage of reject water • United Kingdom: Reuse of reject water from reverse osmosis for steam production
Energy Consider implementing energy saving measures and liaise with facilities operations for improvements in energy efficiencies.	**Retrofit older equipment with energy efficient upgrades** **International examples:** • Retrofit of heat exchangers to dialysis machines • Retro-fit of heat exchangers to haemodialysis machines - Case study and how to guide
	Use of renewable energy where possible • Solar panel installation example: Solar-assisted hemodialysis
	Install/retrofit energy efficient lighting, temperature controls and power saving mode. **Examples:** • Outpatient dialysis centers • Lighting the way forward: Energy-efficient lighting upgrades save money and energy • Lighting project

AREAS FOR CHANGE	SUSTAINABILITY OPPORTUNITIES
Procurement Consider upgrading to newer medical equipment and devices that produce carbon savings. Explore opportunities to purchase from suppliers with sustainability policies. If unfeasible, consider retrofitting or installation of equipment that reduces energy and water consumption.	**If feasible, consider upgrading to water and energy efficient hemodialysis machines** • Example from France: Haemodialysis therapy and sustainable growth: a corporate experience in France **Reduction in waste production** • Example from Poland: Does modern HD machines can improve the waste management? Two-centers observational study **When possible, buy reusables instead of single use supplies** • Example from the CCGHC: Reducing health care-related PPE and medical single use plastic waste through circular economy principles
	Explore options of central acid concentrates and/or higher strength acid concentrations • Example from the United Kingdom: Central delivery of acid for haemodialysis • Example from Italy: In-house preparation and centralised distribution of acid dialysis concentrate: Consideration on a practical experience
	If using acid concentrate canisters, consider exploring option for higher strength concentrates • Example from the United Kingdom: 44:1 Haemodialysis concentrate solution

AREAS FOR CHANGE	SUSTAINABILITY OPPORTUNITIES
Waste Reduction Consider appropriate waste prevention, management and disposal practices.	**Plastics recycling of non-biohazard materials and PVC recycling** • Example from Australia: Staff driven sustainability initiatives in a Melbourne dialysis centre - case study • Example from Canada: PVC 123 recycling program **Recycle plastic acid and bicarbonate cartridges** • Example from United Kingdom: Diversion of Waste to the Recycling Stream through the Use of Baling Machines
	Reduce clinical waste through online priming of dialysis machines • Example from United Kingdom: Reducing Waste in the Dialysis Unit Queen Margaret Hospital, Dunfermline **Reduce clinical waste through use of dialysis connectors for catheters** • Example from Quebec: Le CISSS de Laval s'attaque à son empreinte carbone
	Waste audits and proper waste segregation (may include pharmaceuticals, biohazardous, general waste, sharps and recyclable waste) • Example from the United Kingdom: Waste Management in the Renal Dialysis Unit - Case Study & How-to Guide • Example from the United Kingdom: Improved waste management in the Dialysis Unit Queen Margaret Hospital, Dunfermline **Hazardous waste and non-hazardous waste segregation** • Example from Canada: Clinical and non-clinical waste segregation • Example from Italy: Eco-dialysis: the financial and ecological costs of dialysis waste products: is a 'cradle-to-cradle' model feasible for planet-friendly haemodialysis waste management?

THE 9 R'S OF WASTE MANAGEMENT



Adapted from: Voudrias (2023) and Potting et al. (2017, p.5)

GREENCARE: B.C.'S HEALTH-CARE NETWORK FOR ENVIRONMENTALLY SUSTAINABLE AND RESILIENT CARE

GreenCare provides a series of tools and educational resources for healthcare staff to conduct waste audits and implement proper waste segregation and disposal in their practice setting.

Regulations and guidelines pertaining to recycling and disposal of healthcare waste varies by province, however, the following resources are still useful in guiding healthcare staff on safe waste management practices:

- Waste Reduction Toolkit
- Green Workplaces Opportunities Guide
- Circular Health Care Guide Opportunities
- Zero Waste Education and Resource Guide

Hard Plastics

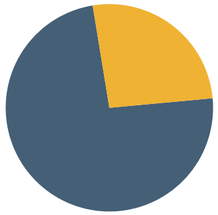
Rigid or hard plastic materials can be recycled and diverted from waste stream. Examples include irrigation bottles, empty medication bottles, CaviWipe containers and plastic medicine cups.
Check in with your institution's green team or sustainability leader on which products are recyclable and which are for disposal in the garbage or biohazardous stream.

RESOURCES

- Navigating Biomedical Waste Management Policies for Sustainability Playbook, CASCADES
- Green Excellence in Dialysis: Recommendations for Sustainable Kidney Care, European Dialysis and Transplant Nurses Association/European Renal Care Association
- "Two clinical recycling programs expand from St. Joseph's to St. Michael's Hospital", Unity Health Toronto
- Medical PVC Recycling Program, Vinyl Institute of Canada
- Measuring and Reducing Plastics in the Healthcare Sector, Healthcare Without Harm
- Plastic Waste Reduction Strategies, Steroplast Healthcare
- Towards Green Dialysis: Good Practice Guide, Green Nephrology group of the Francophone Society of Nephrology, Dialysis and Transplantation (SFNDT)
- Handbook for Reusing or Recycling Reverse Osmosis Reject Water from HD in Healthcare Facilities, Melbourne Health

ACTION 9: ADVOCATE FOR LOW CARBON TRANSPORTATION

Integrating low carbon transport can help reduce carbon emissions in nephrology care, and for those in whom active transport is feasible, exercise related health improvement is an important co-benefit. (78)



Patient & Staff Travel

Represented 28.3% of a US HD facility's total emissions. (8)

Opportunities to Reduce Environmental Impact of Transportation

- Optimize virtual visit
- Increase bicycle infrastructure, locked facility for bicycle parking and consider including shower facilities
- Encourage public transportation, when appropriate
- Consider facility implementation of low-cost or free electric vehicles (EV) charging stations for staff and patients/visitors
- Advocate for hybrid or electric vehicles in the accessible transport system (i.e., Wheel-trans, TransLink etc)

(78-80)

RESOURCES

- Drivers get a Boost with UHN's New Electric Vehicle Charging Stations
- Sunnybrook Electrifies to meet Zero-emissions Vehicle Challenge
- Boosting Healthy and Sustainable Travel in Manchester, NHS
- Sustainable Travel Strategy, NHS

ACTION 10: BUILD CLIMATE RESILIENT INFRASTRUCTURE

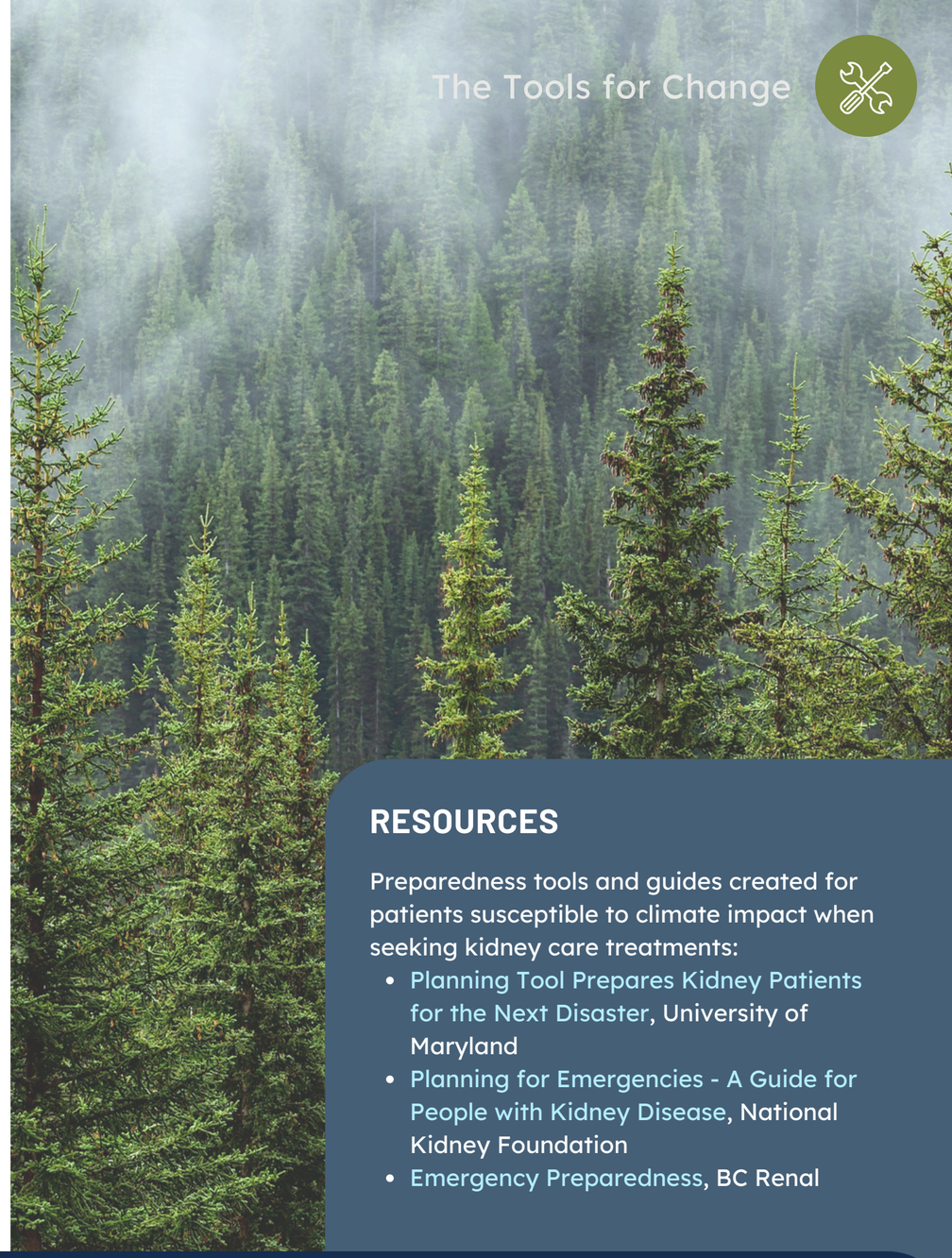
PREPARE HEALTHCARE SYSTEMS FOR RESILIENCE TO CLIMATE CHANGE AND EXTREME WEATHER

Engage in disaster planning and establish contingency plans to protect vulnerable patients from extreme events associated with climate change - including flooding, wildfires, heat warnings and air quality warnings.

People who receive dialysis therapies rely on timely treatments. Extreme weather events can affect road networks, supply chains, communications, and supply of electricity needed to support our patients. With increasingly frequent extreme weather, it is vital that healthcare infrastructure is built and maintained with consideration of regional and global climate change effects.Such considerations include anticipated increased demand for hospital capacity from climate events. (81, 82)

Climate Justice

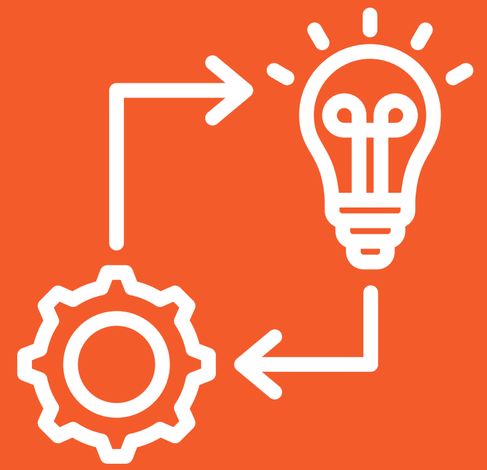
Remote regions with less secure supply chains and less ability to manage surge capacity are expected to disproportionately experience the acute effects of climate change, due to vulnerability or absence of infrastructure and already precarious food and water security. (83)

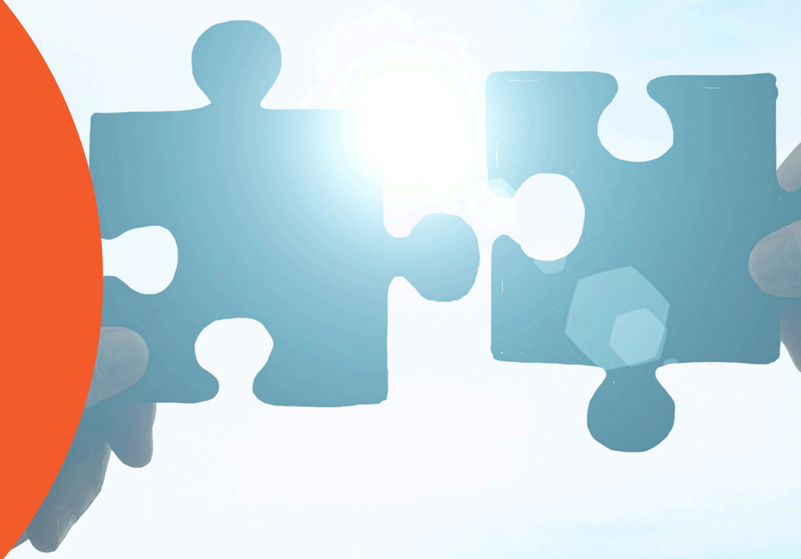


RESOURCES

Preparedness tools and guides created for patients susceptible to climate impact when seeking kidney care treatments:

- Planning Tool Prepares Kidney Patients for the Next Disaster, University of Maryland
- Planning for Emergencies - A Guide for People with Kidney Disease, National Kidney Foundation
- Emergency Preparedness, BC Renal





HOW

Strategy and Partnerships

1. Education for Kidney Care Providers
2. Identification and Measurement of ESKC Metrics
3. Partnerships and Policy Development for ESKC

Education for Kidney Care Providers

EDUCATION FOR NEPHROLOGISTS, TRAINEES AND KIDNEY CARE STAFF

All programs should build awareness of kidney care's environmental impact through education and research. This can be achieved through courses, workshops and training opportunities such as those provided by CASCADES, and engaging with your local (hospital) environmental sustainability group and/or professional organizations.

- A sound knowledge base of kidney care's climate impact and mitigation efforts can promote a culture of sustainability for kidney care professionals in the clinical setting
- Leverage local hospital leaders or management expertise in environmental sustainability and support the establishment of a sustainability role/team within every kidney care program
- Consider implementing a regional committee to oversee and coordinate ESKC
- Establish communication networks with ESKC professionals on national (i.e., SNAP) or international (i.e., GREEN-K) committees and be informed of their outputs and recommendations (84)

SUSTAINABLE NEPHROLOGY ACTION PLANNING

A committee of the Canadian Society of Nephrology with a mission to educate, advocate, and innovate for sustainable kidney care in Canada
The SNAP committee is a national group of kidney care stakeholders dedicated to the study and incorporation of sustainability as a domain of kidney care. Active areas of investigation include prescribing tools for clinicians, optimal waste strategies for kidney programs and home dialysis patients, climate resilience, and low carbon pathways.

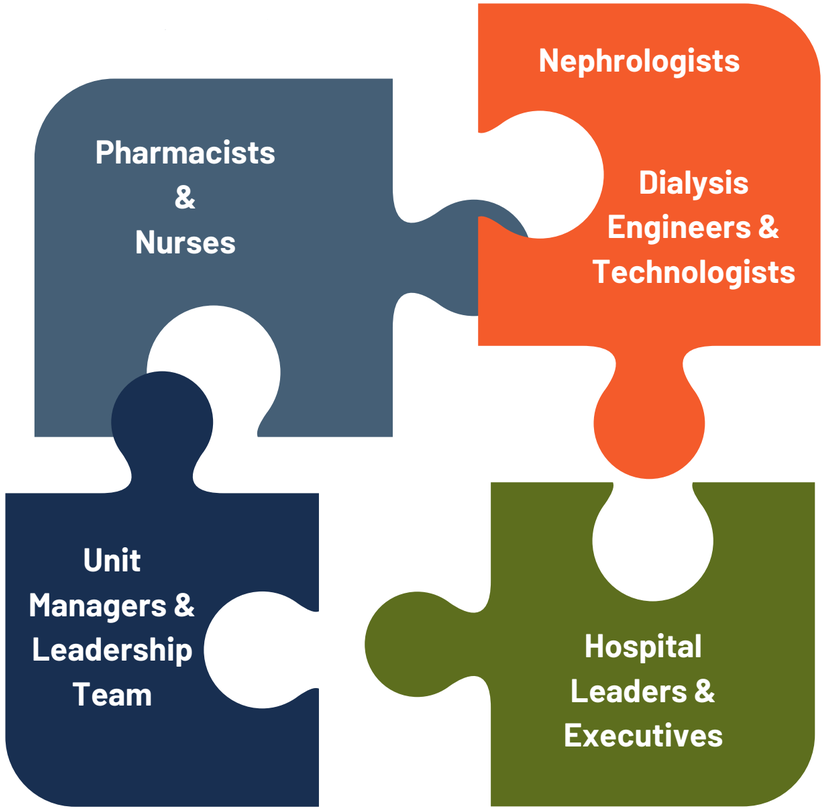
CASCADES RESOURCES

Video: Sick Kids' Green Team

Video: London Health Sciences Centre's Green Team

KIDNEY CARE PROVIDERS AND SUPPORT STAFF

There are many opportunities for kidney care staff to advance sustainable kidney care in clinical settings and at policy levels.



RESOURCES

- Organizational Readiness for Sustainability Playbook, CASCADES

Canadian Organizations:

- Canadian Coalition for Green Healthcare
- Peach Health Ontario
- Healthy Populations Institute (HPI)
- Can-SOLVE CKD
- Canadian Society of Hospital Pharmacy
  - Sustainability Task Force
- Canadian Association of Nurses for the Environment (CANE)
- Renal Administrative Leaders Network of Ontario (RALNO)

International Organizations:

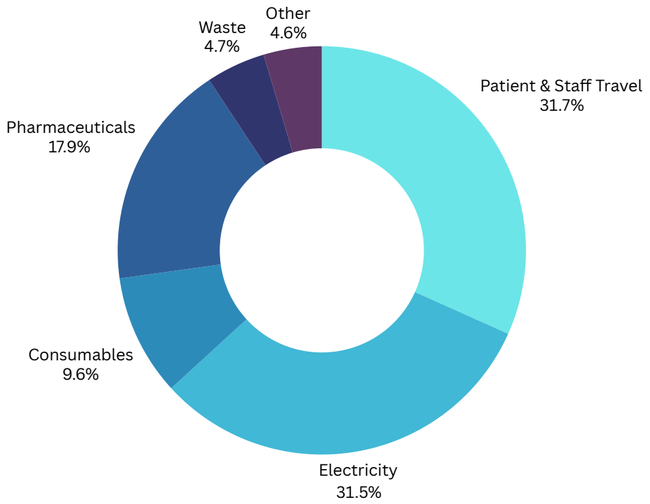
- GREEN-K Initiative
- Centre for Sustainable Healthcare
  - Sustainability Kidney Care Network
- UKKA Sustainable Kidney Care
- Healthcare without Harm
- Planetary Health Alliance

Identify and Measure ESKC Metrics

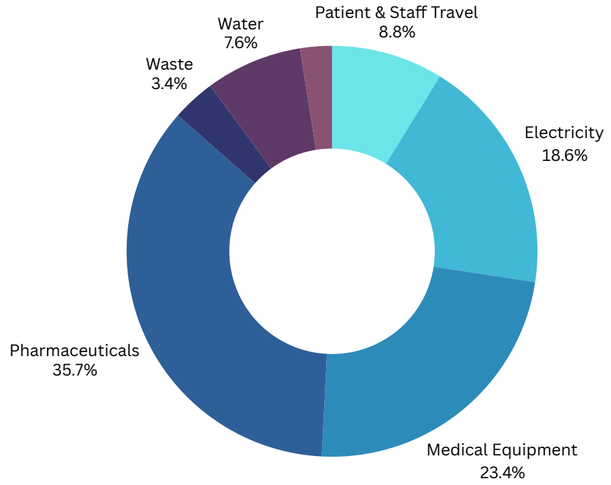
IDENTIFY METRICS AND MEASURE IMPACT

- Consider GHG estimations of dialysis therapies and transplantation; identify change opportunities and leverage support from your partners (i.e., sustainability office or a green team/leader on your unit).*
- Measure the impact of interventions and determine if targets are being met.
- Consider sharing your results and success with sustainability focused health organizations and/or at professional events.

Carbon Emissions Breakdown of In-Centre Hemodialysis Unit in the UK (85)



Carbon Emissions Breakdown of Victoria Suburban Hemodialysis Unit in Australia (13)



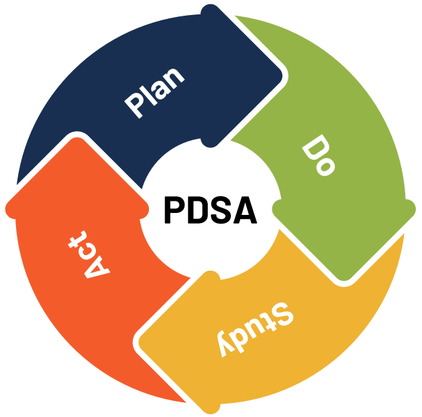
Examples of Key Performance Indicators (KPIs) and Targets in European Setting (63)

KPI	TARGET VALUES
Water consumption per 1 HD treatment	350 to 400L
Electricity consumption per 1 HD treatment	12-15 kWh
Hazardous waste generation per 1 HD treatment	1.0 to 1.2kg
Reduction of plastic materials in percent per dialysis center	10% first year, 5% subsequent years until goal is reached

*It is important to identify and measure ESKC metrics within your own facility. Emissions vary from program to program due to numerous factors. Whether a program is in a rural area or in an urban hospital, for example, may present different transport, electricity and water usage challenges and affect emissions differently. (8)

FRANCE NEPHROCARE CENTRES: AN EXAMPLE OF CHANGE MANAGEMENT METRICS

- Identified electricity, water and care-related waste as improvement targets and performed baseline data collection, then tracked monthly.
- Identified target values for each sustainability KPIs.
- Iterative improvements in care practice and upgrading technologies over 13 years led to measurable lower emissions.
- Improvement in the 3 KPIs resulted in total reduction savings of 102 440 tons of CO_2 equivalent. This is equivalent to a plane flying around the world 11 500 times.
- Some targets for KPIs were not achieved, however, overall reductions established in water and electricity consumption and waste production. (86)



- 52% decrease in water consumption; from 701 L/treatment to 382 L/treatment
- 29.6% decrease in electricity consumption; from 23.1 kWh/treatment to 16.3 kWh/treatment
- 37% decrease in care-related waste; from 1.77 kg to 1.11 kg

The CSN QUIS Committee is developing a comprehensive outcome balanced scorecard environmental metric document which will include sustainability KPIs and change management metrics, balanced to patient outcomes.

RESOURCES

- Healthcare LCA database, CASCADES
- CSN Quality Improvement and Implementation Science (QUIS) committee
  - Currently working to develop ESKC metrics for use in Canadian healthcare settings
- Environmental Performance of Kidney Replacement Therapies: Kidney Transplantation Versus Dialysis
  - Canadian investigators are informing low carbon practice with LCA data on kidney therapies (a more comprehensive report will be produced soon)
- In-centre Hemodialysis Carbon Calculator
  - A tool used to assess the total carbon footprint of the HD unit and inform per patient session carbon footprint

Partnerships and Policy Development for ESKC

POLICY DEVELOPMENT

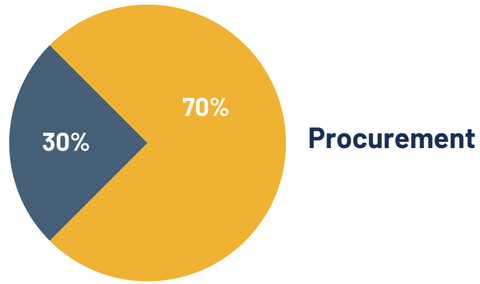
- Implement a culture of sustainability by assembling a sustainability and/or green team to initiate QI projects, support policy development, and practice changes at the unit or organizational level
- Recognize that policy changes in kidney care can go beyond the clinical setting. For example, kidney care professionals can advocate for system coverage of kidney protective medications, and emission reduction targets in healthcare provision. Mitigation efforts at all levels are needed towards achieving environmentally sustainable health systems. (87)
- Currently, there are some provincial, national and international targets for GHG emissions reduction. For example:
  - BC Climate Change Accountability Act
  - Canada is a signatory of the COP 26 Health agreement (Alliance for Transformative Action on Climate and Health) committed to the development of low-carbon, sustainable and climate resilient health systems.
  - Canadian Net-Zero Emissions Accountability Act calls for 'credible, science-based emissions reductions plans' for GHG reduction of 40-45% below 2005 levels by 2030.
  - Paris Accord (Canada) committed to reduce GHG emissions 45% by 2030, net zero by 2050.

Policy Changes within Kidney Care Settings

Many examples were highlighted in this playbook of current and past achievable sustainable kidney care projects (i.e., single-day assessment transplant clinic, alternative energy source, reverse osmosis reject water salvage and central acid concentrate delivery).

PARTNERSHIPS WITH KIDNEY CARE SUPPLIERS FOR CHANGE OPPORTUNITIES

Approximately 70% of kidney care emissions arise from procurement, including that for pharmaceuticals, consumables, and medical equipment. Packaging and transport, in addition to manufacturing and disposal, are sources of procurement emissions. (12, 13, 71). These emission findings are consistent with global healthcare emissions. (88)



Sustainability-minded procurement can involve purchasing from companies who prioritize and incorporate ESG* into their business model, and selecting products with lesser waste or improved reprocessing capability, or those that run on less energy or require less water.

Healthcare can collectively leverage buying power to foster 'pro-innovation procurement', permitting assured markets for environmentally sustainable innovations in manufacturing processes and product design and circularity. (22)

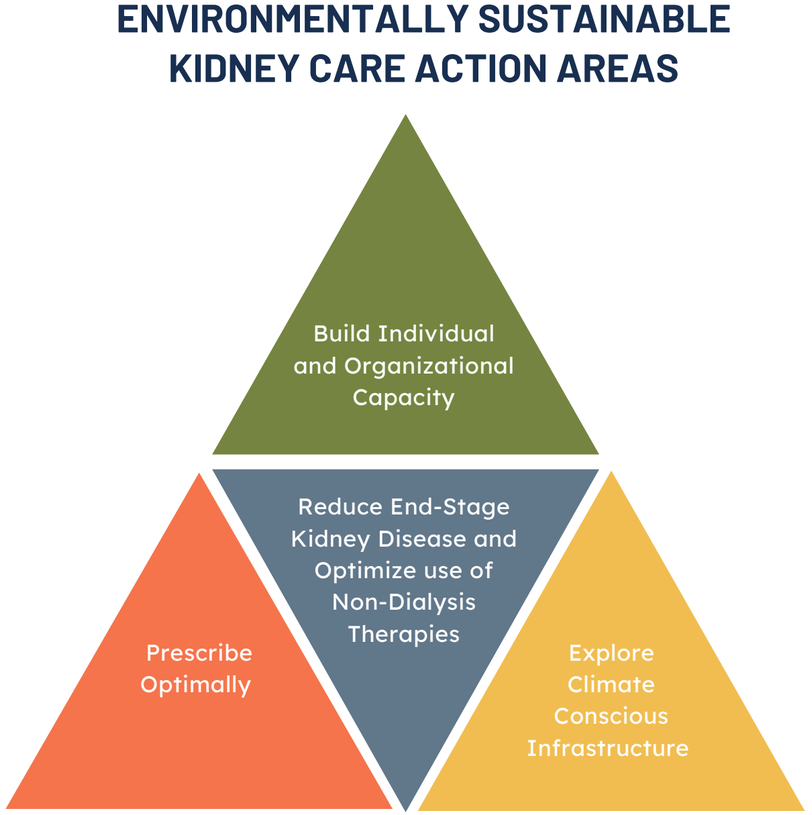
*ESG = Environmental, Social, Governance

COLLABORATIONS

- Alliance for Transformative Action on Climate and Health (ATACH)
  - Canada is a member of ATACH, an alliance promoting the integration of climate change and health from regional to global plans. ATACH is working towards address key thematic areas including supply chain.
- GREEN-K
  - An initiative of the International Society of Nephrology focusing on education and sustainable care, procurement, infrastructure and innovation.
- NHS Procurement
  - As part of their Net-Zero roadmap, successive supply chain reductions are planned.
- The Association of Faculties of Medicine of Canada
  - Advocate for hospitals to become “anchor institutions of sustainability” (Academic Health Institutions’ Declaration on Planetary Health).

Summary

- Climate change is already affecting kidney health and kidney care delivery
- Healthcare, including kidney care, is contributing significantly to the climate crisis
- Kidney care has a disproportionately large contribution to climate change across the spectrum of clinical care
- Capacity can be built to restructure kidney care through incorporating environmental sustainability
- High impact actions can mitigate kidney care's climate impact
  - CKD prevention/delay
  - Optimization of medication strategy
  - Optimization of transplantation over dialysis
  - Optimization of home dialysis (peritoneal over HD)
  - Low carbon transportation
  - Reduction of resource use and waste production in HD and PD
  - Investment in public transit or alternate transportation (i.e., bikes, EV) infrastructure
- Climate resilient infrastructure and disaster planning aligns with the above hierarchy of impact actions and are essential components of kidney care's adaption to climate change
- Building awareness of healthcare's environmental effects, and embracing planetary health principles can give kidney care staff and partnerships the knowledge and tools to implement change in kidney care.



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