INTEGRATING ENVIRONMENTAL SUSTAINABILITY INTO HOSPITAL PHARMACIES

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

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Canada

CASCADES

Canadian Society of Healthcare-Systems Pharmacy
Société canadienne de pharmacie dans les réseaux de la santé

NAVIGATION

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INTRODUCTION

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

Playbooks are developed in collaboration with partners and experts and include key sustainability opportunities, references to evidence, examples, and implementation resources.

This playbook contains background information, resources, and environmental considerations to guide healthcare clinicians, teams and institutions to improve environmental sustainability of pharmacies in Canadian healthcare institutions. It is intended for Canadian healthcare providers and administrators working in pharmacies of bed-based healthcare settings that are providing patient care, contributing to institutional policies, and making institutional changes. While the focus of this playbook centers around hospital pharmacies given the available evidence, the information is applicable to pharmacies in other bed-based facilities, including:

- long-term care facilities
- rehabilitation centres
- palliative care units

The content and accompanying resources have been compiled from a review of the literature, guidance from academics, and interviews with experts in the field and pharmacy leaders.

This document is not intended to provide or take the place of clinical guidance. Providers are encouraged to seek, appraise, and apply best-available evidence related to prescribing.

Disclaimer: Variations in practice exists between institution. The examples in this playbook provide suggestions and ideas based on the current evidence. Environmental benefits of practices may differ based on your institution workflow, processes, and geographical location.

RESOURCES:

The CASCADES Sustainable Hospital Pharmacy Scorecard helps teams:

- Identify sustainability opportunities and access related implementation resources
- Establish a baseline and track progress on sustainability goals
- Share these metrics with the broader community to track collective progress


ORGANIZATION: DATE:

CASCADES

SUSTAINABLE HOSPITAL PHARMACY SCORECARD

Status Options:

OPPORTUNITIES	STATUS	GOALS
LEADERSHIP & TASKFORCE	%	
Implement leadership structure to support environmental sustainability		• A formalized environmental sustainability committee is in place with broad representation that reports at pharmacy meetings and has an executive sponsor. • A taskforce that engages in activities to improve the sustainability of the pharmacy department has been established. • Clinical and dispensing staff are given protected time to participate in regular meetings and implement committee initiatives. • Current medication processes from procurement to disposal are mapped out to find opportunities to reduce medication waste (Examples of pathways include refrigerated products, ward stock, daily fills, emergency and operating room trays, compounding processes, multidose products, non-formulary products, and patient transfers). • Leadership for disaster planning is established. • Standard operating procedures and education for disaster management are developed. • Practice simulations specific to types of possible local emergencies with realistic timelines are planned and implemented. • Continuing annual education is provided on environmental sustainability topics, including the environmental harms of medications, the benefits of sustainability activities, and medication optimization for clinical staff.

Notes:

Total score (Maximum 16):

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PLAYBOOK STRUCTURE

WHY
The Case for Change

An introduction to the issue being addressed in the playbook

WHAT
The Tools for Change

A structured presentation of the opportunities for action and resources to plan and implement change

HOW
The Strategy for Change

An outline of strategies for sustaining change

WHY

The Case for Change

1. Climate Change and Human Health
2. Environmental Impact of Pharmaceuticals and Hospital Pharmacies
3. Environmentally Sustainable Projects

Climate Change and Human Health

Pharmaceuticals and hospitals together represent 47% of total Canadian healthcare related GHG emissions, more than any other healthcare category (6)

Climate change is directly impacting human health, affecting access to clean air, safe drinking water, food, and shelter (1). Humans are being increasingly exposed to heatwaves, extreme weather events, and expanded regions suitable for infectious disease transmission, which in turn increase the risk of hospitalizations. Other negative human impacts include effects on sleep quality, physical and mental health. By 2030, it is estimated that climate change will cause an additional 250,000 deaths and cost $2-4 billion US annually (2).

Health systems are increasingly contributing to the problem. The greenhouse gas (GHG) emissions from the healthcare sector have increased 36% since 2016, disproportionately caused by very high human development index countries including Canada. Approximately a third of all countries are responsible for 91% of global healthcare-related emissions. While it is undeniable that healthcare requires the use of energy, goods, services, and infrastructure, which consumes resources and contributes to greenhouse gas emissions and air pollution, there is a point at which additional resource utilization does not significantly increase healthcare quality. Comparisons of global healthcare systems suggest that benefits to healthcare quality do not improve significantly beyond approximately 400 kg CO_2e per capita (2). Canada's healthcare per capita emissions are 2.5 times this amount (3), highlighting an opportunity to streamline care without compromising quality.

RESOURCES:

There is growing interest from Canadian pharmacy and healthcare organizations in environmental sustainability. Examples include:

- Accreditation Canada
- Canadian Society of Healthcare-Systems Pharmacy
- Canadian Pharmacists Association
- Choosing Wisely Canada
- Canadian Council for Accreditation of Pharmacy Programs

Environmental Impact of Pharmaceuticals and Hospital Pharmacies

Pharmaceuticals and hospitals together represent 47% of total Canadian healthcare related GHG emissions, more than any other healthcare category (4). In addition to their large carbon footprint, pharmaceuticals also pollute our air, soil and water. Some of these residues enter our water systems (5), affect aquatic organisms (6), select for antibiotic resistance (7), and make their way into our drinking water (8,9). Furthermore, hospital pharmacies generate significant amounts of waste from single-use items, such as from packaging and re-packaging, equipment used for sterile compounding, and by-products of medication delivery. The pharmacy at Western Sussex Hospital NHS Foundation Trust collected over half a million items of plastic during a 3-year period (10).

Pharmaceuticals and hospitals together represent 47% of total Canadian health care GHG emissions (4).

Hospital pharmacies play a critical role in the functioning of healthcare facilities and manage a sizeable amount of the overall budget. Approximately $5.5 billion is spent on drugs in Canadian hospitals, about 4.9% of total hospital spending (11). In 2021 hospital spending accounted for 15.5% of total national drug purchases. The average year-over-year increase in spending for hospital drug purchases from 2001 to 2021 was 7.4%, outpacing both growth in retail drug spending at 5.4% (12) and total hospital spending at 4% (11). From 2001 to 2021, the total drug purchases in the hospital sector grew 309% (12).

Hospital pharmacy staff thus oversee a costly and energy-intensive resource on which they can exert a sizeable influence. They also have a history of leading various institutional projects, including those focused on environmental sustainability. A systematic review of studies in sustainable healthcare interventions that included a hospital pharmacist had pharmacists leading the project in 88% of the studies (13). There is also growing interest among hospital pharmacy staff, with a Canadian survey finding 77% of hospital pharmacy staff indicating that they were motivated or highly motivated to engage in more sustainable pharmacy practices (14). Thus, hospital pharmacy staff are well-placed to lead institutional-wide initiatives, teaming up with other healthcare workers in their organization.

Environmentally Sustainable Projects

WHY SHOULD HOSPITAL PHARMACIES BE INTERESTED IN CLIMATE CHANGE ?

Benefits of engaging in environmentally sustainable projects may include:

- Aligning with Canadian healthcare organizations exploring the incorporation of environmental sustainability into their framework
- Enhancing staff wellbeing (see examples below)
- Ethical and professional responsibility to reduce emissions that are negatively impacting patients
- Improving the ability to effectively care for patients affected by climate change through natural disasters, drug shortages, and air pollution
- Fostering interprofessional relationships and goodwill
- Enhancing student experiences with environmental sustainability focused projects during their rotations

Enhancing staff wellbeing	• Improving cost and labour efficiencies through quality improvement projects (15–17) (see examples from Spain and the United Kingdom) • Mitigating the risk of staff burnout through advanced disaster planning from climate emergencies (18) • Attracting pharmacy staff with a passion for sustainability as a recruitment strategy

COST AND STAFF TIME CO-BENEFITS

A common misconception is that implementing environmentally sustainable actions lead to increased costs and time. There are in fact many examples of change activities where a decrease in waste, cost, and staff time were documented, with two shared here:

Spain

A hospital in Spain analyzed purchased oral dosage forms and preferentially selected items that did not require repackaging or re-labelling. They then created an Excel spreadsheet that would make similar recommendations on purchasing based on medication input from other hospital pharmacies. The reported annual reductions were 9% of repackaged units, 33.6 kg of plastic, and 73.5 hours of work (15,16).

United Kingdom (UK)

A hospital team in the UK looked at their workflow to decrease the number of unnecessarily dispensed items. Their interventions led to extrapolated annual savings of £9,600, 1,288.8 kg of CO_2e, and 192 staff hours (17).

WHAT

The Tools for Change

1. Hospital Pharmacy Medication Management
2. Clinical Practice
3. Policies & Procedures

Sustainability Opportunities

To maximize the benefits of eco-friendly initiatives, system-level changes are required. As hospital pharmacy operations consist of both 1. medication management and 2. clinical pharmacy services, changes need to target both areas.

Hospital Pharmacy Medication Management addresses the procurement, inventory, distribution, dispensing, and disposal processes. Given their integral role, pharmacy technicians and pharmacy assistants are encouraged to lead and participate in this area to ensure current processes are correctly mapped out and determine whether change ideas are feasible.

Clinical Practice addresses those clinical action items that can be implemented by all pharmacists, those in specialty areas, and programs that pharmacy departments can implement.

Policies and Procedures address administrative processes that support environmentally sustainable actions in hospital pharmacies' operations and clinical practice areas.

Pharmacy leaders play a significant role in overseeing changes and ensuring sustainability initiatives are supported.

Action Areas

Sustainable Hospital Pharmacy Scorecard

Hospital Pharmacy Operations

Hospital Pharmacy Medication Management

Waste Reduction & Disposal

- Waste reduction
- Waste disposal

Procurement & Formulary

- Drug procurement
- Drug formulary

Inventory & Distribution

- Inventory
- Compounding medications
- Distribution

Clinical Practices

Medication-use Processes

- Medication optimization
- Targeted patient populations
  - Oncology
  - Nephrology
- Stewardship programs

Policies & Procedures

- Disaster management
- Medical directives
- Procurement contract criteria
- Patient use own medication
- Take home multidose medication
- Pharmaceutical waste and disposal

Hospital Pharmacy Medication Management

Hospital Pharmacy Medication Management can be divided into different domains in which sustainability initiatives can be incorporated, including examining waste reduction and disposal, procurement, and inventory and distribution practices (see Table 1).

Table 1: Key operational action areas and recommendations hospital pharmacies can target to reduce their environmental impact

	ACTION AREA	RECOMMENDATIONS
MEDICATION MANAGEMENT	Waste Reduction and Disposal	• Map out current processes to find opportunities to avoid creating medication waste. • Separate non-cytotoxic pharmaceutical waste from packaging, compounding and administration waste for appropriate disposal.
	Procurement and Formulary	• Incorporate environmental sustainability in drug procurement and formulary decision making
	Inventory and Distribution	• Implement effective inventory strategies. • Minimize unnecessary compounding. • Establish sustainable distribution practices

RESOURCES:

- Medication Optimization for Sustainability in Inpatient Care - CASCADES Canada
- 2015 CADTH: Hospital Formularies Decision Making Process, Hospital Formularies Decision-Making Process
- Sustainable medicines use in clinical practice: A clinical pharmacological view on eco-pharmaco-stewardship, E Adeyeye et al. (2022)

WASTE REDUCTION AND DISPOSAL

WASTE REDUCTION

Medication waste refers to any pharmaceutical product that remains unused or not fully consumed throughout the pharmaceutical supply and use chain (19). Waste of potentially viable medication jeopardizes the budget of pharmacy departments by spending limited funds on medications that are never consumed (20). Furthermore, medications that are not used end up being disposed, wasting not only the medication but all the energy used to produce, transport and destroy them. Decreasing the amount of pharmaceutical waste generated can also decrease the cost of hospital resources and labour needed to reorder and repackage medications (21). Although, most pharmaceutical pollution is caused by human excreta as a consequence of medication use itself (22), the contribution of the disposal of unused medication cannot be underestimated (23). Accordingly, to protect the healthcare budget and the environment, the supply and use of medication must be balanced to maintain sustainability.

Map out current processes to find opportunities to avoid creating medication waste

Hospital pharmacies can map out current dispensing processes to identify areas where waste generation can be eliminated or reduced. Identifying and testing out strategies for waste reduction can also align with organizational priorities to improve healthcare quality (24). See Table 2 for strategies that reduce pharmaceutical and associated physical waste (such as packaging).

Table 2: Actions examples to reduce waste generation corresponding to waste type

Waste Type	Reduce	Reuse
Pharmaceutical Waste	• Embed sustainability into prescribing • Manage inventory to reduce waste	• Redispense suitable medications
Associated Physical Waste	• Select products with less packaging	• Choose reusable materials

SPOTLIGHT EXPERIENCE FRASER HEALTH, BRITISH COLUMBIA

The pharmacy team at Fraser Health implemented several quality improvement strategies to examine medication waste:

1. INHALERS

Excessive waste of ipratropium inhalers was found while comparing patient orders to actual inhalers dispensed. They found the greatest reason for inhaler waste was from no doses being administered after an inhaler was dispensed or dispensing an extra inhaler when the directions for use changed (25). In another study, they found 12.5% of all salbutamol and ipratropium inhalers from automated dispensing cabinets were inappropriate duplication withdrawals, representing a cost of over $30,000 over a six-month period (26). They have since worked to decrease the amount of wasted inhalers by weighing the canisters of metered-dose inhalers to determine the number of remaining doses, then sanitizing them through an Infection Prevention and Control (IPAC) approved process, and finally sending the canisters to high-use areas, such as the ICU. Mouth pieces are not reused due to reprocessing concerns.

2. REDISPENSE SUITABLE MEDICATIONS

A survey of hospital pharmacies revealed 30-50% of medications are not redispensed when returned to the pharmacy department, with much of that medication incinerated (27). A further examination of the volume of medications returned from nursing units at three urban hospitals estimated the cost of redistributing suitable medications could net $415,000 when extrapolated to all 21 sites. From an environmental perspective, redistribution would reduce the negative impact on the environment through avoidance of manufacturing and transportation of replacement medication, and the harms caused by the incineration of the discarded medications (27).

VIDEO:
Pharmacists Gigi Wong and Aaron Tejani describe their project and the solutions they tested to solve this problem.

RESOURCES:

The following resources can help institutions review their own processes to identify areas to reduce pharmaceutical waste:

- CASCADES Pharmaceutical Waste Playbook outlines examples of pharmaceutical and its` associated waste reduction strategies [insert link to playbook]
- CASCADES Training for Better Health Outcomes: Integrating sustainability into Healthcare Quality Improvement Education can help clinicians embed and operationalize sustainability as a dimension of quality of improvement, an important measure in many healthcare institutions.
- CASCADES Project Charter is a visual management process and tool to structure and guide behavior change. This tool can help with goal and scope setting, identifying what the problem and opportunities are, examining the current state and root causes of the problem, and designing a change idea that can be measured and tested.

Separate non-cytotoxic pharmaceutical waste from packaging, compounding and administration waste for appropriate disposal

WASTE DISPOSAL

While the most effective strategy for managing waste is minimizing the amount of waste generated, there will always be a certain amount of waste produced by hospital pharmacies. Given that the cost and management of pharmaceutical waste is the responsibility of the healthcare facilities, it is in their interest to generate less and divert waste from the costliest waste management streams. Of all the waste management streams available to facilities, the most expensive, carbon intensive, and polluting is high-temperature incineration, which is how most pharmaceutical waste is managed in Canada (31).

High-temperature incineration has a carbon footprint that is almost 2 times as much as autoclaving, and over 6 times greater than recycling (32). Incineration sites may also be the furthest in distance, with transportation adding significantly to the already carbon intensive footprint. Separating non-cytotoxic pharmaceutical waste, that needs special processing to inactivate, such as high-temperature incineration, from its associated packaging, compounding and administration waste can decrease the volume of waste that is incinerated.

Requirements for handling pharmaceutical waste and disposal vary nationally, thus examining provincial policy and procedures is recommended(33). Cytotoxic waste has its own provincial and federal handling requirements that must be followed and are not addressed in this document. See CASCADES' Navigating biomedical waste management policies for sustainability playbook.

POLYVINYL CHLORIDE (PVC)

PVC plastic is found in all kinds of healthcare products such as urine bags, disposable gloves, catheters, oxygen masks, and most relevant to hospital pharmacy, PVC-based IV bags. Additives to PVC bags include chemicals such as diethylhexyl phthalate (DEHP), which can leach into IV medication products and expose patients to these toxins (34). Prenatal exposure to DEHP has been linked to effects on neurodevelopment, including problems with attention, hyperactivity and poorer social communication (35). It has also been identified as toxic for reproduction and as an endocrine disrupter by the European Union (36). Even at disposal, incineration of PVC releases highly toxic chemicals into the air and soil as ash (37,38).

Efforts should be made to reduce PVC use and waste, such as through IV to oral stepdown therapy, and where feasible, non-cytotoxic medication products should be separated from PVC bags, with the solution sent for incineration, and the PVC bags recycled or sent to landfill.

RESOURCES:

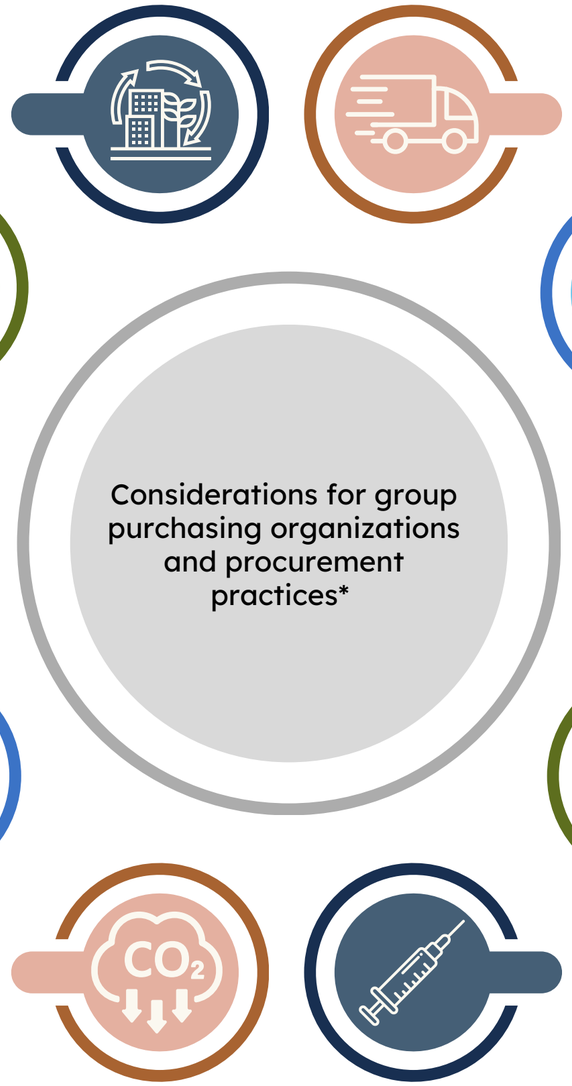
- Pharmaceutical Waste and Disposal for incorporating sustainability into a pharmaceutical waste policy and procedure.
- Managing Non-Cytotoxic IV/Fluid Line & Bag Waste (Ali Abbass)
- Clinical Recycling Trainer Program Guide (BC GreenCare)
- Performing Hospital Waste Audits (Waste Management Healthcare Solutions)

PROCUREMENT AND FORMULARY

Hospital pharmacies play a critical role in the functioning of healthcare facilities and manage a sizeable amount of the overall budget. Pharmacy professionals, and other health care providers are involved in the procurement of medicines through hospital committees such as Medicines Advisory Groups and Pharmacy and Therapeutics Committees (35). While these meetings focus on the clinical efficacy, safety and cost-effectiveness of current and new drugs, the environmental costs are not routinely discussed. By incorporating sustainability assessments using the available environmental product information, greener medication choices can be made, and we can start to develop carbon-friendly formularies (36).

Embedding sustainability criteria into purchasing decisions is helping drive the healthcare industry improve their sustainability practices and remain competitive contenders for contracts (37). A review of the environmental criteria introduced in the tendering of drugs, medical devices and non-medical equipment revealed a growing trend to include environmental criteria (38). In some provinces, group purchasing organizations (GPO) negotiate on the hospitals' behalf, and may already have sustainability criteria in their negotiated contracts, with Canada's largest GPOs currently allotting a 5% total weighting to environmental, social and governance (ESG) criteria combined (39,40). While it is difficult to ensure that expressions of ESG are followed, increasing numbers of institutions showing interest to GPOs in this area can influence GPOs to increase weighting to the ESG category and increase accountability in this domain. Some GPOs can help institutions calculate the environmental impact of certain medication purchases and compare them with lower global warming potential alternatives.

DRUG PROCUREMENT



Sustainability Practices
GPO or Manufacturer's sustainability practices

Deliveries
Limit the number of deliveries for non-urgent medications and supplies

Vial Sizes
Purchase vial sizes that most closely matches the dose being prepared to reduce drug wastage (45)

Package size
Match package size to use. Smaller pack sizes should be use for medications that are not used often to avoid expiration, while large bulk sizes for frequently used medications can minimize packaging.

Expiration Dates
Purchase products with longer expiration dates (41,42)

Single-use devices
Limit the use of single-use medical devices wherever possible (44)

Transportation
Environmental impacts of transportation. Consider local businesses and those that use more environmentally friendly modes of transportation such as by sea, train, and electric vehicles.

Repackaging
Procure drugs that do not require repackaging as they are correctly labelled (43)

Low-carbon alternatives
Purchase carbon friendlier alternatives with similar clinical effectiveness. For example , research showed that single-dose vials caused a waste of up to 60% of ephedrine, while phenylephrine, that was used in the same amount of cases but was distributed in pre-filled syringes, only caused a waste of 3% (42).

Commercial doses
Use commercial doses available in pre-filled syringe like heparin, enoxaparin to save time, decrease error risk and decrease use of single use materials for small batches (alcohol tampons, syringe, needles) (see Spotlight: commercially supplied prefilled syringes for emergency and critical care)

*Note: drug shortages and the group purchasing organization may limit selection

See Procurement Contract Criteria for incorporating sustainability into procurement policy and procedures.

Incorporate environmental sustainability in drug formulary and procurement decision making

GPO or manufacturer's sustainability practices should encourage:

- Minimal manufacturer and distributor packaging (37)
- Reusable pallets for delivery
- Shorter distances between end-to-end medication manufacturing locations
- Disclosure of the carbon footprint and ecotoxicity of medications
- Continuity and diversity of supply to avoid the negative impacts of drug shortages
- Ethical sourcing (Adhere to labour laws, fair trade practices and corporate social responsibility)
- Manufacturers' ecological sustainability certifications

NOTE: Pharmaceutical companies currently cannot provide comprehensive data on carbon footprint but demanding information on their sustainability practices may motivate them to implement policies to ensure competitiveness.

RESOURCES:

- See Procurement Contract Criteria for incorporating sustainability into procurement policy and procedures.

Review emergency medication practices

Hospital pharmacies can also evaluate whether commercially available prefilled syringes with longer expiration dates are available to replace hospital-drawn doses. This is particularly the case for ‘emergency’ medications, where it may be practice drawing up ‘just in case’ doses to correct unanticipated complications rapidly (46). Such formulary changes should be made in partnership with interprofessional emergency, critical care and anesthesia colleagues.

SPOTLIGHT EXPERIENCE

COMMERCIALLY SUPPLIED PREFILLED SYRINGES FOR EMERGENCY AND CRITICAL CARE

A case study in the United Kingdom evaluated the environmental benefits of using prefilled ‘emergency’ medications. Initially, 100% (52/52) of theatres audited drew up emergency drugs with an average 585 syringes of emergency drugs wasted per theatre per year, generating 6.1kg of waste. The estimated global warming potential (GWP) for the production and disposal of the wasted medication was 34.2 kg CO_2e. Following the introduction of prefilled syringes for ephedrine, atropine, metaraminol and glycopyrrolate, 63% of theatres no longer drew up emergency drugs, reducing the amount of waste to 93 syringes per theatre per year, with a mass of 0.8kg and GWP of 4.7kgCO_2eq. This represented a GWP savings of 86%. Co-benefits included a modest cost improvement, and an improved patient safety profile through clear labelling, reduced dilution errors, and lower infection risks (50).

Learn more

DRUG FORMULARY

Sustainability considerations in drug formulary reviews includes adding or changing to low carbon alternatives with similar clinical efficacy. If more environmentally friendly products are not available in their current procurement contracts, organizations should discuss with their GPOs to add them.

Inhalers

- Avoid in hospital auto-substitutions from dry powder inhalers to metered dose inhalers (MDIs)
- Add non-MDI inhalers to formulary
- Switch to low-volume and lower-carbon footprint MDIs
  - A low-volume salbutamol MDI has the GHG equivalent of driving 38.8 km in a standard gasoline powered vehicle (9720 g CO_2e), compared to a high-volume salbutamol MDI which has the GHG equivalent of driving 112.6 km (28,200 g CO_2e) (51).

Inhaled anesthetic gases

- Switch from high to low global warming potential (GWP) anesthetic gases

Anesthetic gases including nitrous oxide, sevoflurane, desflurane, and isoflurane are highly potent greenhouse gases. As use of these gases in clinical care is a major direct source of GHG emissions (52), they should be a target for reducing the environmental impact of health care (52). One consideration would be to substitute a lower GWP gas for another to reduce the harm from emissions. As an example, sevoflurane and desflurane can provide similar anesthetic effects, but desflurane is estimated to be 30 to 50 times more environmentally damaging in terms of its GWP. Initiatives that have engaged anesthesiologists and their professional associations have led to removal of desflurane and reduced use of the most damaging anesthetic gases. Some have suggested removing desflurane entirely from formularies (52–54).

Drug formulary reviews should be done regularly to ensure that the formulary is reflective of current practice and environmentally sustainable considerations.

RESOURCES:

- CASCADES Resources:
  - Climate Conscious Inhaler Practices in Inpatient Care.
  - Nitrous Oxide Waste Reduction Project Charter
  - Eliminating Desflurane Project Charter
  - Anesthetic gases primer
  - Anesthetic gases infographic
- Ontario Hospitals That Have Banned Desflurane, PEACH
- Nix the Nitrous, Canadian Coalition for Green Health Care
- Mitigating the environmental impacts of anesthetic gases in healthcare, Alpamys Issanov, UBC Sustainability Scholar
- Canadian Anesthesiologists' Society (CAS) Background Paper for the CAS Position Statement on reducing harmful emissions, waste and costs

Use environmental data to assess formulary alternatives and additions

In addition to greenhouse gas emissions, other environmental aspects can considered, such as a medication's hazard to the environment, including persistence, bioaccumulation and toxicity to non-target organisms, and its likelihood of causing such effects (55). While this information is not always available, the Stockholm Region Wise List includes a review of the scientific evidence of a medication's environmental impact in their recommendations.

Hospital pharmacies can search Janusinfo's Pharmaceuticals and Environment database to find information about the environmental impact of pharmaceuticals.

Reduce unnecessary formulary items

Unnecessary re-ordering of low clinical value and low-volume products can lead to added pharmaceutical waste. Criteria can be applied during formulary reviews to remove such products. An example of criteria used by Sunnybrook Hospital were (56):

- Remove medications with low clinical value (e.g., docusate and acyclovir ointment)
- Remove medications not used in the past 3 years
- Reduce the number of chemicals in inventory by standardizing compounded medications on formulary
- Adjust inventory based on data of most wasted medications
- Limit the number of products or strengths listed within a class

INVENTORY AND DISTRIBUTION

INVENTORY

Effective inventory management in hospitals is crucial to prevent medication waste and to ensure optimal resource use. Hospital pharmacies must maintain a well-managed stock of medications to ensure that they are available when needed and prevent delays in treatment which may impact patient outcomes. Proper inventory management involves tracking medication usage patterns, predicting future needs and ensuring medications are stored under appropriate conditions to maximize their shelf life (see Figure 1) (20).

Appropriate stock management, including effective purchasing, preparation of medications and dispensing processes can minimize waste (20).

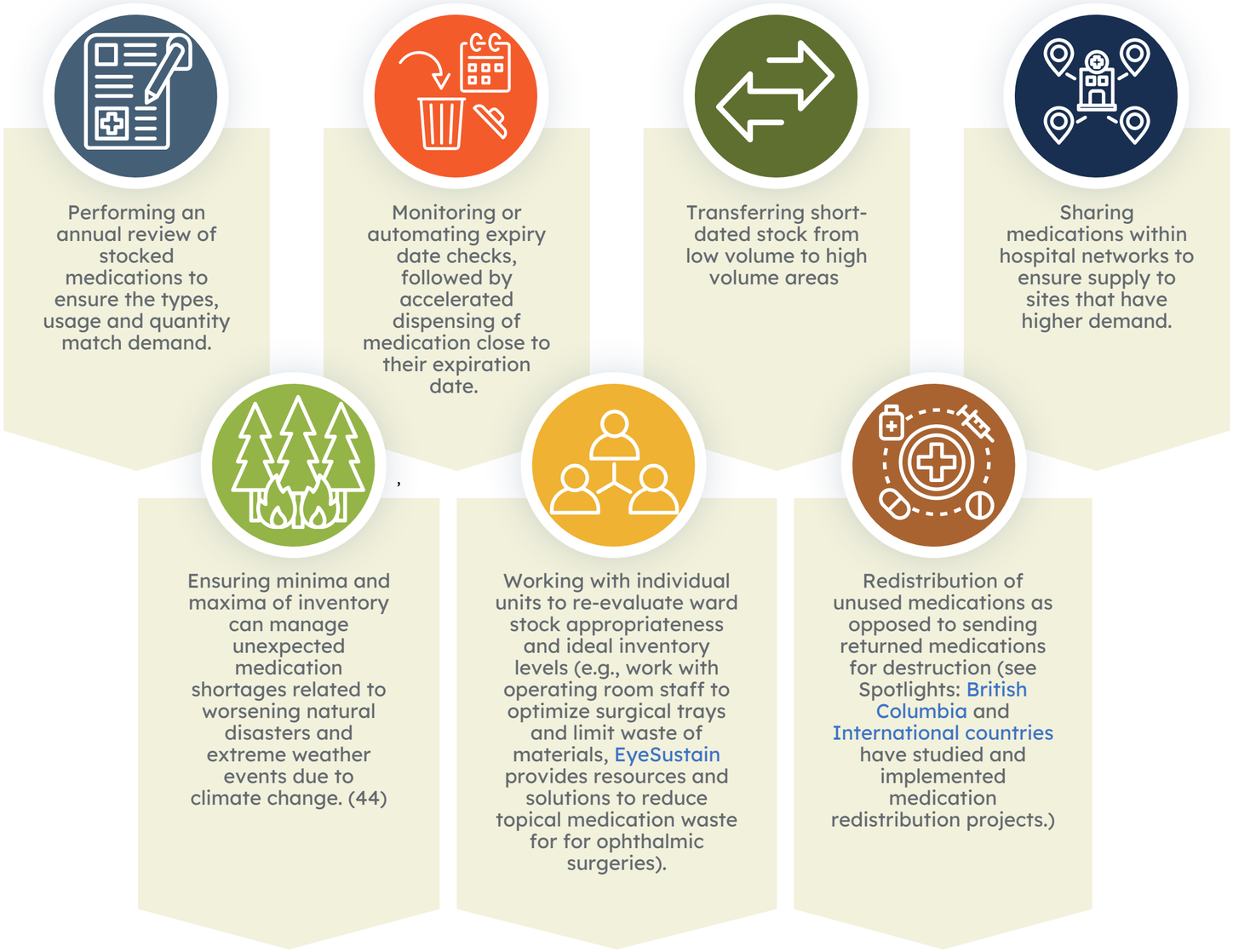
Examples for transferring short-dated stock from low volume to high volume areas

- Move phenylephrine from crash carts to the intensive care unit or emergency areas
- Move short expiry inhalers to respirology units and ICU
- Rotating crash carts
- Sterilize the canister of MDI inhalers according to institutional IPAC rules, and send them to high utilization units where patients can use their existing mouthpieces. Ideal canisters to transfer would be those with only a few doses used before being discontinued. The number of dose remaining can be estimated by weighing the canister.

INTERNATIONAL REDISTRIBUTION

A study conducted at Isala Zwolle in the Netherlands showed most medications could be returned within 15 minutes, and 75% of returns would be appropriate for redistribution. The average savings would be between €208 – 279 per week. Without additional funding or increased staffing levels, Isala Zwolle could safely and cost-efficiently redistribute more than 6000 unused medication units per week. A waste reduction of 84% or more would be possible when using the return boxes and returning all useable medications (53).

Figure 1: Recommendations for inventory management to maximize shelf life and reduce waste



COMPOUNDING MEDICATIONS

One source of waste comprises of compounded medications, as leftovers are usually discarded due to a short shelf-life after preparation (20). Strategies to decrease waste when compounding medications include:

- Increased frequency of batching intravenous medications to reduce returns and associated costs (59).
- Use of an automated vial selection tool (49).
- Evaluate preparation/compounding processes to generate less waste and use more reusable products.
- Prepare “as needed” (PRN) doses on demand, or limit the amount of overnight doses prepared. A review of PRN orders on a pediatric and adult surgical unit at CHU Sainte-Justine in Quebec revealed only 13% of prepared doses were used. (60)
- Prepare dose at point of care for expensive and patient-specific medication that may require dose adjustment based on lab work, or products with a short expiration. The use of Mini – bag plus systems can be evaluated with nursing colleagues for non-cytotoxic medications (20).
- Automated “Flat” or “Fixed” Dose rounding for medications such as biologics, anticancer, antimicrobials and anticoagulants (61,62). This process can be automated in computerized physician order entry systems or manually through automatic substitution policies.
- Cluster scheduling patients that receive the same medication to prevent leftovers from being discarded (63,64).

Minimize unnecessary compounding of medications

DISTRIBUTION

Establish sustainable distribution practices

Hospital medication preparation and distribution processes can be optimized to avoid accumulation and disposal of unused medications (20). Strategies to improve these processes include the following:

- Reduce plastic waste in medication deliveries to wards (65)
- Package to allow for redistribution
- Ensure patient-specific medications are transferred with the patient, especially multidose products
- Use Patient's Own Medications (POMs) for multidose and non-formulary items during admission
- Evaluate "as needed" and multidose products

Establish sustainable distribution practices

Reduce plastic waste in medication deliveries to wards

Hospitals can review the products they use to deliver medication to hospital units and determine if plastic products can be eliminated or reduced. The Greening Hospital project by the Energy and Environmental Sustainability team at the Lower Mainland Health Organizations identified opportunities to improve the environmental performance of pharmacy operations within a hospital setting, among them:

Reusing large plastic bag for antibiotics

Replacing small plastic bags with brown paper bags

Departments can also trial reusable ward delivery totes in place of disposable paper or plastic bags.

Package to allow for redistribution

Medications should be packaged to enable redistribution. When medications are returned, pharmacy staff should have a list of criteria to assess medications for re-dispensing to another patients. The criteria should include the following considerations (21, 30):

- Integrity of packaging. Doses should be unopened and sealed.
- Clear labelling of contents and expiration date on external packaging
- Tamper sealing for multidose products such as creams, eye and ear drops, inhalers, and insulin pens
- Number of times a product has been redispensed for items requiring cold chain
- Unit dose packaging
- Barcoding for returns

Ensure patient-specific medications are transferred with the patient

The International Pharmaceutical Federation (FIP) recommends reviewing the transfer process of medications from admission onwards to reduce unnecessary waste. Re-dispensing misplaced medications creates an increased workload for both the pharmacy and nursing staff (medications need to be re-dispensed by pharmacy and nurses spend time searching and requesting for misplaced medications). In addition to the increased cost of the medicines, there is also increased environmental impacts due to the wastage of duplicate medications. For example, in the Climate Conscious Inhaler Practices in Inpatient Care Cascades Playbook, the authors found inhaler waste in the hospitals occurred at transitions of care (from ambulance to hospital, from emergency department to the ward, from ward to ward and at patient discharge) (51).

Pharmacies, along with interprofessional colleagues, should review and assess the transfer process of medicines from admission onwards to reduce unnecessary waste (48). Portering staff and nursing staff should have a list of locations to check for patient dispensed medication at points of transfer. Designating specific locations for the storage of patient-specific multidose products can not only help make the transfer process more efficient, but reduce the amount of misplaced products requiring re-dispensing during regular administration times.

In the NHS, a trial was conducted where designated members of the pharmacy team actively managed and moved medications when patients were transferred and returned unused medications. Over the month, £6942 was returned for re-dispensing across 8 trial wards. This was a savings of 2,360.28 kgCO2e, equivalent to 11,217 km driven in an average car. Projected annual savings totalled £83,628 (and 28,323.36 kgCO2e, equivalent to 134,618 km driven in an average car. This included the additional savings of £324and 384 kgCO2 for waste disposal. Applying a conservative 50% of calculated savings, the Trust could achieve annual savings of £234,292 and 79.6 Tonnes CO2e, if rolled out to all 45 wards across Hampshire Hospitals (66).

Use Patient's Own Medications (POMs) for non-formulary and multidose items during admission

Patients' own medications (POMs) are medications that patients have obtained from the community setting and have brought with them to the hospital on admissions. Although the Canada Health Act (67) states that drugs are provided as part of hospital services without cost to the patient, it may be necessary to have patients use their own medications to avoid interruptions in drug therapy when the medication is not stocked or is not included in the hospital formulary (68). Patients may also express a preference to use their own supply.

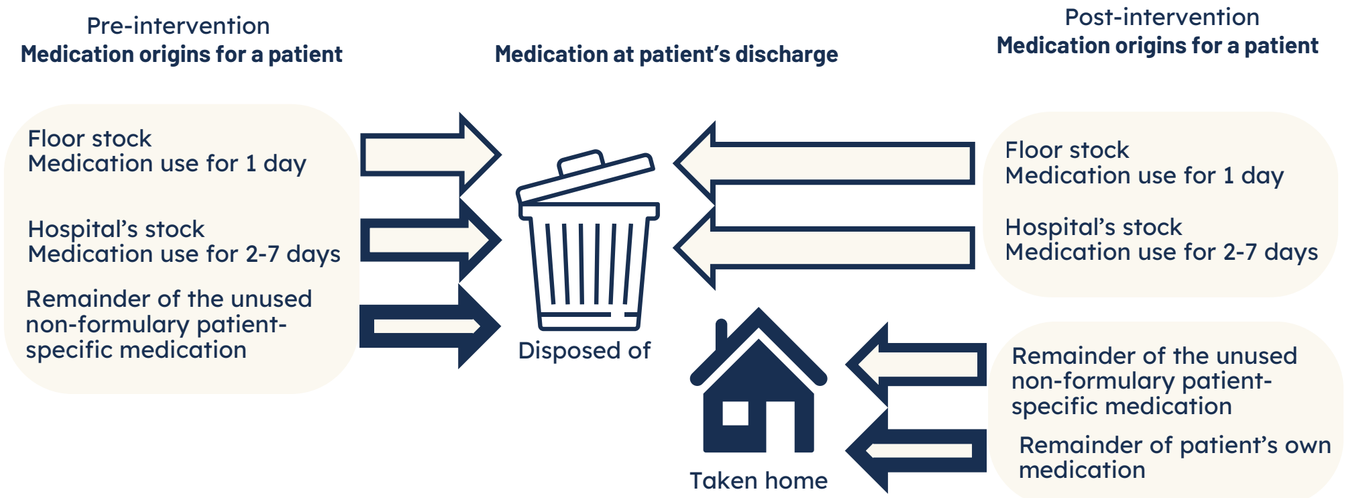


Figure 2: Seven Dutch hospitals measured the economic value of medication waste and time spent by healthcare professionals of using patient's own medications. They observed a decrease in medication waste, with a 39.5% decrease in cost per 100 patient days, and more efficient staff deployment. The thicker arrow represents more medications entering that pathway. Adapted from Figure 1 in van Herpen-Meeuwissen, LJM et al (2019).

Medications may be substituted in hospitals to different brands due to differences in formulary availability between community and hospital or control the costs of inventory. Approximately 31% of home medications are substituted during hospitalizations. Medication substitutions at hospital admission and discharge can contribute to medication waste and result in direct and indirect unnecessary expenses. When substitution is impossible, non-formulary medications are purchased for individuals, not only leading to additional resource use but also taking considerable amount of hospital staff time for assessment and procurement. Unused non-formulary medications are wasted when a minimum supply is purchased and no other patients need it (Figure 2). Upon discharge, substituted medications are resubstituted to patient's original medication. Thus, in-hospital substitution process takes significant time and leads to medication waste (69).

RESOURCES:

- Patient's own medication use for incorporating sustainability into a policy and procedure.

Multidose products during admission

Multidose products are another category where cost, labour, and waste savings can be achieved. Often multidose products dispensed in hospital cannot be discharged home with the patient due to provincial regulations on labelling requirements, which is particularly problematic for short stays where many doses end up being wasted and the product is incinerated. Another issue is that hospital dispensed medications may not show up on provincial health drug data systems other than in health provider documentation notes. Dispensing multidose products in hospitals is also labour intensive, as they must be filled, checked and delivered. When a best possible medication history (BPMH) is taken on admission, patient's own multidose product verification can also take place, including confirming the product, dosage, doses remaining and expiration date, to reduce dispensing time.

A prospective, consecutive, time-and-motion case series, conducted at St. Joseph's Healthcare Hamilton, Canada, in 6 surgical units (250 patients – 20.4% had prescription for POM multidose medication) evaluated the use of patient's own multidose medications (inhalation, nasal and ophthalmic medications). The average verification time was 10.5 + 6.7 min per patient. The cost impact was calculated as the difference between the drug cost with routine hospital dispensing and the cost of verifying home medications, where a positive value indicated a lower cost with verification of home medications (i.e.,' a saving for the hospital). The average cost impact was $40.05 ± $42.60 per patient ($p< 0.001$ by 1-sample t test) ($18.85 ± $15.42 per medication). A total cost saving of $1601.85 was realized (Figure 3). Using patients' own multidose medications instead of routine dispensing resulted in a cost saving of 74%, including labour costs for verification by the pharmacist (70).

Use of non-formulary and multidose medications during hospital admission can thus reduce staff labour time and cost to the hospital. Using POMs have additional reported benefits of continuation of familiar, established therapy; decreased risk that the patient ends up on two of the same therapies; better compliance after discharge; less drug waste within the health care system from discarding hospital supplied product; and potential cost savings to the hospital (71-77). It is important to obtain patient consent given the cost of certain multidose products.

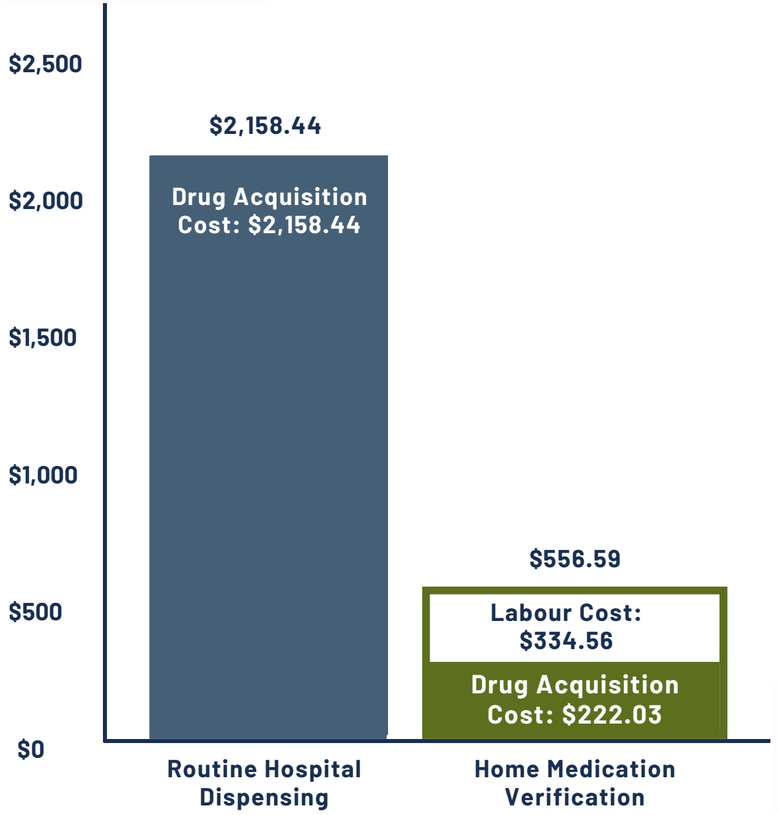


Figure 3: Total cost of routine dispensing compared with use of patient's own multidose medications adapted from Figure 2 in Wong, GY (2014).

SPOTLIGHT EXPERIENCE:

PATIENT'S OWN MEDICATION USE DUTCH HOSPITALS

Implementation of 'Patient's Own Medication' in seven Dutch hospitals decreased the economic value of wasted medication by 39.5% from €3983 to €2411 per 100 patient days. The mean time spent on the total medication process was reduced by 5.2 hours per 100 patients (from 112.7 to 104.4 hours per 100 patients). There was a shift in professional activities, as physicians and nurses spent less time on the medication process, whereas pharmacy technicians had a greater role in it. When time spent was expressed as salary; €1219 could be saved per 100 patients. This study showed that 'Patient's Own Medication' implementation may have a positive economic impact, as the value of medication waste decreases, hospital staff devoted less time on the medication process, and staff deployment was more efficient (69).

Learn more

Evaluate "as needed" and multidose products

An effort should be made to determine if "as needed" and multidose products on admission BPMHs need to be ordered in hospital by clarifying if patients are actively taking them. For instance, seasonal medications or medications used to improve focus may not be needed during a hospital admission. An attempt should be made to collect the admission BPMH prior to physician order entry to avoid ordering unnecessary medications.

Another strategy is to avoid dispensing non-urgent medication until a missing dose is requested. This strategy can also avoid duplicate dispensing when the dose is changed.

Clinical Practices

MEDICATION-USE PROCESSES

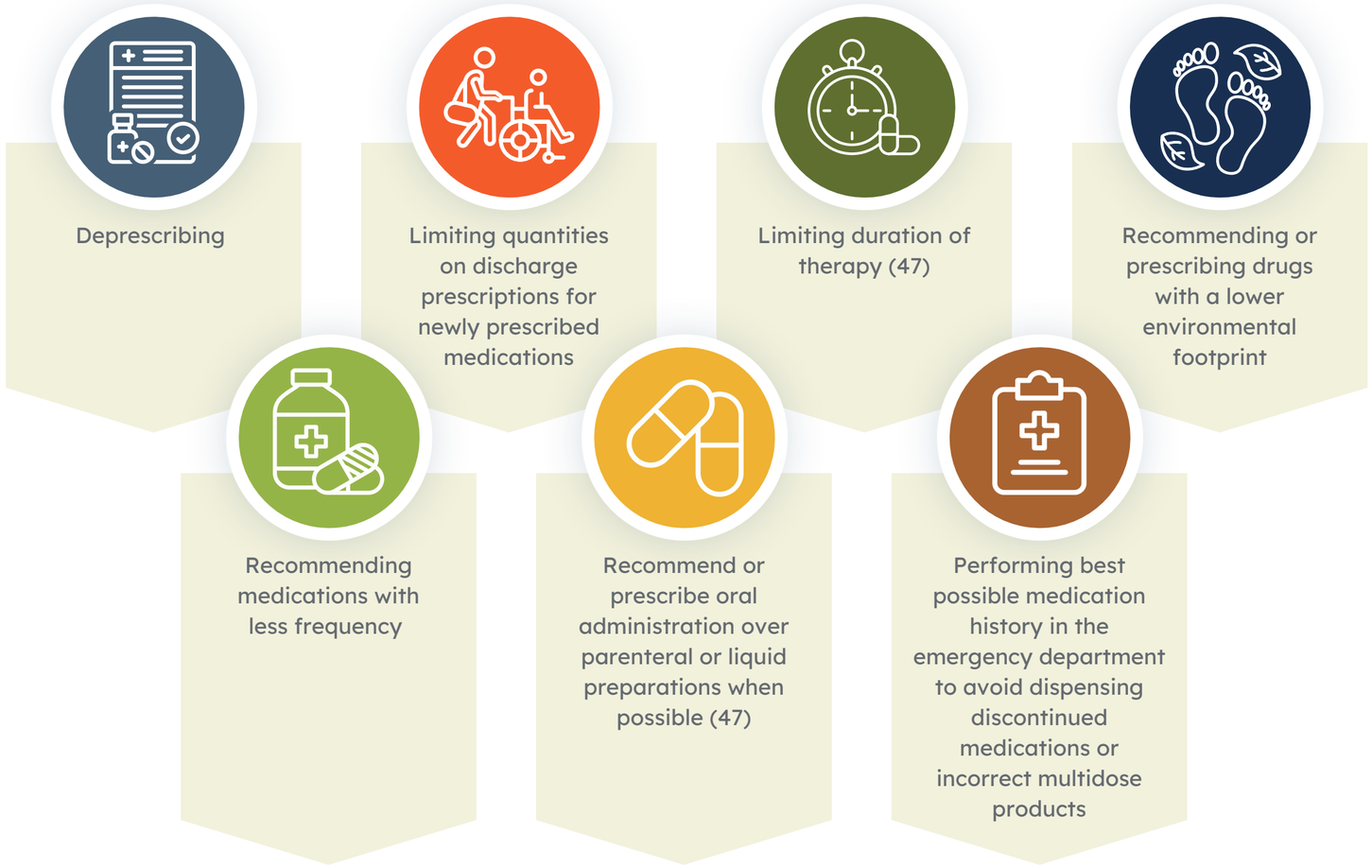
In addition to pharmacy operations, a significant part of the carbon footprint of pharmacy care relates to clinical practice (78). Ensuring patients are receiving the appropriate medications at the right doses, frequencies and durations that improve health and hospitalization while avoiding unnecessary care are fundamental to sustainable pharmacy practice. Strategies in health prevention and promotion should similarly be encouraged. Hospitalizations have a higher environmental impact compared to medical services without hospitalizations. Ambulatory care and public health activities are currently among the least polluting health care activities (78). Supporting pharmacy professional clinical activities not only benefits patient care but can also have environmental co-benefits.

MEDICATION OPTIMIZATION

In Canada, as much as 30% of healthcare is considered low value, which can lead to poor patient outcomes due to adverse events of treatments or unwarranted secondary tests (with potential for overtreatment of incidental findings) and inefficient use of scarce healthcare resources threatening the sustainability of health care systems (79,80). Reducing low-value care and improving healthcare's climate readiness are critical factors for improving the sustainability of health systems. Care practices that have been deemed low or no-value generate carbon emissions, waste and pollution without improving patient or population health (81,82).

Pharmacy professionals should engage in the principles of medication optimization to reduce the patient, health system and environmental harms caused by inappropriate medication use. Medication optimization is a patient-centered approach to improve the effectiveness, safety and adherence of medication regimens. Pharmacy leaders can support pharmacy professionals in activities focused on medication optimization such as medication reconciliation, patient education, addressing drug therapy problems, and participating in interprofessional patient care rounds. Prescribing optimally, not only reduces the number of adverse drugs reactions, but also reduces the number and costs associated with medications which may have co-benefits for the environment (Figure 4).

Figure 4: Strategies that can be implemented, when clinically appropriate, associated with positive environmental impacts



RESOURCES:

- Choosing Wisely Canada's Hospital Pharmacy Recommendations written by the Canadian Society of Healthcare-Systems Pharmacy offer 16 recommendations targeted at reducing low value care with environmental co-benefits.
- CASCADES' Medication Optimization for Sustainability in Inpatient Care includes tools to reduce low value care such as clinical medication reviews, use of non-pharmacological strategies, drug use evaluations, medication stewardship programs and electronic decision support.
- deprescribing.org is a Canadian website that contains research and guidelines to support healthcare providers and patients in reducing or stopping medications that may be harmful or no longer required.

Guidelines and algorithms for five classes of medications that are commonly overprescribed: proton pump inhibitors, antihyperglycemics, antipsychotics, benzodiazepine receptor agonists, cholinesterase inhibitors and memantine.

Therapeutics Initiative by the Department of Pharmacology and Therapeutics, in cooperation with the Department of Family Practice at the University of British Columbia was created to provide clinicians and the public with up-to-date, independent, evidence-based, practical information on healthcare interventions.

RxFiles is an academic detailing program providing objective, comparative drug information to front line practitioners throughout Saskatchewan wanting to provide the best possible drug therapy for their patients. RxFiles serves health providers and educators through:

- Newsletter reviews
- Q&As
- Clinical tools
- Journal articles
- Trial summaries
- Up-to-date drug comparison charts

The RxFiles Drug Comparison Charts, is a practical tool for evidence based and clinically relevant drug use information throughout Canada.

Amoxicillin liquid vs pills

The carbon footprint of packaging, distribution and waste disposal of liquid amoxicillin was estimated to be more than double that of capsules for individually packaged items. Given the lack of data on pharmaceutical excipients, an assumption was made that equivalent doses of active ingredients have a similar carbon footprint. The difference in carbon emissions increased to three-fold for a 7-day course of treatment. This is largely explained by increased , wastage due to the requirement to dispense whole bottles of liquid formulations as opposed to partial packets of capsules (78). This study also highlights the need for increased cooperation from the pharmaceutical industry to provide more accurate carbon footprint data given the wide variability in excipient formulations, that clinicians can then use to create more carbon friendly formularies.

Acetaminophen IV vs PO

The carbon footprint of 1 g of oral tablets of acetaminophen are at almost 4 times less than oral liquid and 8 to 16 times less than intravenous administration (Table 3). The single-use intravenous glass vials also have higher greenhouse gas emissions than the plastic vials for oral tablets. Intravenous administration should thus be reserved for cases in which oral formulations are not feasible. If the emissions reduction opportunity from substituting oral tablets for IV acetaminophen is extrapolated to USA, UK, and Australia elective surgical encounters in 2019, about 5.7 kt CO2e could have been avoided and with 98.3% in cost savings. (84).

Table 3: Comparison of the carbon footprint of different acetaminophen 1 g formulations

Forumlation	Carbon footprint of Acetaminophen 1 g
Oral	38g CO2e
Oral liquid	151g Co2e
Intravenous	310-628g Co2e*

*carbon footprint dependent on type of packaging and administration supplies

TARGETED PATIENT POPULATIONS

Although management and use should be assessed for all medications, certain medications and conditions with known associated environmental harms can be particularly targeted.

Oncology

Oncology medications, which can include cytostatic or antineoplastic compounds, are potent cytotoxic and genotoxic compounds, and even at low concentrations, present a major environmental concern (85).

In 2019, the Centre d'Expertise en Analyse Environmentale du Québec (CEAEQ) identified certain anticancer medications were found in elevated levels in tested aquatic environments. These medications included antiandrogens, antiestrogens, tyrosine kinase inhibitors, and vinca alkaloids. Acute, chronic, or genotoxic effects are known to occur at the measured concentrations, such as reproduction and endocrine disruptions in the case of antiandrogens and antiestrogens (85).

For all the following recommendations, a formal testing protocol should be established and validated at a local level to support their implementation.

Dose Rounding and Dose Banding

Various medications, including some anticancer medications, are dosed either based on weight or body surface area (BSA). Multiple vials may need to be used to obtain the desired dose. As these vials are often single use, any additional medication not drawn up must be discarded, leading to significant waste (86).

A study in the United States was done to assess dose rounding as both a method to reduce waste and cost. Rounding was conducted based on two rules; nearest vial size if its contents were within 10% of the calculated dose, or rounding to the nearest convenient measurable amount, if they were unable to round to the nearest vial size (86). A vial was considered saved if the dose was rounded down and a new vial was not needed. Out of the 40,000 doses administered in this study, it was found that 25% vials of medication were saved as a result of dose rounding. The study did not consider rounding up as a vial saved as the vial was still used, and the medication was only prevented from being thrown away (86). However, in the interest of sustainability, rounding up may also be meaningful, as it represents medication used that would have otherwise been disposed of, which can carry negative environmental impacts.

Building on this idea of dose rounding, dose banding tables can be implemented into hospital EMRs to standardize rounding to within 10% of the calculated dose. Doing so appears to be safe, reduces calculation and rounding errors, and reduces medication waste. An American compared manual doe rounding by a pharmacist to automatic dose-banding of bevacizumab, rituximab, and trastuzumab. Automatic dose-banding lead to less waste, greater cost savings and less errors (Table 4) (87).

Table 4: Amount of drug (in mg) and cost savings (in US dollars) comparing pharmacist-led manual rounding versus automatic dose banding during a 16-week period and extrapolated total annualized drug and cost savings for all 3 drugs combined (82).

Drug savings mg (cost in USD)	Pharmacist manual rounding	Automatic dose-banding
• Bevacizumab • Rituximab • Trastuzumab	686 mg ($5,467) 248 mg ($2,330) 60 mg ($623)	7,106 mg ($56,631) 13,414 mg ($126,027) 4,051 mg ($42,088)
Total annualized savings	3,833 mg ($32,870)	84,243 mg ($770,556)

Same Day Batching

Another strategy that can help reduce waste is same day batching, or vial sharing. Clinics can schedule patients receiving the same weight-based medication to come in on the same day. With this strategy, any remainder in a vial after it is drawn up is to be saved and used in the next patient (89).

Automatic Robotic Dispensing Unit

Automated preparation of anticancer medication using robotics offers another avenue for practitioners to reduce cytotoxic waste and may be able to support extending the BUD of single-use vials. Automated Robotic Dispensing Units (ARDUs) allow for continuous monitoring and control of the entire process and optimization of inventory and vial sizes to reduce waste. Compared to a manual preparation process, an automated process may facilitate the reuse of partially used vials to reduce costs and waste. One such ARDU does so by preparing one master bag of medication combining multiple vial sizes to be withdrawn from for compounding patient specific preparations, instead of compounding each patient's preparation manually from individual vials. This automated approach to vial sharing allows residual amounts that would have been left in the vial if prepared manually to be used up instead (91).

WASTE REDUCTION USING SAME DAY BATCHING

A 2014 study from the United Kingdom looked at the amount of waste that could be avoided by vial sharing or batching cytotoxic medications. Over two years, they found that same day batching led to a 30-37% reduction in waste. If vial sharing is extended over to a 7-day rolling basis using CSTE, an even higher reduction in waste of 44-53% was observed (90).

WASTE REDUCTION USING AUTOMATIC PREPARATION PROCESSES

A study from Morocco analyzed the waste reduction when using an automated preparation process. It found that by using an automated drug preparation process, cytotoxic drug consumption fell by 19.74%. Such processes also allowed for a reduction in waste (91).

Alternative Dosing Regimens

Many cancer biologics are administered at doses, frequencies, and/or durations greater than necessary to achieve a therapeutic effect (92), which can lead to unnecessary waste. As cancer care-related GHG emissions can harm human health, there is an opportunity to lower GHG emissions, and improve societal health outcomes, if alternative dosing, frequencies, or durations of therapy are considered (93).

Alternative dosing regimens are experimental and require further research. Prospective clinical trials evaluating low-dose or reduced-frequency administration of anticancer and therapeutic monoclonal antibodies are warranted and needed.

ANTI-HER2 AGENT TRASTUZUMAB ALTERNATIVE DOSING STRATEGIES

A study conducted using the anti-HER2 agent trastuzumab illustrate how alternative dosing strategies has the potential to reduce GHG emissions. The initially approved dose of 4 mg/kg every 3 weeks for 12 months was compared to an extended interval of 6 mg/kg every 4 weeks with a shortened adjuvant therapy duration of 6 months. The authors also calculated the environmental impact of trastuzumab and its administration by taking into consideration drug production, patient travel to care facilities, and medical waste generated from trastuzumab administration (93).

Relative to baseline, it was found that the extended interval of every 4 weeks led to a 4.5% reduction in GHG emissions in the neoadjuvant setting, a 10.4% reduction in the adjuvant setting, and a 14.6% reduction in the metastatic setting. A shortened adjuvant treatment duration led to a 9.9% reduction in GHG emissions. Lastly, extending the interval of administration as well as shortening the adjuvant treatment duration led to 4.5% reduction of GHG emissions in the neoadjuvant setting, a 18.7% reduction in the adjuvant setting, and a 14.6% reduction in the metastatic setting (93).

The example of trastuzumab illustrates the potential reduction of GHG emissions that can be achieved by considering alternative dosing regimens that can allow us to administer less medication. By exploring alternative dosing for other anticancer drugs if appropriate, there is a tremendous opportunity for us to cut back on GHG emissions, leading to a greener future in the field of oncology.

Nephrology (Chronic Kidney Disease/Hemodialysis)

End-stage kidney disease (ESKD), kidney replacement therapies such as hemodialysis (HD) and peritoneal dialysis (PD) are carbon intensive due to the procurement, water, electricity, transportation and waste management involved and the recurring need for these treatments (94). In British Columbia, the patient yearly greenhouse gas emission for a patient on hemodialysis is 3960 kg CO2e (95).

One study found the prevalence of polypharmacy in patients with chronic kidney disease was over 80% (96). Pharmacists can have a significant impact in sustainable kidney care by engaging in medication stewardship for CKD patients to reduce polypharmacy and progression to dialysis. Slowing the progression to ESKD has benefits for quality of life, costs associated with dialysis, and the environment (56).

*

Table 5: Comparison of environmental impacts of different modes of dialysis (Sustainable Kidney Care Playbook, CASCADES)

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

**Reflects current market value as of July 26, 2024

STOPMed-HD is a Canadian project examining the use of inappropriate medications in HD patients to develop a list of potential medications to deprescribe.

Activities that pharmacists can partake in include:

- Ensure medications that slow CKD progression are optimally used
- Avoid prescribing medication in CKD patients that may worsen kidney function, such as non-steroidal anti-inflammatory drugs
- Perform regular medication reviews to deprescribe potentially inappropriate medications
- Avoid concurrent use of angiotensin-converting enzyme inhibitors and angiotensin receptor blockers due to higher risk of acute kidney failure and hyperkalemia
- Switch patients from intravenous to oral alternatives when clinically appropriate
- Prescribe erythropoietin stimulating agents only when clinically indicated

STEWARDSHIP PROGRAMS

Medication stewardship refers to coordinated strategies and interventions to optimise medication use, usually within a specific therapeutic area where there is a high risk of inappropriate prescribing or adverse outcomes. Medication stewardship programs can reduce variations in practice and improve patient outcomes. Successful medicine stewardship programs aim to enable clinicians and patients to select and use treatment options wisely, safely and effectively. Successful medication stewardship programs have been demonstrated for antimicrobials, opioids, anticoagulants and psychotropics (97).

Pharmacists, at the core, are stewards for all medications. They are ambassadors for optimizing medication use both for individuals and the global population at large (98). Medication stewardship can also reduce costs and resources associated with administering certain drugs. For example, use of intravenous medication has 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 (99). Thus, hospitals and bed-based facilities should include drug stewardship initiatives in their institutions to optimize patient health, safety and reduce drug use which have environmental co-benefits. Hospital-based stewardship programs and prescribing decisions must include communicating with general practitioners, community pharmacists, and community or aged-care nurses across transitions of care and facilitating ongoing care in the community (97).

- Antimicrobial
- Anticoagulation
- Opioid
- Psychotropics

RESOURCES:

- Medication Optimization for Sustainability in Inpatient Care - CASCADES Canada
- Council of Australian Therapeutic Advisory Group Medicines Stewardship Toolkit
- Polypharmacy Stewardship: a novel approach to tackle a major public health crisis
- Alberta Health Services Drug Stewardship initiatives

Antimicrobial Stewardship Programs

Antibiotics are some of the most prescribed pharmaceutical agents in the world, both for human and agricultural use. As wastewater treatment systems are not capable of completely removing pharmaceutical residues, improper disposal practices and natural human excretion enter water supplies, spread to soil, and surface waters. Antimicrobial overuse and misuse are common and are important factors contributing to antimicrobial resistance (AMR) (31). To prevent AMR, international, national and local action supporting antimicrobial stewardship (AMS) is required.

AMS programs have been shown to reduce antimicrobial usage in both hospital and long-term care settings (100,101). A systemic review evaluating the effectiveness of pharmacist-led AMS interventions in hospital inpatients found that education-based interventions were effective in increasing guideline compliance and reducing duration of antimicrobial therapy without increasing mortality. In Australian hospital settings, AMS programs have been shown to reduce AMR by 30%, reduce mortality by 35% through adherence to treatment guidelines and improve patient safety by avoiding drug-related adverse events (102). A meta-analysis showed that AMS with a pharmacist effectively reduced mortality, inappropriate use, cost, length of stay, duration of treatment, consumption of antimicrobials, and the return rate to hospital. All these have potential environmental co-benefits (103).

Switching from intravenous to oral antimicrobial therapy at the earliest opportunity is another key feature that supports reduction of the environmental impacts of healthcare (101). A life cycle-analysis evaluating the environmental impact of ciprofloxacin when administered intravenously (CIP-IV) compared to orally (CIP-PO), showed that CIP-PO has a significantly lower environmental impact than intravenous administration. The marine ecotoxicity of CIP-IV is over 233 times greater than that of CIP-PO, while the global warming potential of CIP-IV is approximately 71 times higher than CIP-PO. The substantial difference in environmental impact is largely due to the extensive use of medical supplies, particularly the maintenance infusion bag. Thus, reducing the number of the infusion bags and promoting the switch from intravenous to oral administration where clinically appropriate could decrease the environmental impact of antibiotic treatments (104).

RESOURCES:

The following are resources to assist in the set up antimicrobial stewardship programs:

- Public Health Ontario Antimicrobial Stewardship Resources: Tools for getting Started
- How to start an antimicrobial stewardship programme in a hospital
- WHO: Antimicrobial Stewardship or targeted AMS strategies or interventions (WHO: Antimicrobial Stewardship Interventions: A practical guide
- Sinai Health System – University Health Network Antimicrobial Stewardship Program Clinical Resources

Opioid Analgesic Stewardship Programs

Opioid stewardship programs include evidence-based guidelines, policies, person-centered practices and research to promote rational prescribing, use and deprescribing of opioids for managing pain and specified health conditions. Opioid stewardship programs should aim to optimize treatment by maximizing clinical benefits for the patients and the wider society and minimizing adverse consequences, including overuse, misuse, and diversion. Effective patient-provider communications and involving patients and/or their caregivers in decision-making are key to implementing any opioid stewardship program by considering evidence-based outcomes that matter to patients. Stewardship programs should also focus on safe procurement, storage, and disposal practices (105). Opioid stewardship programs have been successfully implemented in hospital (106–108), rehabilitation (109), and ambulatory care environments.

Opioid stewardship is another area in which hospital pharmacists have positive impacts. The Society of Hospital Pharmacists of Australia (SHPA) performed an audit of hospital activities and found that the presence of an Opioid Stewardship service substantially increases the likelihood of a range of opioid-related harm minimization activities being implemented across both medical and pharmacy areas. These included an increase in smaller quantities of oxycodone dispensed to patients, increased analgesic weaning in hospitals and inclusion in medical discharge summaries. SHPA recommends pharmacist-led opioid stewardship programs in Emergency Departments, perioperative and surgical services.

Additionally, pharmacists should be involved in the education and training of prescribers as well as lead the development, promotion, implementation, and maintenance of best practice guidelines, procedures, and protocols related to the optimal use of opioids and analgesics. They also recommend a national electronic medication management system across all Australian hospitals to support the gathering and collation of nationally standardized data sets for organizations to benchmark against and to aid in timely extraction of prescribing data (110).

RESOURCES:

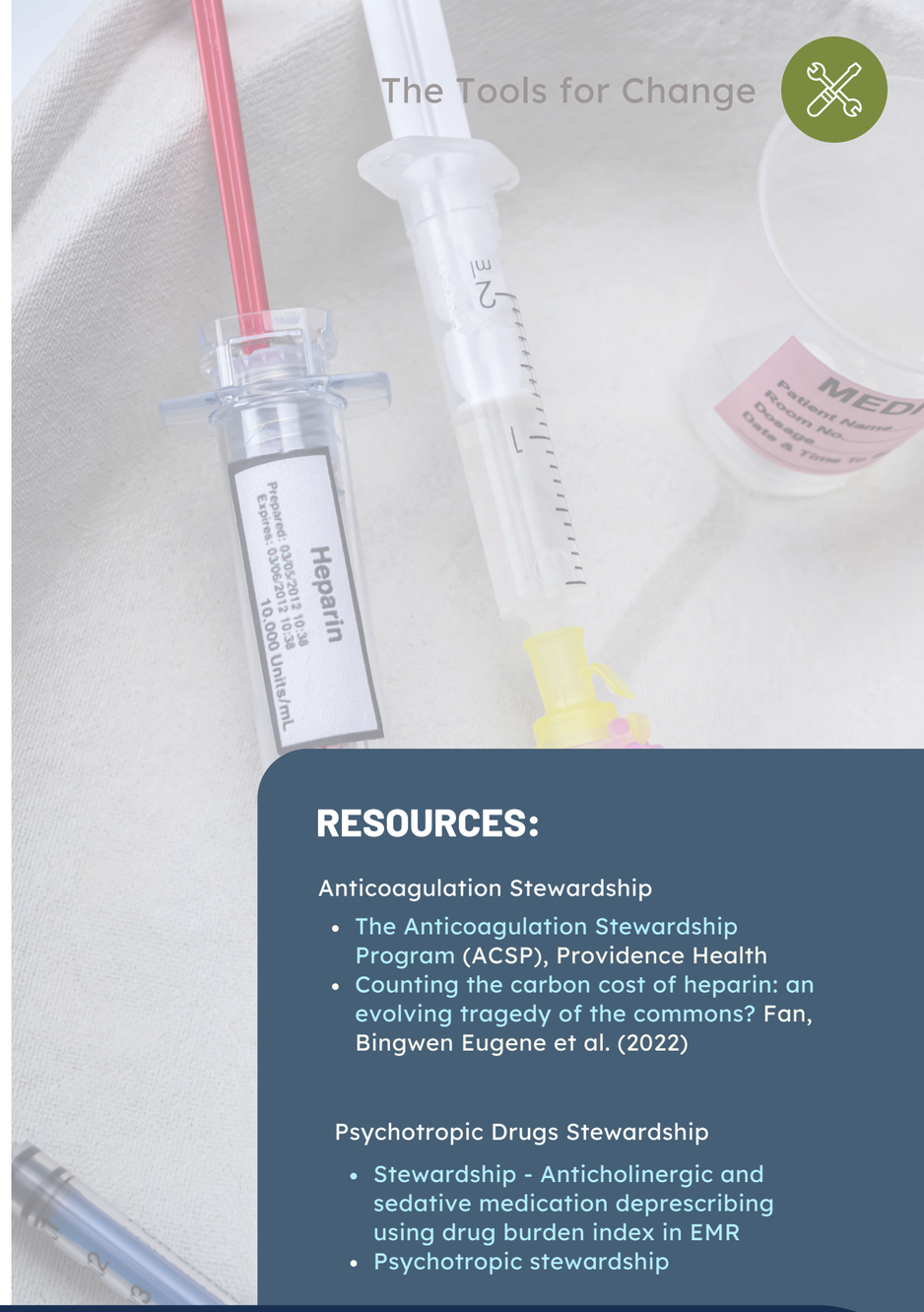
- Saskatchewan Health Authority Opioid Stewardship Program can assist institutions wishing to implement opioid stewardship programs

Anticoagulation Stewardship

Anticoagulants, including vitamin K antagonists (VKAs), unfractionated heparin (UH), low-molecular-weight heparins (LMWHS) and direct oral anticoagulants (DOACs) are among the medications frequently responsible for causing adverse drug events in hospitalized patients (111). Multi-disciplinary and Pharmacist lead Anticoagulation Stewardship Programs (ASP) have been shown to improve adherence to venous thromboembolism prophylaxis (VTE) in hospitalized medical patients and reduce the associated costs and risks (112,113). Heparin is dependent on the global porcine industry for its production, which is estimated at 668 million tonnes of CO2 annually. The carbon footprint generated from the porcine industry through procurement of fresh porcine intestines indirectly contributes to the net global C02 emissions from the pharmaceutical industry, which is estimated at 52.0 megatonnes of CO2 in 2015, a higher value that that generated by the automotive industry (46.2 megatonnes of CO2) (114). Thus, attention should be given to the judicious use of heparin products.

Psychotropic Drugs Stewardship

Psychotropic medications are an emerging target for medication assessments. Psychotropic drug stewardship programs aim to reduce adverse effects and inappropriate chronic use. People with disabilities and the elder population, for whom antipsychotics or benzodiazepines may be overused or misused as chemical constraints, would benefit from stewardship programs (106–109,115). Strategies to support the monitoring, review, and deprescribing of psychotropic medications as well as reinforcing non-pharmacological management of agitation in delirium are all interventions that may be employed.



RESOURCES:

Anticoagulation Stewardship

- The Anticoagulation Stewardship Program (ACSP), Providence Health
- Counting the carbon cost of heparin: an evolving tragedy of the commons? Fan, Bingwen Eugene et al. (2022)

Psychotropic Drugs Stewardship

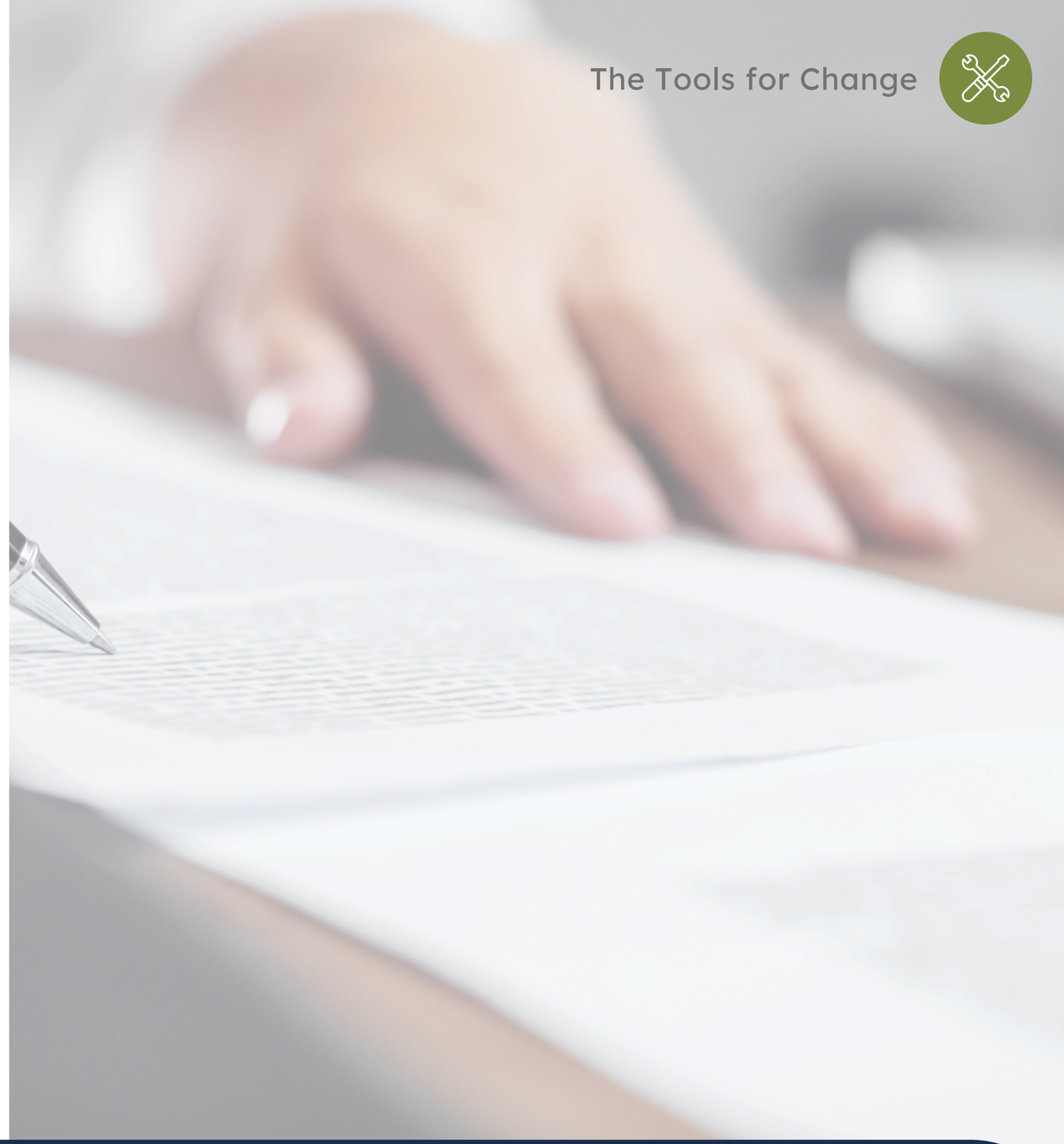
- Stewardship - Anticholinergic and sedative medication deprescribing using drug burden index in EMR
- Psychotropic stewardship

Policies & Procedures

Integrate sustainability into policies and procedures

Hospital policies and procedures guide day-to-day operations, standardize practices, streamline processes across the organization, and communicate expectations to staff, ensuring that every patient receives the same level of care. Policies and procedures should be created or updated in the areas below, to enable staff perform actions towards a sustainable pharmacy practice:

- Disaster management
- Medical directives
- Procurement Contract Criteria
- Patient's use own medications
- Take home multidose medications
- Pharmaceutical waste and disposal

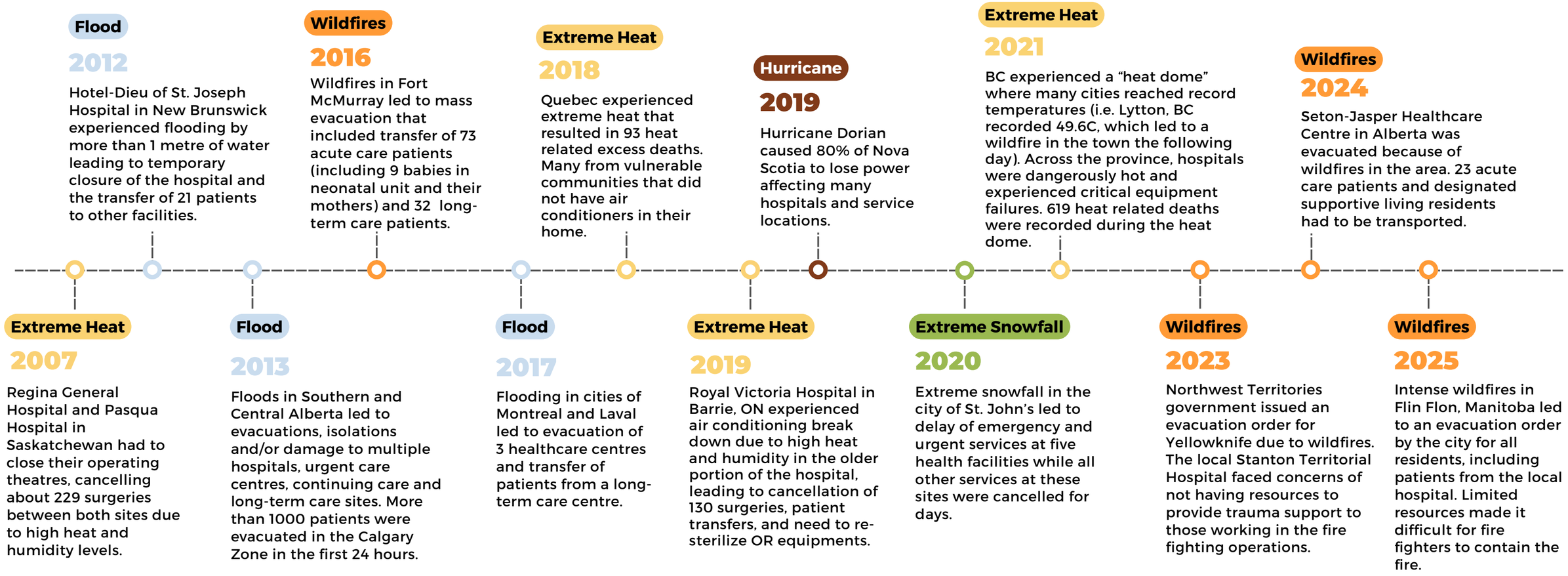


DISASTER MANAGEMENT

Climate change is a significant threat to human health in the 21st century and changes in climate are already evident globally, including in Canada. Climate change encompasses concerns such as higher temperatures, shifting rainfall patterns, vector pattern changes, and rising sea levels–changes that are predicted to persist and intensify over the coming decades leading to more extreme weather events. Disasters and extreme weather events have significant impacts on Canadian lives, including the healthcare system. Hospitals have similarly been impacted with increasing severity and frequency in the past decade (Figure 5). It is necessary therefore to understand the impacts of disasters on the healthcare system and start building resilience through awareness, training, and adaptation to reduce the associated human health risks and costs.

Disasters impact hospitals pharmacies in many ways. They can be directly impacted (e.g., fire) or they can be indirectly impacted by disruptions to the medicine supply chain. Disasters can lead to compromised care in hospitals and pharmacy personnel need to be prepared for their roles in disaster management. Executing an organized response to an additional surge of disaster-related patients or impacts of a disaster on the hospital pharmacy requires pre-planned emergency management procedures. These procedures should take an all-hazard approach as it is not known what the next specific disaster event will be but the impact on the healthcare system and pharmacy's response will be similar. Pharmacy professionals can address impacts of drug shortages with prioritized drug procurement and inventory management strategies which may improve the availability of key medications required for a disaster response.

Figure 5: Timeline of natural disasters impacting Canadian healthcare facilities showing increasing severity and frequency (144-162).



Disaster management can be broken down into phases – mitigation, preparedness, response, and recovery. Mitigation is reducing the impact of potential hazards and risks from impacting the hospital (e.g., vaccination campaigns to reduce outbreaks and epidemics). Preparedness is developing comprehensive SOPs and practising with them, so all personnel know the disaster management plan. Response is addressing the short-term health needs of the disaster and recovery is addressing the long-term health needs and reestablishing normal operations. It is imperative for healthcare professionals to understand their roles and responsibilities as they evolve throughout the disaster management phases.

In 2016, the International Pharmaceutical Federation (FIP) released guidelines for how pharmacies should prepare for and respond to natural disasters. The Guidelines state that:

“Regional hospital pharmacists should create, provide, and promote guidelines for emergency SOPs.” and “Designated pharmacy emergency planning teams must organize periodic emergency drills to assess effectiveness of the SOPs”.

FIP also has provided an updated Statement of Policy: The role of pharmacists in disaster and emergency management in 2023 with seven recommendations for individual pharmacist that can help to ensure continued care is provided to patients. The recommendations include having a local disaster and emergency response plan tailored to the most likely risks and scenarios in their geographical area and having an evacuation plan and hibernation kit of essential supplies in areas prone to major disasters.

STANDARD OPERATING PROCEDURES GUIDELINES

CASCADES’ Standard Operating Procedures (SOP) Guideline aims to address the lack of disaster management SOPs specific to hospital pharmacies by creating a framework and resources that can be adapted to create an individualised SOP for each hospital pharmacy.

RESOURCES:

- International Pharmaceutical Federation (FIP):
  - Guidelines (Responding to Disasters: Guidelines for Pharmacy 2016)
  - Statement of Policy: the role of pharmacists in disaster and emergency management (2023)
- Saskatchewan College of Pharmacy Professionals Emergency Preparedness Resource Kit for Pharmacists and Pharmacy Technicians
- Kaitlyn E Watson, Jason Chou, Deborah Simonson, The need for an emergency planning and preparedness strategic plan for pharmacy leadership, American Journal of Health-System Pharmacy, Volume 81, Issue 14, 15 July 2024, Pages 647–651

MEDICAL DIRECTIVES

A medical directive is a written order to perform a controlled act for any patient who meets the criteria set out in the medical directive. A medical directive can order a procedure or series of procedures under specific conditions without a direct assessment of the patient by the authorizer (e.g. authorizing a pharmacist to order INR testing for a patient receiving warfarin therapy). Ideally, all health professionals involved in authorizing and implementing procedures under medical directives participate in their development (116).

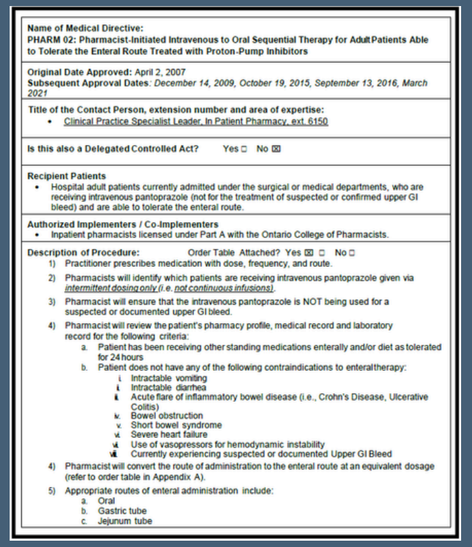
The breadth and scope of clinical activities undertaken by pharmacists in Canada varies widely by province/territory due to health care actives being governed primarily at a provincial/territorial rather than federal level. Additionally, medical directives vary between institutions/health authorities as the scope of the directives need to be agreed on by each institution's medical advisory committee or health authorities.

For provinces, institutions or practitioners who do not have independently prescribing authority, medical directives allow practitioners to independent perform activities related to patient care.

Having medical directives for the following items may help pharmacists champion sustainable prescribing and practices:

- Switch intravenous to oral antibiotics and proton pump inhibitors when clinically appropriate
- Stepdown broad spectrum to narrow spectrum antimicrobials to decrease risks of antimicrobial resistance
- Automatic substitution to sustainable medication choices (e.g. inhalers)
  - → To allow pharmacists to initiate conversations with patients to consider switching to more carbon-friendly inhaler choices
  - → To allow pharmacists to switch to clinically effective sustainable therapeutic options.

RESOURCES:



Name of Medical Directive:
PHARM 02: Pharmacist-Initiated Intravenous to Oral Sequential Therapy for Adult Patients Able to Tolerate the Enteral Route Treated with Proton-Pump Inhibitors

Original Date Approved: April 2, 2007
Subsequent Approval Dates: *December 14, 2009, October 19, 2015, September 13, 2016, March 2021*

Title of the Contact Person, extension number and area of expertise:
- Clinical Practice Specialist Leader, In Patient Pharmacy, ext. 6150

Is this also a Delegated Controlled Act? Yes ☐ No ☒

Recipient Patients
- Hospital adult patients currently admitted under the surgical or medical departments, who are receiving intravenous pantoprazole (not for the treatment of suspected or confirmed upper GI bleed) and are able to tolerate the enteral route.

Authorized Implementers / Co-Implementers
- Inpatient pharmacists licensed under Part A with the Ontario College of Pharmacists.

Description of Procedure: Order Table Attached? Yes ☒ ☐ No ☐

1) Practitioner prescribes medication with dose, frequency, and route.
2) Pharmacists will identify which patients are receiving intravenous pantoprazole given via *intermittent dosing only (i.e. not continuous infusions).*
3) Pharmacist will ensure that the intravenous pantoprazole is NOT being used for a suspected or documented upper GI bleed.
4) Pharmacist will review the patient's pharmacy profile, medical record and laboratory record for the following criteria:
   a. Patient has been receiving other standing medications enterally and/or diet as tolerated for 24 hours
   b. Patient does not have any of the following contraindications to enteral therapy:
      i. Intractable vomiting
      ii. Intractable diarrhea
      iii. Acute flare of inflammatory bowel disease (i.e., Crohn's Disease, Ulcerative Colitis)
      iv. Bowel obstruction
      v. Short bowel syndrome
      vi. Severe heart failure
      vii. Use of vasopressors for hemodynamic instability
      viii. Currently experiencing suspected or documented Upper GI Bleed
4) Pharmacist will convert the route of administration to the enteral route at an equivalent dosage (refer to order table in Appendix A).
5) Appropriate routes of enteral administration include:
   a. Oral
   b. Gastric tube
   c. Jejunum tube

Example of a Medical Directive

- Medical Directive and/or Delegation, St. Joseph's Unity Health Toronto: Pharmacist-Initiated Intravenous to Oral Sequential Therapy for Adult Patients Able to Tolerate the Enteral Route Treated with Highly Bioavailable Antimicrobials
- Medical Directive and/or Delegation, St. Joseph's Unity Health Toronto: Pharmacist-Initiated Intravenous to Oral Sequential Therapy for Adult Patients Able to Tolerate the Enteral Route Treated with Proton-Pump Inhibitors

PROCUREMENT CONTRACT CRITERIA

An estimated 80% of a healthcare organization's total greenhouse gas emissions are from the supply chain (117). This includes all purchased products, including pharmaceuticals, but excludes direct energy purchases. Therefore, it is essential that there is a strategy to curb supply chain emissions to mitigate greenhouse gas emissions.

Vendors and distributors have been prioritizing planetary health and social responsibility in recent years. Some group purchasing organizations (GPOs) have platforms where carbon footprint changes can be calculated based on product purchases. Others focus on procuring healthcare products from local or indigenous-led industries. Have a conversation with your GPO to assure them this is an issue that is important to your organization, discover what tools they offer to help your organization make environmentally conscious choices, and ensure that the criteria they use to assess environmental sustainability are verifiable and accountable.

Pharmacy departments themselves are unique in that they procure items outside the regular purchasing departments depending on the needs of the pharmacy and can thus establish their own procurement policies. Currently, it is difficult to assign planetary health priorities to companies or products due to the lack of data from the pharmaceutical industry. Nevertheless, there are opportunities to prioritize:

- A reusables first approach (e.g., Reusable waste bins and reusable gowns for non-cytotoxic sterile compounding)
- Procuring from local or indigenous-led organizations
- Purchasing from companies with an environmental disclosure
- Procuring based on the amount of packaging materials

Hospitals can also work with their distribution partners to advocate for reusable transportation products, such as transport receptacles, ice packs, and temperature monitors. Sustainability criteria should be included in the considerations for purchasing medications and other pharmacy supplies.

RESOURCES:

- CASCADES Reusables First Approach in Healthcare playbook
- The Canadian Coalition for Green Health Care created a Green Hospital Procurement Guide.
- Health Care Without Harm (Europe)'s report Procuring for Greener Pharma discusses some of the challenges of sustainably procuring pharmaceuticals and highlight European countries that have set environmental requirements for drug procurement.
- Sweden and Norway have set environmental and social sustainability criteria for purchasing.
- In England (NHS) and Germany, attention has been placed to procurement criteria and supplier requirements.

PATIENT USE OWN MEDICATIONS (POMs)

Facilities may find it useful to create a policy and procedure for the management of patient's own medications. The CSHP Guidelines for Practice states patients who have brought in their own medication be encouraged to send those medications home or, if this is not possible, the medications must be identified, stored in a secure area, and returned to the patient at the time of discharge.

If POMs are to be used the following must be in place (118):

- Hospital policy and procedures for the use of POMs within the hospital
- POMs must be verified before administration
- Prescribers must write orders for the administration of POMs
- POMs that are not returned to the patient are to be destroyed according to local requirements

The College of Pharmacists of British Columbia also developed Guidelines for use of patient's own medicinal products in hospitals with defined guiding principles and pharmacist role that institutions can use to develop their own documents.

TAKE HOME MULTIDOSE MEDICATIONS

When patients are discharged from the hospital, unused or partly used dispensed multidose medications are not provided for the patient to take home and are often disposed. For example, inhalers prescribed in the hospital not given to the patient are discarded unless there is an inhaler reuse and recycling program in place. One consideration is to provide the patient with their partially used inhaler; however, provincial regulations, bylaws and standards of practice may require additional labelling and counselling requirements than are used in hospital settings. Medications dispensed in hospitals may not show up on provincial central health databases. Thus, additional human resources would be required to ensure compliance to regulations and bylaws and ensure documentation on dispensed medications are accurate and complete. This initiative may involve coordination with other healthcare professionals. A policy and procedure would be required to ensure that this initiative be successful.

RESOURCES:

- Example Use of Patient's Own Medications from Mackenzie Health
- Guidelines for use of patient's own medicinal products in hospitals, College of Pharmacists of British Columbia
- Hospital Pharmacies Providing Pharmacy Services to Outpatients: Releasing Medications, College of Pharmacists of British Columbia

PHARMACEUTICAL WASTE AND DISPOSAL

Given the amount of materials used in medication processing and distribution, a policy would help hospital staff manage pharmaceutical waste. A pharmaceutical waste policy and procedures document should include information about:

- The environmental impact of pharmaceutical waste to encourage proper disposal
- Segregation
- Management of narcotics, targeted, hazardous and unknown substances

Policies and procedures should be developed with a multidisciplinary approach involving pharmacy, environmental services, nursing, affected hospital unit leadership, and any other logistical services. Education should be provided to all staff. Waste audits and feedback should be done regularly to improve practice and update the document.

Hospital staff should also consider use of reusable pharmaceutical and sharps containers. Contracted waste vendors can let hospitals know which one of their bins are reusable and which ones are single-use. For institutions looking to implement a reusables system, there are certain considerations that should be taken into account to maximize their use. Pharmaceutical waste and sharps collection should be separate from all other hospital contracts, including from other forms of waste contracts. Hospitals often change suppliers, leading to changing waste systems throughout the organizations. This leads to waste due to bins being discarded, and negating or worsening the carbon footprint of a reusable system. It is thus important to do up-front interprofessional analysis on the type of bins that work best for clinicians, where the bins will be installed, and the size that is needed for the various locations.

SPOTLIGHT EXPERIENCE:

LOMA LINDA UNIVERSITY HEALTH

A large American hospital examined the impact of switching from disposable to reusable sharps containers. They calculated a reduction of 50.2 tonnes of plastic annually, diverting 31.8 tonnes from landfill and 18.4 tonnes from incineration. An additional 8.1 tonnes of cardboard would be eliminated. The total annual GHG reduction was estimated at 164.4 metric tonnes of CO_2e, equivalent to consuming over 70,000 litres of gasoline (119, 120).

Learn more

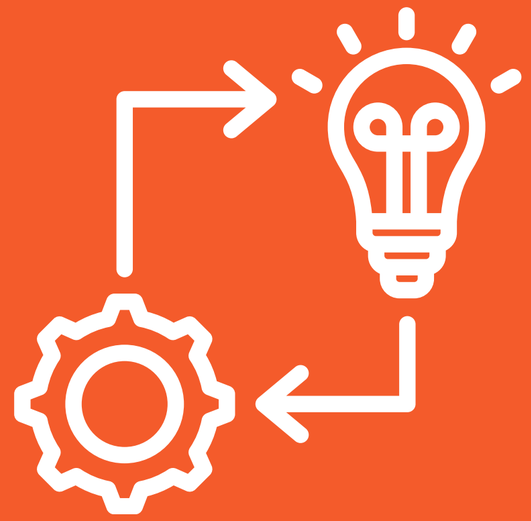
FRASER HEALTH

After their successful use at COVID-19 immunization clinics, Fraser Health expanded implementation of reusable sharps containers across the health authority. The design of the reusable container limited the times a clinician needed to touch the container, decreasing the risk of cross-contamination and needlestick injuries. These sharps containers also reduced the amount of plastic and cardboard sent to landfill (121).

Learn more

RESOURCES:

- Performing hospital waste audits
- Examples of pharmaceutical waste disposal policies and procedures:
  - Providence Health Care
  - Lower Mainland Pharmacy Services
  - Fraser Health



HOW

The Strategy for Change

1. Align with Organizational Objectives
2. Sustainability Taskforce
3. Education
4. Research, Measurements and Reporting

Align with Organizational Objectives

CLINICAL PHARMACY KEY PERFORMANCE INDICATORS

Environmental sustainability efforts should align with existing priorities. Choose activities that prioritize patient safety and outcomes, lowers costs, and/or reduces labour with environmental co-benefits. For pharmacy professionals, use clinical pharmacy key performance indicators (cpKPIs) with environmental co-benefits to create change.

cpKPIs were developed to address a need to measure hospital clinical pharmacy services. They can also be used as a measurement and reporting tool to support pharmacists to target and prioritize clinical pharmacy services (122, 123). In discussions with hospital pharmacy leaders across Canada, cpKPIs were identified as an important prioritization setting tool used as a quantifiable measure of clinical pharmacy care provided by pharmacists.

To learn more about Clinical Pharmacy Key Performance Indicators, see the Canadian Consensus on Clinical Pharmacy Key Performance Indicators: Knowledge Mobilization Guide.

Climate change reduction and adaptation activities that could be documented and counted as cpKPIs fall under:

- Medication reconciliation on admission
- Drug therapy problems
- Medication reconciliation at discharge
- Patient education

Medication Reconciliation on Admission

Medication reconciliation early in a hospital admission can reduce the number of unnecessary and inappropriate medications continued in hospital. There is also an opportunity to assess multidose products, and a patient's actual use and indication for as needed medications. Patient's may be agreeable to use their own multidose and non-formulary products if they have been brought to the hospital, particularly if a product would be substituted in hospital. They may also agree to hold certain medications during their admission, such as medications for improving focus or environmental allergies.

Medication Reconciliation at Discharge

Medication reconciliation at discharge presents a prime opportunity to assess patients for appropriate medication use. Medications started in hospital for acute illness can also be unintentionally continued after discharge. A 2016 study reviewed over one million patients over 66 years of age who had been hospitalized in Ontario between 2002 and 2011. They found patients still receiving medications for acute illness one year after discharge, costing the healthcare system an additional $18 million (124). Studied medications included antipsychotics, benzodiazepines, and respiratory inhalers – all medications with known environmental and climate harms (125,126).

Medications can also be restarted after discharge if reasons for discontinuation are not clearly communicated to primary care providers. Twenty-seven percent of medications discontinued during hospitalization due to an adverse drug event were prescribed to geriatric patients within 6 months of discharge, regardless of the type and severity of the reaction (127). Pharmacists reviewing and documenting medication changes may reduce the instances of unintentional continuation of medications after discharge.

CSHP developed a Discharge Medication Management Toolkit to optimize medication management at discharge for pharmacy professionals. The pharmacy-led discharge medication management bundle is rooted in improving patient care but also have links to sustainability (Figure 6).

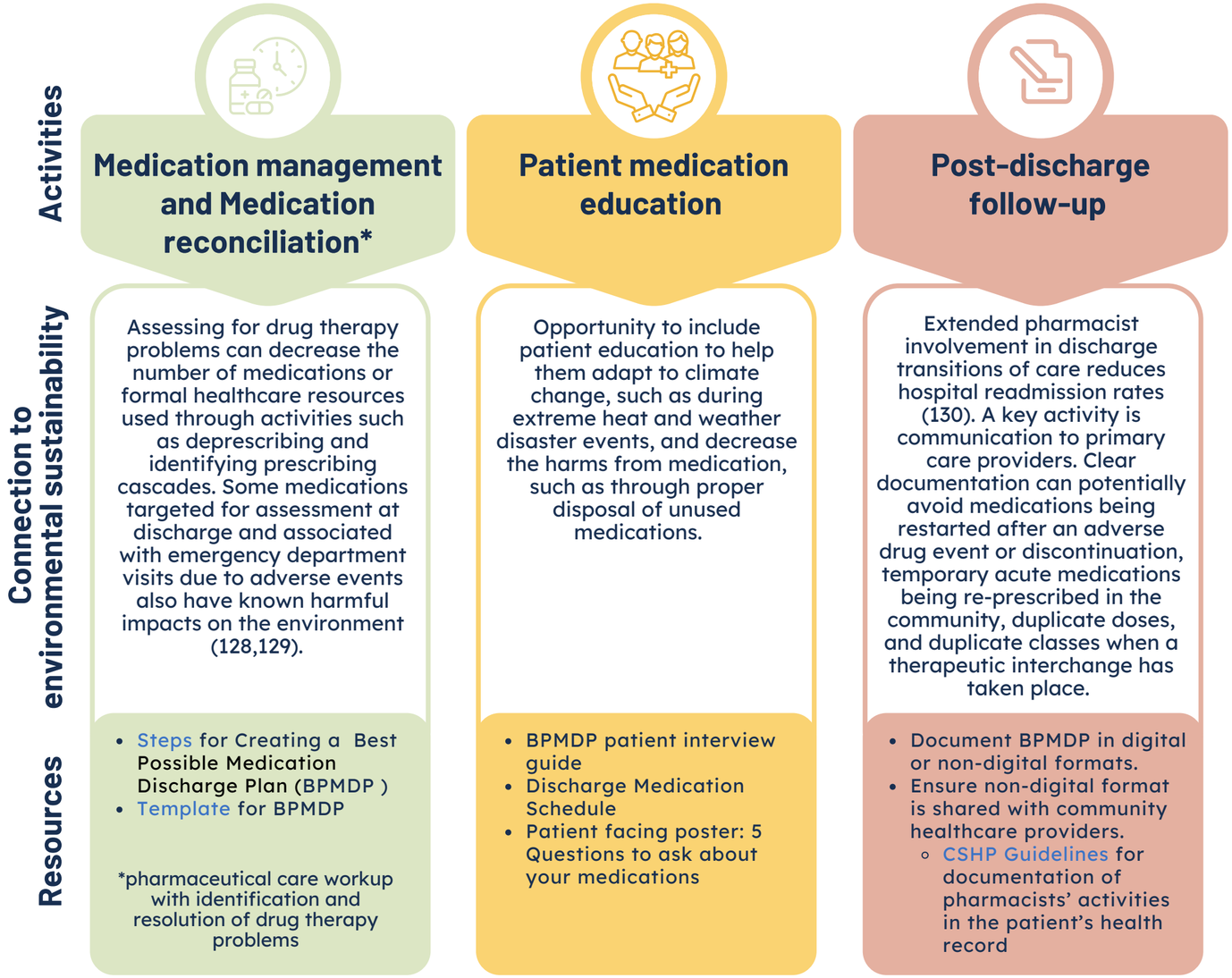


Figure 6: Discharge Medication Reconciliation Plan Checklist tasks with resources and how the activities relate to environmental sustainability.

Drug Therapy Problems

A drug therapy problem (DTP) is any undesirable event or risk of an event experienced by the patient that is suspected to involve drug therapy. DTPs interfere with achieving the desired goals of therapy and require professional judgment to resolve (132). Unaddressed drug therapy problems can lead to temporary or permanent harm and increase in healthcare and resource use (133).

Environmental co-benefits of addressing DTPs result from approaches to reduce the amount of medication used, thus decreasing the amount of active pharmaceutical ingredients discarded and excreted, and optimizing medication therapies and access to prevent rehospitalization.

Table 6: Examples of Clinical Hospital Pharmacy Sustainability Opportunities for Drug Therapy Problems

UNNECESSARY DRUG THERAPY	NEEDS ADDITIONAL DRUG THERAPY	INEFFECTIVE DRUG	DOSAGE TOO LOW	ADVERSE DRUG REACTION	DOSAGE TOO HIGH	NON-ADHERENCE OR NONCOMPLIANCE
• Hold or discontinue medications not needed during hospital stay (e.g. seasonal medications such as nasal sprays) • Assess potentially inappropriate medications for a clear indication and benefit for the patient • Assess indication for inhalers • Assess intravenous antimicrobials for indication and consideration to stepdown to oral therapy regularly • Consider non-pharmacological, social factors that could improve patient health, such as access to medications and social programs • Assess for prescribing cascades	• Add medications that delay the need for hemodialysis • Add medications that decrease the risk of hospitalization or rehospitalization or delays end stage renal disease • Assess for optimal inhaler control (CTS guidelines Table 2) • Address disease prevention and health promotion activities. Activities include vaccination and smoking cessation	• Assess inhaler technique to ensure medication is being deposited in the right location • Discontinue drugs that are ineffective or where the risks outweigh the benefits	• Optimize doses for blood pressure and diabetes to prevent rehospitalization and delay end stage renal disease	• Ensure adverse drug reactions are properly documented and shared with primary healthcare providers as well as the patients and caregivers to avoid restarting them at discharge	• Assess whether medications can have lower doses to reduce amounts excreted into the environment	• Involve patients in discussions regarding medication use • Ensure therapies address issues that matter to them

Patient Education

Climate change not only impacts the environment but also has a direct negative impact on human health (134). Counseling can be provided on medication management, access, and monitoring during extreme weather events. Patients can also be advised on proper disposal of their medications to avoid unintentional environmental contamination. Pharmacists are well placed to identify patients who are vulnerable to the acute impacts of climate change and educate them on creating plans for increasing incidents of extreme weather events during counselling and medication reconciliation activities. (See Table 7)

Talking about climate change with patients

These patient education topics in table 7 do not necessitate a conversation about climate change. However, for pharmacy professionals interested in discussing climate change with the appropriate patients, the World Health Organization developed a "Communicating on climate change and health: Toolkit for health professionals". This resource helps ensures the message to patients on the health benefits of tackling climate change is effective and engaging. Choosing appropriate patients that would be receptive to these discussions and incorporating a message regarding the health benefits of mitigating and adapting to the impacts of climate change are paramount (136).

Table 7: Pharmacy Education Tools Related to Climate Change

HEAT EDUCATION	DISASTER PLANNING	DISPOSAL
As number of extreme heat events rises in Canada, we can expect a rise in heat related illnesses. There are several things clinicians can counsel on regarding heat days: • A number of medications can increase the risk of harm on extreme heat days. • Seek out places that are climate-controlled where possible. • Have increased point of contact with someone that can check on them. • Recognize the signs of systems of heat-related illness and when to access medical care.	Climate change is increasing the risk of extreme weather events, such as wildfires, flooding, temperature extremes and heavy precipitation (135). Planning for disasters can help patients be prepared to have continued access to their medications.	Improper prescription disposal can lead to active pharmaceutical ingredients (APIs) leaching into the ecosystem. APIs have been found in rivers globally (5) and even in our drinking water (8,9). Prompting patients to think about what they do with unused medications and reminding them of the benefits of bringing them back to the pharmacy for proper disposal can be embedded within the best possible medication history interviews and during medication counseling.

• Health Canada Extreme heat and human health: Information for Pharmacists and Pharmacist Technicians: Information on
  ◦ Identifying heat-related illness
  ◦ At-risk populations
  ◦ Medication classes associated with increased heat risk factors
  ◦ Non-pharmacological prevention techniques
  ◦ Algorithm to manage extreme heat events
• CDC Guidance for clinicians: Heat and medications: List of medications that increase the risk of harm on hot days
• National Collaborating Centre for Environmental Health: A guide for in-person or remote health checks during extreme heat events. Includes:
  ◦ Rapid risk assessment checklist
  ◦ Recognizing and responding to heat-related illness
  ◦ Guidance for in-person and remote health checks
  ◦ Guidance for measuring body and room temperature
	• CPhA: Medication checklist for emergency preparedness
	• FDA: Safe drug use after a natural disaster
		• HPSA: How to return unwanted medications

SUSTAINABILITY TASKFORCE

ORGANIZE A SUSTAINABILITY TASKFORCE (OR GREEN TEAM)

Given that environmental sustainability projects in Canadian hospitals rely largely on volunteers, working together as a team helps distribute the responsibilities of projects, making individuals more accountable, but responsible for less tasks. A Sustainability Taskforce (or Green Team) can also be helpful to give departments and institutions direction.

Organizing a Sustainability Taskforce in your organization can be challenging. Aligning the goals to those of your organization can be helpful in garnering support from leadership, gaining access to resources and protected time to engage in sustainability activities. One strategy that has been successful is linking climate change issues to those important to the organization, such as planning for staff wellness and disaster planning and management.

Important Elements of a Green Team (125, 126)

People

- Establish leadership sponsorship and advocacy
- Identify interdisciplinary champions and members

Action

- Create a team mission and terms of reference
- Map existing initiatives and perform a needs assessment
- Create and evaluate measurable goals
- Meet regularly and set deadlines
- Embed sustainability in quality frameworks
- Report and communicate successes
- Anticipate barriers and challenges

RESOURCES:

Organizations looking to start their journey into environmental sustainability can consult:

- CASCADES Strategic Planning for Sustainable Healthcare playbook
- CASCADES Organizational Readiness for Sustainability playbook
- Island Health Building your Green Team. Key steps and consideration for staff who want to develop, lead, and sustain a thriving and successful Green Team
- Practice Greenhealth Step-by-Step Guide for Creating Effective Green Teams in Health Care: Introduction to creating green teams
- Practice Greenhealth Comparison chart of hospital green teams and their structures
- Unity Health Toronto Terms of Reference
- How to create a workplace green team, David Suzuki foundation
- Canadian Coalition for Green Healthcare Green Teams project
- Saskatchewan Health Authority: Overview of a Pharmacy Environmental_Committee
- Lunch & Learn: Green Teams in the Spotlight — Sustainability in action, Greencare

SPOTLIGHT EXPERIENCE:

GRASS ROOTS MOVEMENT IN SASKATCHEWAN

The Regina Department of Pharmacy Services in the Saskatchewan Health Authority organized a Pharmacy Professionals Wellness and Environmental Committee. They astutely tied staff wellness with environmental priorities, given the known links between human and planetary health (134,139).

Assigning leads to champion agenda items and having a leadership sponsor for the committee were key to their success.

Learn more

TOP-DOWN INFLUENCE IN BRITISH COLUMBIA

The deadliest impacts and greatest costs associated with the 2021 heat wave in British Columbia were health related. The Lower Mainland identified 1,300 excess emergency department visits, and the number of patients identified as “imminent risk of death” increased by 170%. Fraser region experienced double the number of expected hospitalizations, and heat strokes increased by 16,876% from baseline rates (18).

Other findings included (18):

- Heat exposure led to increased hospitalization and medical care costs
- The health system could not provide critical medical care to everyone
- Health professionals experienced trauma and burnout

The Canadian Climate Institute’s report The Case for Adapting to Extreme Heat identified that there were no clear clinical procedures or guides for healthcare providers to reference during the heat wave.

The province subsequently created a Climate Preparedness and Adaptation Strategy and health communities and authorities have embedded planetary health into their strategy (140,141). Fraser Health Authority is also planning forward by creating a leadership position that joins emergency preparedness and planetary health. Planning for climate disasters also have a financial benefit, with the Global Commission Report Adapt Now: A Global Call for Leadership on Climate Resilience estimating that for every dollar spent on measure to prepare for climate impacts, savings of between $2 to $10 can be achieved.

RESOURCES:

- Living Well: Pharmacy Professional Wellness and Environmental Committee Terms of Reference
- Development of an Environmental Audit Tool for Hospital Pharmacy
- The case for adapting to extreme heat: Costs of the 2021 B.C. heat wave
- Damage Control: Reducing the costs of climate impacts in Canada
- British Columbia Climate preparedness and adaptation

SUPPORT PARTICIPATION IN SUSTAINABILITY INITIATIVES WITH DEDICATED RESOURCES

Sustainability initiatives by students and/or staff often have resource saving outcomes, justifying protected time to pilot and implement them. For instance, a study looking at reusing returned medications found potential savings of approximately $415,000 annually across 21 sites (21). When implemented, every dollar invested in redistributing returned medications saved $6. Another study found unnecessarily withdrawn salbutamol and ipratropium inhalers cost an estimated $4,000 annually, without accounting for the cost of disposal (29).

SPOTLIGHT EXPERIENCE:

REGINA GENERAL HOSPITAL AND PASQUA HOSPITAL

Regina General Hospital, Pasqua Hospital, and Wascana Rehabilitation Centre assigns a specific technician position to return dispensed medications for redistribution alongside other duties.

Returned medications arrive from various rounds, including cart exchanges, IV deliveries, and automatic dispensing unit restocks. They are then sorted into bins and organized alphabetically for reloading into the medication storage device, returned to the IV room, or placed in designated spots. Medications from a unit under an outbreak protocol are wiped down upon return, quarantined, or disposed.

Education

Facilitate opportunities for staff, clinicians and leaders to develop and share knowledge and skills, including through continuing professional development. Hospital teams looking for education to support sustainability initiatives can focus on education on sustainable health systems and appropriate prescribing. Examples are found in Table 8.

Table 8: Education modules

Education Tool	Description	Relation to climate change and the environment
Introduction to sustainable health systems, **CASCADES and RCPSC**	Online course to introduce the relationship between climate change, health, and health systems.	• Introductory self-guided course linking climate change and health systems.
deprescribing.org **Polypharmacy and deprescribing learning module**	Online learning module to help improve understanding of polypharmacy and approaches for deprescribing. Learn how polypharmacy develops over time and how to recognize common drug-induced symptoms and prescribing cascades.	• Decreasing the number of medications used can decrease the amount of active pharmaceutical ingredients that end up in the environment. • Discontinuing potentially inappropriate medications can reduce the risk of hospitalization, which also has a carbon footprint.
Centre for Effective Practice Social Prescribing**: a Resource for Health Professionals**	Online learning module introducing social prescribing, and how healthcare practitioners can start social prescribing.	• Social determinants account for 50% of health outcomes (142). Addressing these determinants can decrease the use of medication and formal healthcare resources, while improving community resilience in the face of climate change. • Pharmacists can improve outcomes through improved access to discharge medications by matching prescriptions to coverage (143). Ensuring patients can access their medications is an important step to improving unintentional nonadherence due to cost and potentially decrease the risk of rehospitalization.
Therapeutics Initiative	Therapeutic Initiatives assesses clinical evidence in published articles, meta-analyses and scientific materials, then disseminates the evidence to healthcare practitioners and policy makers.	• Appropriate care can decrease the use of inappropriate medications and healthcare use.

Research, Measurements and Reporting

Hospital pharmacies should examine incorporating sustainability across its various activities.

- Departments can add sustainability as a quality dimension of care (Figure 7).
- Research can be conducted with measurements of cost, staff time, and emissions.
- Clinicians can run quality improvement projects to gain support for further sustainability initiatives.
- Measurements can be obtained from various resources, depending on the project (see resources).

Figure 7: Embedding environmental sustainability into the six dimensions of quality of care (CASCADES)

RESOURCES:

Examples of emissions and conversion data can be found on the following resources:

- Calculating the carbon footprint of pharmaceutical waste
- Calculating the carbon footprint of inhaled anesthetic agents
- Calculating the carbon footprint of nitrous oxide
- Carbon footprint of inhalers
- Greenhouse Gas Equivalencies Calculator | Natural Resources Canada (nrcan.gc.ca): Translate carbon dioxide emissions into concrete terms.
- Healthcare LCA: environmental impact estimated of healthcare products or processes
- Health care emissions impact calculator: an accounting tool specifically designed to help health care organizations measure their greenhouse gas (GHG) emissions.
- BC Health Quality Matrix

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