



Researching a Circular Economy of Plastics in Health Care

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August 2020

Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organizations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

This project was conducted under the mentorship of Energy and Environment Sustainability team. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of Energy and Environment Sustainability team or the University of British Columbia.

Cover photo retrieved from:

The Need to Grow. (2019). Retrieved from: <https://www.imdb.com/title/tt4553542/>

Acknowledgements

I would like to thank my mentor, Marianne Dawson for the continual support and encouragement throughout this project. Thank you for sharing your wealth of knowledge and facilitating valuable connections throughout this experience. Thank you for the opportunity to explore an area of both personal and professional interest of mine in exploring approaches to achieve sustainable health care.

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Abbreviation List

Energy and Environment Sustainability (EES)

Lower Mainland Health Organizations (LMHO)

Circular economy (CE)

Intravenous (IV)

Greenhouse gas (GHG)

Biodegradable plastics (BDP)

Magnetic resonance imaging (MRI)

Computed tomography (CAT)

Extended producer responsibility (EPR)

Education, information, and awareness training (EIAT)

Canada's gross domestic product (GDP)

Driver, Pressure, State, Exposure, Effect, and Action (DPSEEA)

Regenerate, Share, Optimize, Loop, Virtualize, and Exchange (ReSOLVE)

Provincial Health Services Authority (PHSA)

Thermoplastic patient accessories (TPA)

Project Overview

Introduction

The Energy and Environment Sustainability (EES) team for the Lower Mainland Health Organizations (LMHO) has a zero-waste focus area to increase waste diversion and decrease waste intensity and a long-term goal to decrease the environmental impact of plastics in health care. These EES sustainability goals coupled with an increase in public and staff concern about the abundant use of plastic in health care has generated interest in how circular economy (CE) principles can address both the sustainability goals and public concerns. This project seeks to contribute to the body of research on how CE can be applied to plastics in health care.

Background and Objectives

Health care is a unique context that requires additional considerations when it comes to implementing sustainability and CE practices. Accordingly, this project aims to achieve the following objectives:

- (1) Learn more about CE and its potential application in health care.
- (2) Identify and develop a project plan for one CE initiative that addresses a priority health care plastic.
 - *Reinstituting the Reusable Laryngeal Mask Airway in Health Care: A Circular Economy of Plastic Approach* (See Appendix).

Methodology

To achieve the project's objectives listed above, the following methods were used:

- Online literature scan: A review of grey literature, reports, and journals related to CE of plastics in health care.
- Key area identification: Analysis of potential opportunities in health care where CE principles might be applied.
- Stakeholder interviews: With LMHO staff, Green+Leaders, and key stakeholders to gain insight into the potential limitations and/or challenges with a CE of plastics in health care.
 - Green+Leaders are volunteer green champions of sustainable health care practices in their respective LMHO. Link: [Green+Leaders](#).

- Compiling CE practices from the literature scan and other organizations: Informing future recommendations for the application of CE of plastics in health care.
- Project plan for one CE initiative proposition and development: Preparing a project plan for one CE initiative based on research findings and the analysis of potential application areas for CE of plastics in health care.

As described above, the research methods were both quantitative and qualitative in nature; critical appraisal of the literature was performed to compile key findings and semi-constructed interviews with stakeholder to draw out meaning and themes from past involvement in sustainability projects was also performed.

Limitations

First, due to the COVID-19 pandemic, interviews were conducted on Zoom and by phone call- potentially altering the delivery and/or meaning of the question and/or response. Second, due to limitations on the Sustainability Scholar Project's timeline, the project plan will identify the first steps for one CE initiative that should be feasibly completed within 12-18 months. As such, these limitations have been taken into consideration when selecting which priority plastic to focus on.

Research Findings

Literature Review

Circular Economy Principles and Best Practices

Linear Economy

Currently, most of the world is operating on a linear economy. This traditional approach to the economy adopts the principles and practices that first take natural resources, turn those resources into products for human use and consumption, and lastly dispose of the products at the end of their lifecycle. Linear economy practices align with society's consumeristic appetite of take, make, and dispose without considering the environmental and financial impact of the wasted resources. (Ellen MacArthur Foundation, 2017; Environment & Climate Change Canada, 2019).

A LINEAR ECONOMY "...IS INCREASINGLY PUTTING PRESSURE ON OUR NATURAL SYSTEMS, COMMUNITIES, AND PUBLIC HEALTH." (GOVERNMENT OF CANADA, 2020)



Figure 1: Linear Economy. Cite: Impact Hub

Circular Economy

According to the Ellen MacArthur Foundation (2017), a CE is based on the following three principles:

One: Design out Waste and Pollution

- To ensure waste and pollution are not created in the first place.

Two: Keep Products and Material in use

- Closed-loop flow of products and material to remain in circulation as long as possible.
- Circulation is achieved through the reuse, repair, and remanufacturing of products and materials.

Three: Regenerate Natural Systems

- Aim to enhance natural resources without their depletion and the accumulation of waste in the natural environment.

A CE is an economic model that enables productive and sustainable financial and social growth while simultaneously fostering environmental sustainability. A CE provides endless economic possibilities to create a thriving society. However, this new economic model requires a world-wide systematic operational transformation. Now is the time to begin this transformation and take part in creating a new economy, one that is circular and environmentally, financially, and socially sustainable (Ellen MacArthur Foundation, 2017; Circular Economy Leadership Coalition, 2019).



Figure 2: Circular Economy. Cite: Supply Chain Queen

Plastics in Health Care

Linear Plastics

Plastic production and consumption have been steadily growing over the past decades and based on the current linear economy, are projected to continue to escalate (Environment & Climate Change Canada, 2020). By 2050 demand for resources could reach 400 per cent of Earth's total capacity (Smart Prosperity Institute, 2018).

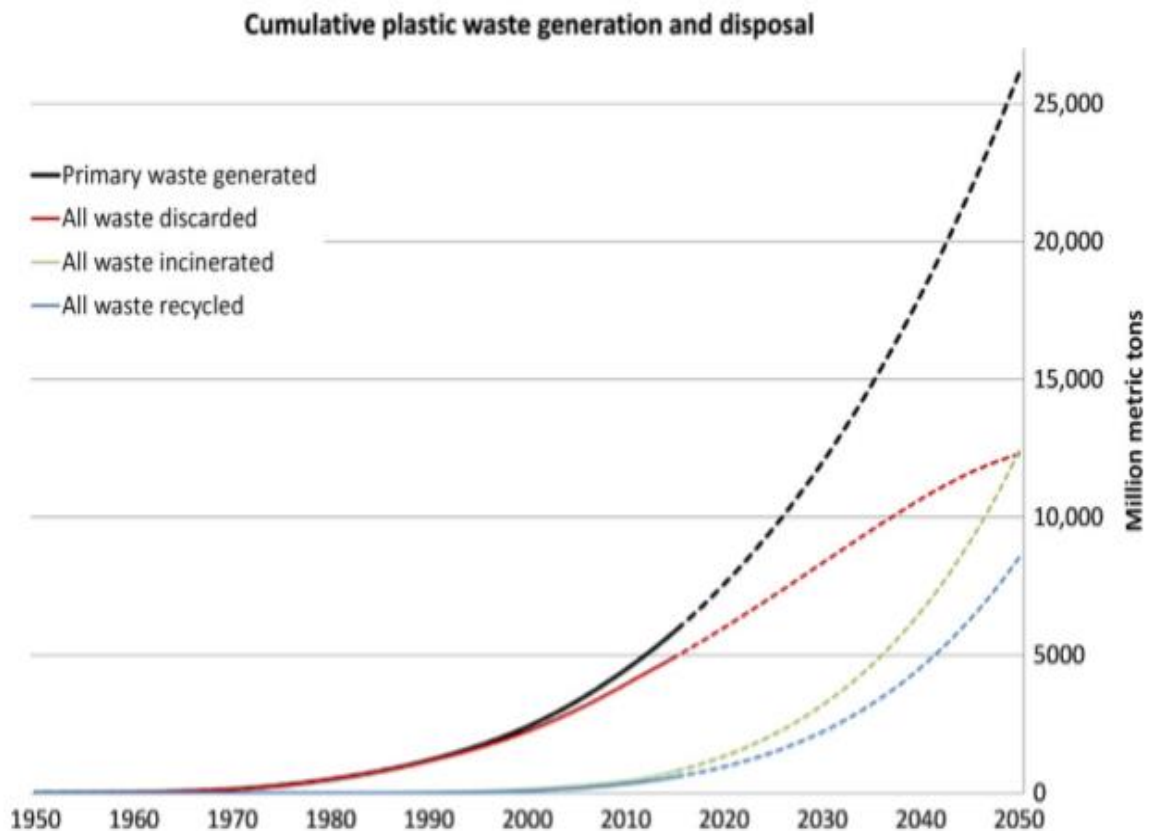


Figure 3: Projection of the Acceleration of the Accumulation of Plastic Waste. Cite: Geyer, Jambeck, and Law (2017)

In Canada, 86 per cent of plastic waste ends up in the garbage, making its way to a landfill. An estimated 9 per cent of all plastic waste is recycled, 4 per cent incinerated for energy recovery, and 1 per cent leaked directly into the environment (Environment & Climate Change Canada, 2019).

47 PER CENT OF THE TOTAL PLASTIC WASTE IS GENERATED FROM PACKAGING (ENVIRONMENT & CLIMATE CHANGE CANADA, 2019).

In health care, plastics are part of everyday operations. Plastics offer the health care system versatility at a lower cost (Environment & Climate Change Canada, 2019). Consequently, plastics are embedded into the health care system and are used at every point of care from intravenous (IV) bags to deliver IV solutions and medications, airway maintenance devices, syringes, sterilization blue wrap, basins, to patient garment bags. This list is not exhaustive, but merely demonstrates the pervasiveness of plastics in the delivery of health care.

To understand the scale of health care's contributions with linear plastic practices, in 2019, the LMHO threw out 3, 436, 024.4 kg of non-recyclable plastic (calculation based on Waste Weight Stream of LMHO; Garbage Composition Study of the St. Pauls' Hospital, 2019).

3, 436, 024.4 KG OF NON-RECYCLED PLASTIC EQUATES TO APPROXIMATELY 541 AFRICAN ELEPHANTS (ELEPHANT WORLD, 2019).

The categories of non-recyclable plastics that were included in the Garbage Composition Study of the St. Pauls' Hospital (2019), were vendor prohibited, medical packaging, medical hard plastics, and single use. Non-recyclable plastics that ended up in landfills consisted of:

- IV bags
- Tubing
- Medical vials
- Urinals
- Specimen containers
- Filters
- Gloves
- Soft plastic packaging
- Composite paper products
- Shopping bags
- Rigid plastic items
- Kidney basins
- Needle caps

This data demonstrates health care's contributions to the linear economy. Some impacts can be measured through life cycle assessments and calculating greenhouse gas (GHG) emissions, while other impacts cannot, such as long-term health impacts and pollution. Thus, the opportunity for health care to apply circularity to plastics is of great consequence.

PLASTIC IS BAD FOR BUSINESS AND BAD FOR THE ENVIRONMENT (CIRCULAR ECONOMY LEADERSHIP COALITION, 2019).

Bioplastics

Over the past few years, bioplastics have appeared in the marketplace as an alternative to conventional plastics and are gaining in popularity and usage- appearing to offer health care a solution to their plastic consumption and waste problem. Biodegradable plastics (BDP) (derived from petroleum) and bioplastics (polymers derived from biomass) have chemical functionalities that render them more susceptible to degradation or by decomposition by living organisms. Light and heat, also play a factor. However, landfills, where most plastics end up, do not give these types of plastics direct access to light or oxygen to perform degradation/ decomposition- especially in deeper landfill layers (Environment & Climate Change Canada, 2020). Therefore, not only does the type of plastic determine its biodegradation, but also the environment where the BDP or bioplastic is disposed (Emadian, Onay, & Demirel, 2017).

Additional concerns for disposing of these types of plastics are:

- BDP such as polylactic acid may increase the amount of landfill methane (a GHG) emissions into the environment (Krause & Townsend, 2016).
- BDP, and petroleum-based plastics in the natural environment and/or landfill break down into microplastics- a potential new health risk under increasing study (Kubowicz & Booth, 2017).
- BDP poses an issue for recycling; isolating biodegradable from conventional mixed plastics is difficult. Furthermore, technology to isolate BDP is not economical due to the insufficient volume received of this type of plastic. BDP is “considered an undesirable contaminate within the recycling stream of conventional plastics” (Kubowicz & Booth, 2017, p. 12059) and consequently, not accepted in recycling or compost (Environment & Climate Change Canada, 2020).

BIODEGRADABLE IS AN APPEALING MARKETING TERM. HOWEVER, THE CONDITIONS OF LANDFILLS DO NOT MEET THOSE LABORATORY SPECIFICATIONS (KUBOWICZ & BOOTH, 2017).

As of today, bioplastics are not the solution for plastics in health care due to the constraints surrounding their design and functionality. At the end of the day, bioplastics are still plastic and have some of the same end-of-life effects as fossil fuel-based plastics, once in the environment they may not degrade as well as suggested (Environment & Climate Change Canada, 2020).

Importance of a Circular Economy of Plastics in Health Care

Health care is defined as assisting in the maintenance or restoration of physical, mental, and emotional well-being (Merriam Webster, 2020). However, health care is over-run with plastics some of which are causing public health concerns and adverse health effects (See Table 1). For example, polystyrene and polyvinyl chloride can leach chemicals of concern directly into human bodies and into the environment. Additionally, these two types of plastics are hard to recycle, and most often end up in landfills (Environmental Defence, 2020). It is, therefore, imperative that a CE model is assessed for its potential application to plastics in health care. As well as for the principles of circularity to be utilized in health care to foster the protection, promotion, and restoration of holistic health of Canadians’, while fostering sustainable growth and innovation.

Table 1: Plastic, Common Uses, and Adverse Health Effects

Plastic	Common Uses	Adverse Health Effects
Polyvinylchloride	Food packaging, pacifiers, toys, IV bags, and tubing.	<ul style="list-style-type: none"> • Carcinogenic • Birth defects • Genetic changes • Indigestion • Liver dysfunction
Phthalates: <ul style="list-style-type: none"> • high-density polyethylene • polyethylene terephthalate • diisononyl 	Blood bags and tubing, IV containers and components, surgical gloves, breathing tubes, labware, inhalation masks, irrigation bottles for saline and sterile solutions, sterile barrier packaging, water bottles, food containers, toys, kitchenware, and plastic bags.	<ul style="list-style-type: none"> • Carcinogenic • Endocrine disruption • Developmental and reproductive effects (birth defects) • Infertility • Contributor to the development of asthma • Immune system impairment
Polyester	Clothing, bedding, disposable diapers, and food packaging.	<ul style="list-style-type: none"> • Skin, eye, and respiratory tract irritation
Polyurethane Foam	Mattresses, pillows, and cushions.	<ul style="list-style-type: none"> • Skin, eye, and respiratory tract irritation

Acrylics	Blankets, clothing, adhesives, dentures, food preparation equipment, and sanitary napkins.	<ul style="list-style-type: none"> • Breathing difficulties • Headaches • Fatigue • Vomiting and diarrhea • General weakness
Bisphenol A (used in polycarbonate)	Medical tubing, food can linings, thermal paper, and toys.	<ul style="list-style-type: none"> • Endocrine and immune disruption • Increasing incidents of breast cancer • Abnormal growth patterns and neurodevelopmental delays in children
Brominated flame retardants	Electronics and building products.	<ul style="list-style-type: none"> • Carcinogenic • Endocrine disruption

(Adapted from Ecology Center, 2020; Healthcare plastics recycling council, 2019; Health Care Without Harm, 2020; World Health Organization, 2018).

HEALTH CARE CANNOT CONTINUE DOWN THE PATH OF BUSINESS AS USUAL, A BUSINESS THAT CONTRIBUTES TO THE DETERIORATION OF HUMAN HEALTH THROUGH EXCESSIVE PLASTIC WASTE AND ITS ADVERSE HEALTH EFFECTS.

Health care must become an innovative leader in the creation of a new economy of plastics-systematically address the economical, societal, and environmental challenges and burdens health care’s current linear plastic practices are causing. A CE of plastics can be adopted by health care as a people-centered health care approach, addressing plastic-related health concerns by offering a circular solution that is sustainable into the future.

Circular Economy of Plastics Application in Health Care

OVER THE NEXT DECADE, HEALTH CARE FACES A GROWING CHALLENGE TO PROVIDE CARE. HEALTH CARE COSTS ARE RISING FROM AN AGING POPULATION, ADVANCES IN NEW TECHNOLOGY, AND INCREASED PATIENT EXPECTATIONS (ELLEN MACARTHUR FOUNDATION, 2015) FOR THE DELIVERY OF HEALTH CARE SERVICES.

The application of a CE of plastics in health care is more than just a potential option it is a viable solution and one that is long overdue. However, changing how health care operates requires time, investment, and innovation; time to change the disposable plastic culture, investment by

senior leadership to endorse the transition to a CE- committing both financial and human resources, and innovation to overcome the linear economy barriers and challenges.

To support these first steps, the Ellen MacArthur Foundation (2020) has created Circulytics- a circularity measurement tool that supports organization’s transition towards a CE. After a detailed report submitted by the organization, the tool creates a comprehensive breakdown of their results and an overall circularity score. This tool offers health care a platform for circularity to first be assessed and then to gain valuable insight into opportunities for the application of CE practices. Link: [Circulytics: Measuring Circularity](#).

To have full integration of a CE of plastics in health care, in addition to supporting the first steps towards circularity, health care must address plastic management across its life cycle. The identification of where plastics are ill-managed in the life cycle and identification of priority life cycle steps to intervene with CE action will hold health care accountable for its plastic consumption and waste. Fortunately, health care can leverage its organizational scale and maximize its resource efficiency to minimize its environmental impact while obtaining significant cost savings from the implementation of CE actions (World Health Organization, 2018).

To transition health care towards a sustainable future, identifying where circularity can be applied is an essential step to take. It is recommended that CE be applied in the following key areas within health care: innovation, organization, and people.

Innovation

- Go Beyond Recycling

“WE CANNOT RECYCLE OUR WAY OUT OF THE PLASTIC ISSUE WE CURRENTLY FACE.” (ELLEN MACARTHUR FOUNDATION, 2019, P. 8)

Recycling is required to address plastic waste at the end of its life cycle. However, these traditional efforts in recycling must be “matched by a similar investment and ambition level across [health care]” (Ellen MacArthur Foundation, 2019, p. 21). This matched investment and ambition level will address health care plastic pollution and the consequent health effects at the source, thereby, allowing for the introduction of innovative solutions that look to eliminate and/or reuse plastic (Ellen MacArthur Foundation, 2019) in health care.

THE RECYCLING SYMBOL HAS BEEN AROUND FOR MORE THAN 40 YEARS, YET GLOBALLY ONLY 14 PER CENT OF PLASTIC PACKAGING IS RECYCLED (ELLEN MACARTHUR FOUNDATION, 2016).

- Sharing Platforms

Health care has an abundant reserve of supplies to provide essential services for patients, families, and communities, however, some supplies sit on shelves, rarely used. Traditionally, sharing platforms in health care are often used to find a new home for furniture and medical equipment, however, it can also be used for rarely used or overstocked health care supplies. A sharing platform would allow for these supplies to be rented, shared, or swapped out to other LMHO to allow for full utilization (Smart Prosperity Institute, 2018). This efficient platform, consequently, would lessen health care expenditure by decreasing the need to re-purchase expired rarely used supplies, as well as saving on space to store them.

- Product as a Service

What if health care never owned the thousands of expensive products (i.e. magnetic resonance imaging (MRI) scanners, computed tomography (CAT) scanners, ventilators, surgical tools, patient monitors, etc.) or was responsible for product repairs? With the application of a CE model, “[o]wnership gives way to stewardship” (Nature, 2016, p. 435). Health care no longer buys or absorbs expensive fixes- manufacturers and vendors are instead held responsible. Leasing these products will create a shift from the volume of sales to performance, reliability, longevity, and reusability of products. This performance model would have a direct impact on reducing the cost of health care operations while improving health care services (Smart Prosperity Institute, 2018; World Health Organization, 2018).

- Extended Producer Responsibility (EPR)

Currently, the end-of-life disposal of plastics is health care’s responsibility and thus, health care’s burden in contributing to the consequential health and environmental effects of plastic waste. EPR can be an effective means “to support the creation of a CE” (Government of Canada, 2019). EPR is a model where companies that produce plastic products or sell products with plastic packaging are responsible for the collection, reuse, recycling, and/or end-of-life management of plastic products and packaging (Government of Canada, 2019). Thus, shifting companies and their priorities to rethink and redesign plastic products with less waste.

- Investment in CE Research, Development, Innovation, and Pilot Studies

Health care’s investment in a CE model requires commitment and innovation. The benefits that will come from this initial investment will contribute to improving health systems and public health- the foundational pillar which health care strives to attain and maintain. Today, hospitals have the opportunity to become leaders in:

- Supporting research and development for durable reusable materials for delivery of care;
- Supporting the maturity of technology to foster the acceleration of innovative solutions;
- Supporting pilot studies that look to reduce waste and enhance recycling viability;
- Creating provincial health care guidelines and/or targets (Ellen MacArthur Foundation, 2015; Environmental Defence, 2020; World Health Organization, 2018).

Organization

- Create a Transition Roadmap

Without a clear vision, how can we expect health care to apply a CE model? Therefore, it is essential that a transition roadmap is created to describe the mission, vision, and values of the health care organization to guide its actions in achieving resource efficiency and sustainability. A transition roadmap can showcase the tangible benefits of a CE by highlighting best practices and pilots that can be replicated and expanded (both within the health care organization and provincially) to provide added value on a larger scale (European Environment Agency, 2019).

- Plastic Packaging and Packaging Avoidance Strategies

There is no doubt, health care requires the use of some plastics. However, there is ample room for improvement in addressing unnecessary plastic packaging as well as finding opportunities where health care can avoid plastics altogether while maintaining utility. Health care can develop guidelines to decrease plastic packaging and commit to specific strategies to avoid excess plastic. The application of a CE model allows for these advancements to be made by health care (Health Care Without Harm, 2019; Ellen MacArthur Foundation, 2019).

The Ellen MacArthur Foundation (2019) has identified six characteristics of a new vision of a CE for plastics packaging:

1. Eliminate problematic and unnecessary plastic packaging through innovative redesigns and employment of a new delivery model.
2. Reuse models are applied, reducing the need for single-use packaging.
3. 100% reusable, recyclable, or compostable plastic packaging.
4. In practice, all plastic packaging is reused, recycled, or composted.
5. Plastic is decoupled from the consumption of finite resources.
6. For the health, safety, and rights of all people involved, all plastic packaging is free of hazardous chemicals.

Additionally, plastic packaging data must be made transparent and packaging recycled percentage content minimum required (As You Sow, 2020).



Image: The New Plastics Economy. Cite: Ellen MacArthur Foundation (2019)

- Purchasing Plastic Policies

Plastic purchasing policies can be established by health care as part of a sustainable procurement policy, ensuring that all those involved are operating under the same definition and follow the same sustainability rules when purchasing plastic items. By building circularity into internal supports and policies, highlights what plastic products can and cannot be purchased and ultimately helps to ensure a sustainable and healthy health care environment (Health Care Without Harm, 2020; National Zero Waste Council, 2016).

- Adopting a Performance Model in Procurement

Adopting a performance model in procurement has been identified as a key CE opportunity (Ellen MacArthur Foundation, 2015). Thankfully, innovative performance models in procurement are increasingly becoming more popular by hospitals. Adopting a performance model enables the creation of an organization culture more accepting of innovation, allowing for custom sustainable designs in health care and cooperation across markets (Health Care Without Harm, 2019; Nordic Innovation, 2019). Link: [GreenProcurement](#)

- Partner with Local Suppliers, Innovative Businesses, and Local and Federal Government

A CE in health care has the potential to reduce the risk of price and supply volatility- reducing dependency on out-of-province or out-of-country suppliers. Creating a local supply chain allows for greater certainty, efficiency, and productivity, allowing health care to better respond to patients' concerns and suppliers' inquiries, while simultaneously advancing health care's CE objectives within a local platform (Smart Prosperity Institute, 2018; World Business Council for Sustainable Development, 2020).

PARTNERSHIPS ALLOW FOR THE COLLABORATION BETWEEN PARTIES TO LEARN, INNOVATE, AND BUILD CAPACITY (SMART PROSPERITY INSTITUTE, 2018).

In addition to local partnerships and supply chains, health care can build collaborative relationships with government and other agencies to further advance the application of a CE of plastics in health care, such as:

- Canada's Plastic Science Agenda has outlined five key themes to cover the lifecycle of plastics:
 1. Detection, quantification, and characterization of plastics in the environment;
 2. Impacts on wildlife, human health, and the environment;
 3. Plastic design and alternatives;
 4. Sustainable use of plastic;
 5. Waste diversion and recovery (Environment & Climate Change Canada, 2019).
- The Canada-wide Strategy to Zero Plastic Waste has identified main areas of action for a CE of plastics in Canada (See Figure 4) (Canadian Council of Ministers of the Environment, 2019).

Health care does not need to transition to a CE alone. Partnerships with local suppliers, innovative businesses, and local and federal government can allow for a more robust application of circularity that ensures health care's sustainable longevity.

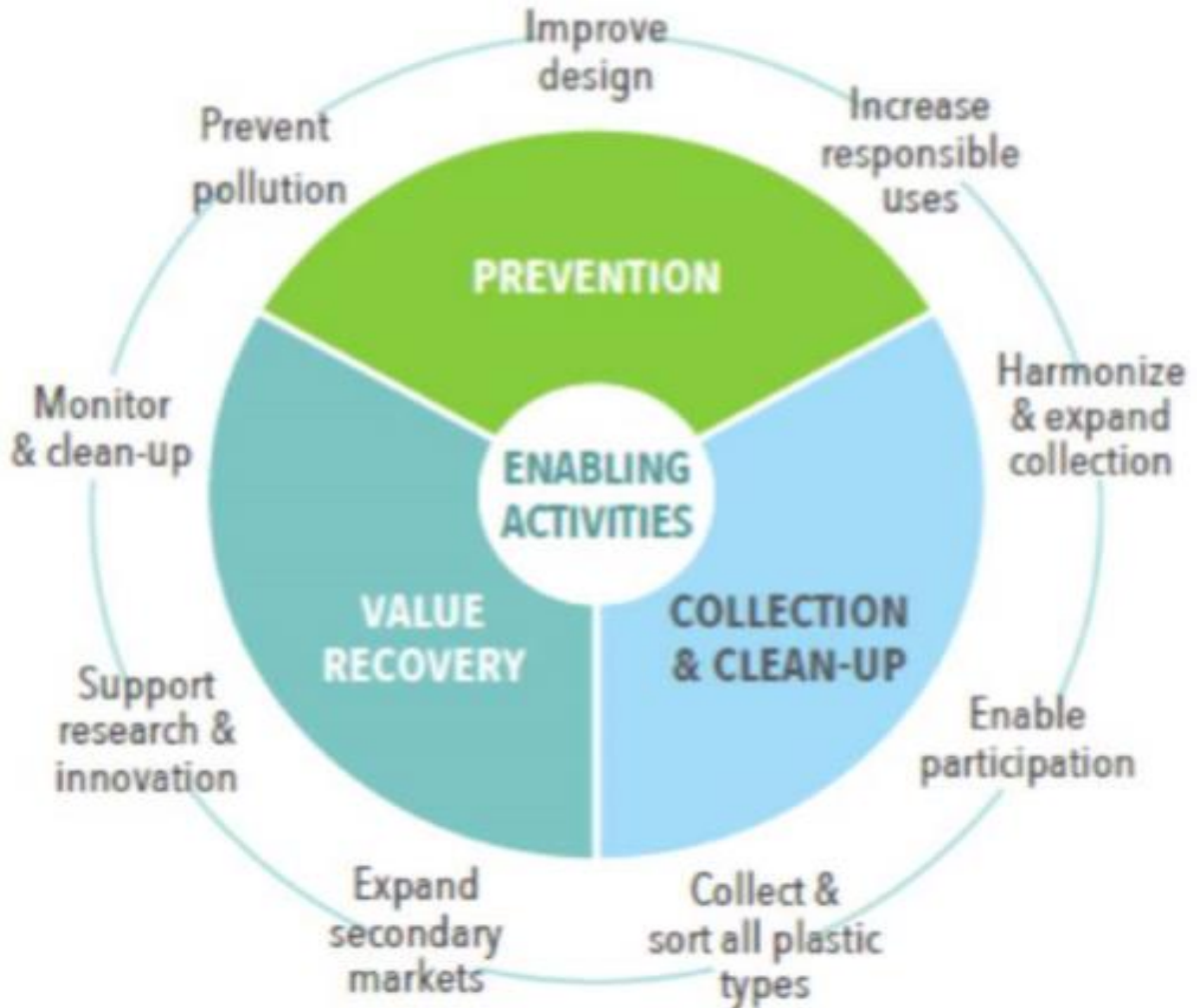


Figure 4: The Canada-wide Strategy to Zero Plastic Waste Main Areas of Action for a CE of Plastics. Cite: Canadian Council of Ministers of the Environment (2019)

- Management Sustainability Focus

Health care's management board and agenda are extensive and complicated. However, sustainability and circularity deserves a place on that board and agenda for the added value they offer health care. With the top-down endorsement of a CE transition, the traditional linear economy and hierarchy can be addressed and dismantled and, in its place, a new management focus for a new economy. This new economy where local health care authorities work in accordance with sustainable management systems that prioritize sustainable and circularity decisions (Nordic Innovation, 2019).

- Improved Collection and Recycling Systems

As addressed, health care must look beyond recycling. However, improving sorting, collecting, and recycling systems can be an opportunity for health care to initially tackle the transition period between a linear and CE of plastics in health care. Health care has the potential “to become leaders in recycling and waste reduction” (Ellen MacArthur Foundation, 2015, p. 83) through best practices, and most importantly in plastic use prevention strategies (Ellen MacArthur Foundation, 2015).

People

- Education, Information, and Awareness Training (EIAT)

A CE in health care has the potential to facilitate a health care community coalition that rallies together to build-up the capacity and capability of health care organizations (Circle Economy, 2019) allowing for the sustainable delivery of patient-centered-care. This desirable outcome can be achieved through a CE EIAT and by sharing best practices (World Health Organization, 2018). First, health care leadership can engage staff, on all levels in the organization, to take part in educational sessions that look to explore the opportunities and benefits of a CE, as well as how to overcome the barriers and challenges to get there. Secondly, global circular practices can be analyzed and put into a local context- what has worked in other health care organizations and how can that practice be applied locally. By promoting EIAT of CE allows for space, time, and opportunity to explore what a CE of plastics means for health care.

- Re-evaluating Standard Practices

What has worked in the past, is not necessarily working at the same efficiency level today. It is essential that health care unites on all fronts to re-evaluate what is and is not working, entrenched norms, and standard practices. The unity required to re-evaluate standard practices will involve collaboration across health care organizations that no one hospital could address on its own (Ellen MacArthur Foundation, 2019).

A CE HAS BEEN FOUND TO IMPROVE RELATIONSHIPS AND EMPLOYEE SATISFACTION (WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT, 2020).

- Preventive Health Care

“THE HEALTH CARE SECTOR IS BOTH A SIGNIFICANT CONTRIBUTOR TO THE GLOBAL PLANETARY HEALTH CRISIS AND UNIQUELY BURNED BY IT.” (PRACTICE GREENHEALTH, 2020)

Environmental and population health have a corresponding relationship, when global pollution increases, human health decreases. This intertwined relationship, coupled with the increasing cost to the delivery of health care has prompted the government to look for preventative interventions to increase the overall health of the population. By transitioning the focus to preventative health care, along with the successful integration of a CE, offers valuable opportunities for health care and results in long-term direct and indirect health benefits. These benefits include lessening the costs associated with acute care by working towards environmentally sustainable health care practices, helping to achieve a healthy and thriving population (Ellen MacArthur Foundation, 2015; World Health Organization, 2018).

KEY MESSAGE: LET US KEEP PEOPLE AND COMMUNITIES HEALTHY BY AVOIDING UNNECESSARY PLASTIC CONSUMPTION IN HEALTH CARE.

The three key areas of recommendation: innovation, organization, and people that CE could be applied, as discussed above, highlight the considerable potential available to the application of a CE of plastics in health care. The adoption of a CE has the potential to create a health care system that reflects the values of the current era- a sustainable and resilient health care system that enables the health of both people and the environment to flourish simultaneously.

Transitioning to a Circular Economy Framework in Health Care

To better understand why health care should apply a CE framework, it is essential that we first analyze the linear economy model- which has stood as the benchmark economy in health care for decades. In Canada, in 2019, the total health expenditure was estimated to amount to 264.4 billion dollars which represents 11.6 per cent of Canada’s gross domestic product (GDP). In British Columbia, the total health care expenditure equates to 6, 548 dollars per person (Canadian Institute for Health Information, 2019). Additionally, in 2016, Canada lost 7.8 billion dollars related to unrecovered plastics- a lost economic opportunity due to plastic waste entering landfills. By 2030, it is estimated that Canada will lose an estimated 11.1 billion dollars (Environment & Climate Change Canada, 2019).

These statistics reflect the current linear economy model- take, make, and waste. This economic model has no room for an innovative redesign- nor a sustainability focus, both of which health care desperately requires to achieve sustainable universal health care services. Conversely, a CE can “retain value, reduce costs, drive economic growth, and reduce environmental degradation and waste” (Smart Prosperity Institute, 2019, p.10).

A CE MODEL IN PROCUREMENT COULD SAVE DENMARK HOSPITALS 70-90 MILLION EUROS (106- 137 MILLION CANADIAN DOLLARS) BY 2035 (ELLEN MACARTHUR FOUNDATION, 2015; (1 EUR€=1.52 CAN\$, JUNE 30, 2020).

“There is no one-size-fits-all circular solution.” (National Zero Waste Council, 2016, p. 7). Therefore, health care can take innovative and customize steps to tailor a CE of plastics. To begin to understand the value of applying a CE framework, health care can start by asking the following questions (adapted from National Zero Waste Council, 2016):

1. Value Chain Opportunities:

What opportunities are available for health care with a CE approach? What inefficiencies and waste can be minimized or eliminated altogether?

2. Patient Value Creation:

How will switching to a CE improve patient care- how does a CE relate to patients’ values? How can health care reimagine the delivery of care? How to address the disposable culture in health care? How can health care capture new business opportunities and products?

3. Technology and Innovation:

Where is innovation needed? How to apply new technology to deliver care? How can health care save money with a CE model?

4. Business Benefits:

What are the short and long-term benefits and which of these benefits contribute the most to the prospects and sustainability of health care?

Once health care has completed answering these fundamental questions and come to a consensus of the added value a CE offers, two frameworks have been developed to help guide health care’s transition to a CE for business and the delivery of patient-centered health care:

1. Driver, Pressure, State, Exposure, Effect, and Action (DPSEEA) Framework

DPSEEA framework is a tool for mapping links and relationships between the environment and health, more specifically between the social, political, and economic drivers of the environment and their effects on health. The DPSEEA can assist health care to identify and characterize the health impacts of each CE process (World Health Organization, 2018).

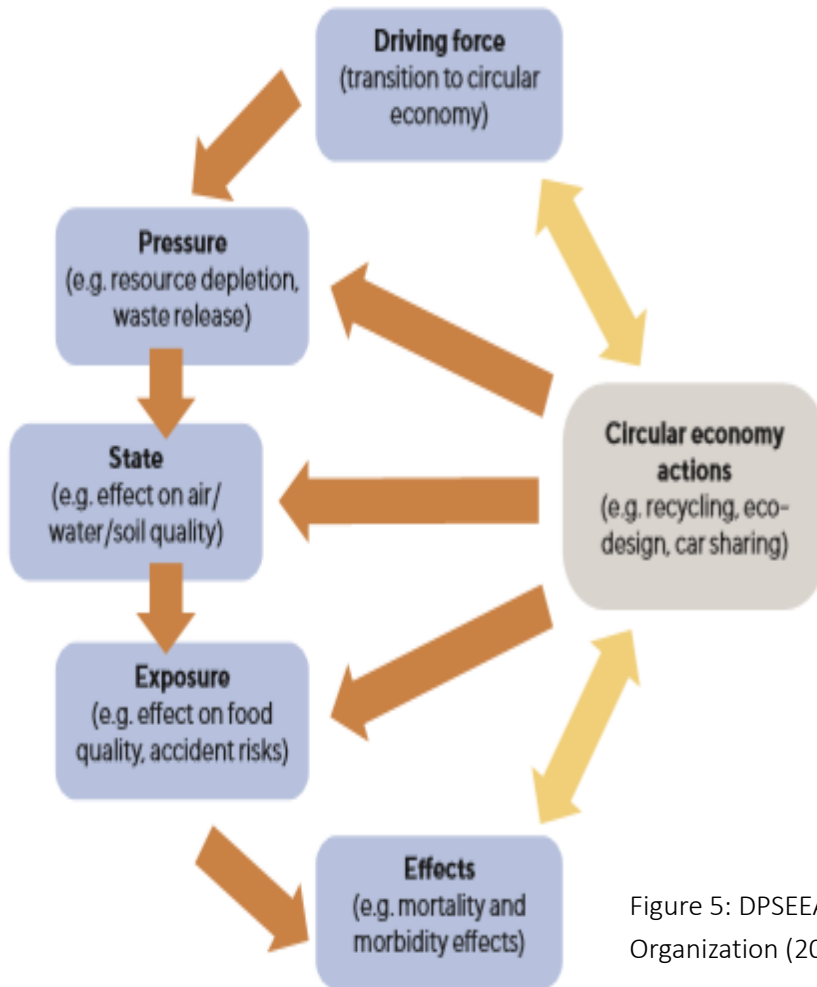


Figure 5: DPSEEA Framework. Cite: World Health Organization (2018)

Additionally, the DPSEEA framework can be used by health care to assess plastic and plastic alternative impacts on health, and whether the change is positive or negative on human health. The DPSEEA framework also categorizes the CE process or action (consumption or production) and labels the type of process or action (See Figure 6) (World Health Organization, 2018). This categorization can be useful for health care to match future circular plastic initiatives (category) to the most appropriate process or action (type).

Category (consumption or production)	Type
Reduced use of primary resources (production)	Recycling Efficient use of resources Use of renewable energy sources
Maintain the highest value of materials and products (production)	Remanufacturing, refurbishment and reuse of products and components Product life extension
Change utilization patterns (consumption)	Product as service Sharing models Shift in consumption patterns

Figure 6: Category and Type of CE Process and Action. Cite: World Health Organization (2018)

2. Regenerate, Share, Optimize, Loop, Virtualize, and Exchange (ReSOLVE) Framework

The Ellen MacArthur Foundation (2015) developed the ReSOLVE framework that identifies six actions that can be taken to transition to a CE. For a CE of plastics in health care these six transition steps could look like the following:

1. Regenerate
 - Shift to reusable plastics
2. Share
 - Sharing platforms
 - Prolong life expectancy of plastics through a redesign
3. Optimize
 - Procure durable products
 - Remove excess plastic waste in the supply chain
 - Leverage innovative technology

4. Loop
 - Products as a Service and EPR
 - Reduce, reuse, and recycle
5. Virtualize
 - Reduce quantity of plastic products (opt for high-quality plastic alternatives)
6. Exchange
 - Utilize a performance model in procurement
 - Choose sustainable plastic or plastic-alternative products

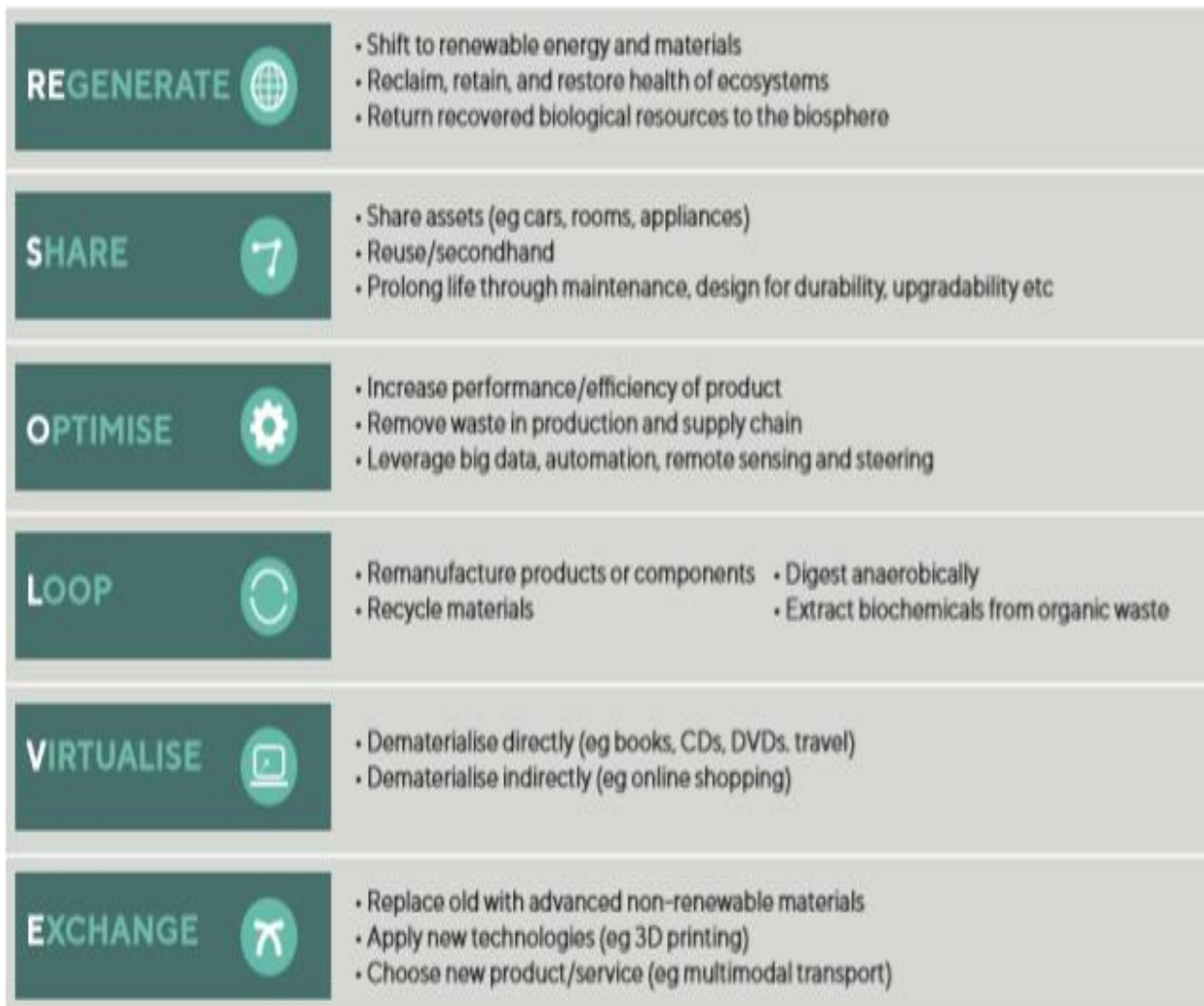


Figure 7: ReSOLVE Framework. Cite: World Health Organization (2018)

It is not realistic nor expected that health care will change its linear practices overnight. However, it is expected that health care begins to decouple its dependency on plastics that are wreaking havoc on both human and environmental health by opting to transition to a circular framework that is sustainable.

Integrating Circularity into day-to-day Work Routines

Being that CE is a relatively new framework to base the operation of health care by, the integration of circularity into day-to-day work routines requires circularity to become the new norm. To achieve this desirable outcome, steps that normalize and seamlessly integrate circular practices are essential.

Step 1: **Develop a common language** with the introduction of standard definitions consistent with a CE as well as plastics and their uses in health care (Environmental Defence, 2020; Circular Economy Leadership Coalition, 2019). Health care and health care professionals must become comfortable practicing circular terminology- although some individuals may already be practicing circularity without knowing it or without using the appropriate CE language to describe their actions. Regardless, a common language will help to facilitate an understanding amongst all involved. Link: [Glossary of CE Terms](#).

Ideas for Integration:

- CE word board.
- Matching CE practices to the corresponding terminology.

Step 2: **Involve circularity into daily discussion** by incorporating CE principles into board meetings, organizational opportunities, and on each unit in the hospital or community health center. Education sessions can help develop an understanding of the concepts of a CE and what it means for health care and professional practice. Once awareness of a CE is achieved, health care professionals can begin to implement circularity into their day-to-day work routines.

Ideas for Integration:

- Have a brainstorming session for areas where circularity could be applied in your workplace.
- How to spot areas in your work environment that are ripe for CE action.
- Who to involve in potential CE initiatives.
- Health care decisions consulted with CE policies.

Step 3: **“Facilitate peer-to-peer learning and knowledge transfer”** (Circle Economy, 2019, p. 9). Health care professionals can accelerate the uptake of CE practices by sharing what they know with others (Circle Economy, 2019). Thus, enabling a collaborative culture to overcome linear obstacles.

Ideas for Integration:

- Create a CE board in each health care department, hospital, or facility.
- Time set aside for sustainability/CE work.
- A monthly broadcast of CE updates, new initiatives, barriers, success stories, etc.

Step 4: **Create a plastic pact** as part of the Ellen MacArthur Foundation’s (2019) Plastic Pact network. Gather dedicated individuals with a passion for a CE of plastics who can bring together key stakeholders- at all levels, to bring forth innovative solutions to health care’s linear plastic addiction. A plastic pact will act to build momentum and receptivity towards health care’s CE transition.

Ideas for Integration:

- Create a plastic pact at each health care facility.
- Utilize individual networks to bring key stakeholders to the table.
- Create awareness of the importance of a CE of plastics in health care.

Step 5: Develop and standardize **a feedback form for plastic products** across health care. Health care staff who use, process, or dispose of plastic products can identify plastic products’ excessive use, infrequent use, end-of-life implications, and ideas for alternative plastic solutions and/or reusable plastic options. This information can then be used to help resolve the identified plastic concern.

Ideas for Integration:

- The creation and description of one inclusive feedback form that can be easily filled out and delivered to a dedicated personal/ department.
- The feedback form will highlight the identified areas of concern(s) on plastic products and packaging. For example, an area of concern could be on a product that comes with an excessive amount of packaging.
- The feedback forms can serve as a track record, which can then be analyzed and utilized to make plastic purchasing decisions i.e. plastic alternatives and/or reusable plastics.

Step 6: **Circular actions must be recognized and rewarded** by health care and senior leadership. The unanimous recognition of individual and group efforts on actions towards a CE of plastics in health care will help gain further momentum for similar actions.

Ideas for Integration:

- Individual and/or group CE action posted on the health authorities' website, and/or departments' communication board, and/or a CE wall of recognition.
- Personalized thank you from management and/or senior leadership.

Barriers, Challenges, and Special Considerations

A CE of plastics in health care is undoubtedly confronted by numerous barriers and challenges and special considerations that are unique to health care- all of which must be strategically accounted for to allow for a successful transition.

Barriers, Challenges, and Special Considerations within Health Care's Control:

1. Lack of clear communication between various actors leads to non-circular choices (Smart Prosperity Institute, 2019).
 - The lack of feedback from health care professionals about plastic products' excessive use, infrequent use, end-of-life implications, and ideas for alternative plastic solutions and/or reusable plastic options, etc. enables a linear economy.
 - Lack of communication with vendors (Health Care Without Harm, 2019).
 - Lack of education and training on CE practices i.e. use of performance models or sharing platforms (Ellen MacArthur Foundation, 2015).
2. Existing policies block the development of CE practices.
 - There are either no policies or ineffective policies in practice that blocks innovation and further entrenches the current linear norms; deepening health care's disposable culture (Smart Prosperity Institute, 2019).
 - The perception that leasing is more expensive than owning products and the uneasiness that private sectors will have the ability to then influence public health care (Ellen MacArthur Foundation, 2015).

3. Health care's belief that waste management will solve the linear plastic problem.
 - By not addressing the root of the linear plastic economy, it will not matter how many resources health care invests in waste management, it will not solve the bigger problem.
 - The emphasis must be placed on designing out waste in the first place (Ellen MacArthur Foundation, 2017).
 - Recycling is the last step in the CE system.
 - Habitual practices that contribute to the consumption and production of excess waste (Ellen MacArthur Foundation, 2015).

4. Lack of plastic packaging standards (Health Care Without Harm, 2019).
 - Leading to excessive waste.
 - "Products or packaging design choices are divorced from the realities of end-of-life resource recovery" (Smart Prosperity Institute, 2019, p. 33).

5. The belief that single-use and disposable plastic products are superior.
 - Lack of specific cost analysis information on the economic case for non-linear practices and reusable products (Ellen MacArthur Foundation, 2015).
 - The low purchase cost of disposals (Smart Prosperity Institute, 2018).
 - The assumption that reusable products cannot be properly sterilized or retain the same high-quality clinical function.

6. Outstanding circumstances preventing plastic items from being reduced, reused, repurposed, or recycled.
 - The biohazardous contamination of plastic is inevitable (Health Care Without Harm, 2019).
 - The current design of disposable single-use plastic products renders them for single-use only i.e. IV bags (Smart Prosperity Institute, 2018).

7. Insufficient awareness and/or data on CE in health care.
 - Lack of CE concepts and familiarity thus compliance for CE practice is diminished (Smart Prosperity Institute, 2018).
 - Incorrect or misinterpreted data being used to halt the transition to a CE (Smart Prosperity Institute, 2018).

Barriers, Challenges, and Special Considerations Outside of Health Care's Control:

1. Plastic produced from fossil resources is cheaper than reusing, recycling, or renewable chemistries.
 - Renewable and recycled plastic prices do not match with fossil-based resin commodity prices. Consequently, there is no incentive to change linear business models (Smart Prosperity Institute, 2019).
 - Profitability is driven by the production and consumption of disposable plastic products (Ellen MacArthur Foundation, 2015).
 - Subsidies for fossil-based plastics (Smart Prosperity Institute, 2019).
2. Technological barriers to implementing circularity
 - Existing facilities do not incentivize the innovation of products and/or packaging (Smart Prosperity Institute, 2019).
 - Robust collection and separation technology (Ellen MacArthur Foundation, 2015).
 - In Canada, much of the recycled plastic is downcycled (the plastic no longer has the original chemical or physical properties and cannot be reused in the same application) and is unable to be recycled further and is consequently disposed of (Smart Prosperity Institute, 2019).
3. Inconsistent policies and standards across health care authorities, cities, provinces, and the country.
 - Fragmented jurisdiction and the lack of standardization has allowed the adoption of vastly different approaches to plastic: procurement, performance models, end-of-life management, etc. (Smart Prosperity Institute, 2019).
 - Lack of recycled content mandate for plastic products (Ellen MacArthur Foundation, 2019).
 - Limited economic incentives for plastic recycling and value recovery (Environment & Climate Change Canada, 2019).
4. Lack of investments into a CE transition.
 - Lack of innovation for the redesign of health care plastic products.
 - Lack of support for innovative initiatives/ pilot tests (Smart Prosperity Institute, 2018).

- Lack of incentive to change linear customs and habits (Ellen MacArthur Foundation, 2015).
- Canada's chemical industry is extensive, consisting of more than 200 facilities (Smart Prosperity Institute, 2019).

Benefits of Implementing Circular Economy of Plastics in Health Care

A CE in health care can bring about lasting benefits of a responsible, sustainable, innovative, and productive health care economy. In addition to the benefits and opportunities referenced earlier in this report, key benefits for implementing a CE in health care are:

Substantial Cost Savings in the Long Term

- CE offers an approach to maximize value while eliminating waste by improving and transforming how products are designed, sold, used, and reused (Smart Prosperity Institute, 2018).
- Value in shifting away from small single-use disposables to larger volume components for multiple uses (Ellen MacArthur Foundation, 2019).
- Reduced demand for the continuous need for new products (Environment & Climate Change Canada, 2019).

Increase in Innovation

- System thinking and re-thinking to create viable solutions to linear problems (Ellen MacArthur Foundation, 2015).
- Adopting a CE of plastics in health care can foster sustainable growth and innovation while obtaining the additional benefit of resilience (Ellen MacArthur Foundation, 2015).
- The development of plastic alternatives and/or the redesign of plastic that proved the same beneficial functions of the original plastic product without causing plastic guilt (Environment & Climate Change Canada, 2019).

Increased Resilience

- A CE would mean using fewer virgin materials (i.e. resin for plastic products) and more recycled input content reducing companies' exposure to volatile raw material prices. Supply chains are at the mercy of global markets, political balance, natural and biological disasters, leaving companies vulnerable during crisis i.e. COVID-19. A CE would reduce price volatility and provide greater security of necessary suppliers (Ellen MacArthur Foundation, 2020).

- Improve business competitiveness and generate new and deeper relationships between customers and supplies (Smart Prosperity Institute, 2018).
- A CE would not only increase the resiliency of the health care system but the resilience of human and environmental health (World Health Organization, 2018).
- Creation of local jobs (Ellen MacArthur Foundation, 2016).

Opportunity to work with Local Suppliers

- Partnership with local businesses and supplies for tailored, high-quality products (Ellen MacArthur Foundation, 2016).
- Working with local suppliers raises awareness in other businesses on how they can reduce their problematic plastic usage and waste and encourages them to shift to a more efficient circular model for doing business (Ellen MacArthur Foundation, 2019).

Global and Local Circular Economy Successes Embedded in Health Care

Showcasing successful examples of CE practices in health care can help facilitate the adoption of a CE model of plastics in health care. The following examples are both global and local CE successes embedded in health care that demonstrate the added economic, social, and environmental benefits that come with the practice of circularity in health care.

Global

1. Landspítali, Iceland

Systematically working on the reduction of single-use disposable products and options to replace them with reusable products.

- In 2012, disposable plastic wrap covering textile trolleys (delivers textiles to each unit in a hospital) was replaced by a reusable textile covering, saving 10 tons of plastic per year and ISK 6 million per year;
- In 2016, the Blood Bank initiated a collection and return model. 100 Styrofoam boxes and 200 cooling gel packs were used, collected, and return for reuse;
- In 2014, criteria were set for green procurement of nursing products that did not contain PVC, phthalate, or DEHP i.e. examination gloves (Landspítali, 2017).

2. Philips

Practicing circularity while minimizing waste by keeping products, parts, and materials in use through a loop system- service, refurbish, parts recovery, and recycle. Philips has a 2025 goal to extend all CE practices to all medical equipment (Philips, 2020).

- Looking at redesign and refurbishing products, such as MRI systems through the reuse of components (World Health Organization, 2018).
- Performance model and offering products as a service (Philips, 2020)- supporting CE in practice in health care.

3. United Kingdom (UK)

Protecting the environment and safeguarding the future with the proper end-of-life management of inhalers across the UK.

- Complete the Cycle is a recycling and recovery strategy of used respiratory inhalers that involves the cooperative and participation of patients, pharmacy, and health care professionals (GlaxoSmithKline, 2018).

4. Denmark

Practicing circularity through vendor EPR and performance model.

- Over the past 20 years, the Nya Karolinska hospital has used the CE model of performance for the delivery, installation, maintenance, repairs, updating, and replacing of medical imaging equipment i.e. MRI and ultrasound equipment (Ellen MacArthur Foundation, 2015).

Local: Vancouver

1. Disposable Gloves: Reused

A lab in one of the LMHO hospitals has partnered with Terracycle, initiating a pilot project to tackle the end-of-life of plastics by incorporating CE principles.

- Gloves are one item of personal protection equipment health care professionals use to keep themselves safe, as well as patients. Single-use gloves are no longer discarded and set to the landfill, but collected, processed into raw material, and designed to produce new products (Terracycle, 2020).

2. Medical Sharps Container

In 2020, Daniels Health and Provincial Health Services Authority (PHSA) negotiated a contract which includes options for facilities to participate in the Sharpsmart reusable sharps containers program.

- Daniels Sharpsmart container offers an alternative to the single-use disposable plastic sharps container. Once full, the sharps container is collected, sanitized, and cycled back into use (Daniels, 2020).

3. Green+Leaders Plastic Projects

Over the years, GreenCare Green+Leaders have initiated a wide range of CE projects that have incorporated a variety of frameworks and/or practices with great success. Some of these projects include:

- St. Paul's Hospital Glove Pilot Project: Collecting and recycling single-use plastic gloves in one lab;
- Thermoplastic patient accessories (TPA) Project: Between PHSA and a private contractor, a circular process was developed for the collection and recycling of TPA. Note: TPA are single-patient use items;
- Garment Bag Project: In PHSA BC Cancer Surrey, plastic patient garment bags were successfully swapped for paper ones as well as reducing overall bag use by asking patients to bring their reusable bag (A. White & R. Tam, personal communication, May 26, 2020; G. Wong, personal communication, May 26, 2020).

Senior Leadership and Stakeholder Engagement

Engaging senior leadership and key stakeholders will help precipitate the transition to a CE of plastics in health care. Engaged senior leadership and stakeholders in a CE transition will create buy-in across the health care organizations that will enable the conditions for effective collaboration, new processes, and new practices to take root (National Zero Waste Council, 2016).

Senior Leadership

To achieve a CE of plastics in health care, senior leadership needs to be involved and heavily invested. "Engaged leadership is the platform upon which every sustainable project rests" (Practice Greenhealth, n.d., p. 1). To help facilitate the engagement of senior leadership to invest in a transition to a CE of plastics, the value must be demonstrated.

The Ellen MacArthur Foundation (2019) has created a workable document: Making a CE Pitch, for CE advocates to effectively communicate CE ideas to ambivalent health care leadership. Link: [Making a Circular Economy Pitch Worksheet](#) This workable document allows the user to focus on:

1. Understanding the audience, you want to influence
2. Internal and external organizational context
3. Define the CE idea(s) and explain the benefits

The conversation around the practice of sustainable health care is one that is long overdue. Senior leadership must take the initiative to re-focus the disposable and wasteful plastic practices in health care, ensure that CE expertise, resources, and support are provided to help the transition, and demonstrate accountability for sustainable health care practices.

Key Stakeholders

A key stakeholder in the transition to a CE of plastics is health care professionals. To effectively achieve buy-in from the majority of health care professionals, senior leadership needs to:

1. Inform and educate;
2. Consult and gain opinions and feedback;
3. Involve and ensure health care professional concerns inform CE decision making;
4. Collaborate towards actionable goals (National Zero Waste Council, 2016).

To further ensure the buy-in and participation of health care professionals' senior leadership can:

- “Demonstrating the commitment and buy-in of senior management
- Building circularity into corporate strategy, policies, guidelines, and procedures [i.e. procurement]
- Including circularity in job descriptions, reward, and recognition systems
- Training employees in aspects of circular production
- Communicating regularly and highlighting success stories” (National Zero Waste Council, 2016, p. 21).

Using a CE business model, engaging key stakeholders in facilitating the transition to a CE of plastics in health care could look like the following:

Business model	Sample top external stakeholders
Product as a Service	Suppliers and customers
Product Life Extension	Customers, suppliers, retailers and distributors
Circular Supply Chains	Suppliers
Recovery and Recycling	Recycling plants, regulators, landfill operators, haulers
Sharing Platforms	Users, insurers, governments

Figure 8: Engaging Key Stakeholders. Cite: National Zero Waste Council (2016)

Emerging Themes from Stakeholder Interviews

Health care professionals are embedded into the every-day operations of the health care system. 24/7 staff are engaging in practices that involve the consumption and disposal of plastic products. Health care professionals, therefore, have valuable insight and possible solutions for the transition to a CE of plastics in health care. The following is a summary report of the emerging themes from the conducted stakeholder interviews:

1. Educating current and new staff on CE and the benefits of sustainable practice.
2. Factors that limit frontline staff from engaging in circularity:
 - The pressure to perform- demands places on staff today requires time-saving practices that are quick and convenient and not necessarily sustainable.
 - Limits placed on staff i.e. time and resources.
 - Staff engaging in sustainable practice is not honored nor recognized.
3. How to engage frontline staff in circularity:
 - Inquire what initiative(s) they see as adding value to sustainable health care practices.
 - Honour staff and their ideas for innovative solutions to a linear economy.
 - Maintain engagement through regular activities and progress reports.

- Honour and reward achievements towards circularity.

4. Barriers/Challenges:

- The channels of communication and elevating concerns are not concrete or well-known- a pathway is needed for CE communication and concerns.
- Differing management priorities; top-down engagement for sustainable projects is necessary.
- Management needs to be open to alternative suggestions made by staff.
- The collection of quantitative data is needed to demonstrate cost-benefits.
- Current procurement principles and practices are not based on sustainability.

5. Sustainable projects need to define measurement(s) of success in their infancy.

6. How to transition towards a CE:

- Top-down support and bottom-up action.
- Demonstrate that sustainable initiatives can provide cost benefits, free-up human resources, and achieve organizational goals.
- Identification of unsustainable and wasteful linear practices that can be exemplified to gain buy-in across health care for system-wide change.
- Incorporate sustainable practice into the job description for health care professionals.
- Collaboration between health care and vendors on how to create the desired change i.e. the redesign of plastic products to allow for reusability.
- Environmental sustainability practices built into the strategic plan.

(A. White & R. Tam, personal communication, May 26, 2020; G. Wong, personal communication, May 26, 2020; S. Shyluk, personal communication, May 21, 2020).

Summary

TODAY OUR WORLD IS 91% LINEAR AND THAT IS NOT A GOOD THING.

The current linear approach to plastics in health care is unsustainable. Humanity's habitual linear practice of taking natural resources, turns those resources into products for consumption, and then disposes those products into the environment is resulting in an excessive accumulation of waste. Most of these wasted plastic products end up in landfills, polluting, and leaking toxic chemicals into the environment, many of which cause adverse health effects for humans.

Unfortunately, health care has adopted this linear economy and arguably perfected it through its insatiable appetite for the consumption and disposal of plastic products. Health care's plastic consumption is steadily growing; single-use disposable plastic products are found in abundance in health care and once disposed are rarely recovered or recycled.



Image: Plastic health care products. Cite: Health Facilities Management

Fortunately, there is an alternative economy, one that is circular. A CE is based on three principles according to the Ellen MacArthur Foundation (2017):

- Design out waste and pollution
- Keep products and material in use as long as possible
- Regenerate natural systems

There are unique circumstances for applying a CE model to plastics in health. However, these circumstances can be overcome by system thinking, focusing on innovation, organization, and people. A CE of plastics in health care cannot not only build a resilient health care system but resilient communities as well.

A CE of plastics holds immense potential for health care to leverage resources towards creating circular practices that are designed around sustainability. No longer will health care be a major contributor to unsustainable plastic consumption and waste, but a leader in circularity, enabling a people-centered sustainable health care approach that provides economic, societal, and environmental benefits.

Recommendations

During this research project, the following list is identified gaps and consideration for future research of the application for a CE of plastics in health care:

1. Analyze the influence of COVID-19 on the consumption and waste of single-use disposable plastic products in health care.
2. Learn how to lessen pandemic plastic consumption using plastic alternatives or reusable plastic products.
3. With the understanding of the potential barriers, challenges, and special considerations facing health care's transition to a CE of plastics, the next step to take is for health care to visualize what the future delivery of health care services should look like and how a CE will allow health care to reach that vision.
4. It is important that health care is careful in how it processes and educates health care professionals about CE. CE discussion can often be narrow- words such as closed loops, a new business model, products as services can be used. However, it is essential that health care looks at CE as a holistic system. A system that involves elements of science and philosophy to shape a new economy one that is recognized in legislation and societal infrastructure (Ellen MacArthur Foundation, 2020).
5. A CE is an economic framework that holds immense potential to enable health care to provide sustainable health care into the future. However, sustainability must be conceptualized, defined, and regulated.

6. Health care is a unique operating system with many moving parts it must, therefore, analyze what plastic practice changes will have the greatest impact.
7. Health care must research how to redesign plastics to enable reusability or look to alternative forms of plastics altogether, when possible.
8. The low production costs of single-use plastics enable the linear plastic economy to continue, therefore, plastic reuse, value recovery, and recycling must be incentivized.
9. Further research must be done on:
 - The possible effects of microplastics on human health.
 - Redesign of plastic or plastic alternative products for health care.
 - Sterilization techniques of reusable plastic products.
 - Social impacts of the transition to a CE i.e. inequalities and job creation.
 - The direct and indirect impact of a transition to CE on human health.

References

- A. White and R. Tam, personal communication, May 26, 2020.
- As you Sow. (2020). Waste and opportunity 2020: Searching for corporate leadership. Retrieved from: <https://www.asyousow.org/report-page/waste-and-opportunity-2020-searching-corporate-leadership>
- Canadian Council of Ministers of the Environment. (2019). Canada-wide action plan on zero plastic waste. Retrieved from: https://www.ccme.ca/files/Resources/waste/plastics/1289_CCME%20Canada-wide%20Action%20Plan%20on%20Zero%20Plastic%20Waste_EN_June%202027-19.pdf
- Canadian Institute for Health Information. National health expenditure trends, 1975 to 2019. Ottawa, ON: CIHI; 2019.
- Circle Economy. (2019). The circularity gap report. Retrieved from: <https://www.legacy.circularity-gap.world/2019>
- Circular Economy Leadership Coalition. (2019). A circular economy for plastics in canada: A bold vision for less waste and more value. Retried from: http://circulareconomyleaders.ca/downloads/A_Circular_Economy_for_Plastics_in_Canada.pdf
- Daniels. (2020). Sharpsmart: Rethinking safety. Retrieved from: <https://www.danielshealth.com/sharpsmart>
- Ecology Center. (2020). Adverse health effects of plastic. Retrieved from: <https://ecologycenter.org/factsheets/adverse-health-effects-of-plastics/#plastichealthgrid>
- Elephant World. (2019). How much does an elephant weigh. Retrieved from: [https://www.elephant-world.com/elephant-weight/#Average_weight_Savanna_Elephant_\(Loxodonta_africana\)](https://www.elephant-world.com/elephant-weight/#Average_weight_Savanna_Elephant_(Loxodonta_africana))
- Ellen MacArthur Foundation. (2020). Circulytics- measuring circularity. Retried from: <https://www.ellenmacarthurfoundation.org/resources/apply/circulytics-measuring-circularity>
- Ellen MacArthur Foundation. (2015). Growth within: A circular economy vision for a competitive Europe. Retrieved from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf

- Ellen MacArthur Foundation. (2019). Making a circular economy pitch. Retrieved from: <https://www.ellenmacarthurfoundation.org/assets/downloads/Making-a-circular-economy-pitch-worksheet.pdf>
- Ellen MacArthur Foundation. (2019). New plastics economy global commitment. Retrieved from: <https://www.ellenmacarthurfoundation.org/assets/downloads/GC-Report-June19.pdf>
- Ellen MacArthur Foundation. (2015). Potential for Denmark as a circular economy. A case study from: Delivering the circular economy- a toolkit for policy makers. Retried from: https://www.ellenmacarthurfoundation.org/assets/downloads/government/20151113_DenmarkCaseStudy.pdf
- Ellen MacArthur Foundation. (2020). The circular economy in detail. <https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail>
- Ellen MacArthur Foundation. (2019). The initiative. Retrieved from: <https://www.newplasticseconomy.org/about/the-initiative>
- Ellen MacArthur Foundation. (2019). The new plastics economy global commitment: 2019 progress report. Retrieved from: <https://www.newplasticseconomy.org/assets/doc/Global-Commitment-2019-Progress-Report-Summary.pdf>
- Ellen MacArthur Foundation. (2016). The new plastics economy: Rethinking the future of plastics. Retrieved from: <http://www.ellenmacarthurfoundation.org/publications>.
- Ellen MacArthur Foundation. (2017). What is circular economy. Retrieved from <https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy>
- Emadian, S. M., Onay, T. T., & Demirel, B. (2017). Biodegradation of bioplastics in natural environments. *Waste management*, 59, 526-536.
- Environment and Climate Change Canada. (2019). Canada's plastics science agenda. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/sciencetechnology.html>
- Environment and Climate Change Canada. (2020). Draft science assessment of plastic pollution. Retrieved from: <https://www.canada.ca/content/dam/eccc/documents/pdf/pded/plastic-pollution/Science%20Assessment%20Plastic%20Pollution.pdf>

- Environment and Climate Change Canada. (2019). Economic study of the canadian plastic industry, markets and waste: Summary report. Retrieved from: <http://publications.gc.ca/site/eng/9.871296/publication.html>
- Environmental Defence. (2020). No time to waste: Six ways canada can progress to zero plastics waste by 2025. Retired from: <https://d36rd3gki5z3d3.cloudfront.net/wp-content/uploads/2020/03/No-Time-to-Waste-Report-March-2020.pdf?x75608>
- European Environmental Agency. (2019). Resource efficiency and circular economy in Europe- even more from less. Retried from https://www.eionet.europa.eu/etcs/etc-wmge/products/b-country-profile-finland_final.pdf
- Garbage Composition Study of the St. Pauls' Hospital. (2019).
- Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science advances*, 3(7), e1700782.
- GlaxoSmithKline. (2018). Complete the cycle. Retrieved from: <https://uk.gsk.com/en-gb/responsibility/our-planet/complete-the-cycle/>
- Government of Canada. (2020). Circular economy. Retrieved from: <https://www.canada.ca/en/services/environment/conservation/sustainability/circular-economy.html>
- Government of Canada. (2019). Government of canada taking action to reduce plastic pollution. Retrieved from: <https://pm.gc.ca/en/news/backgrounders/2019/06/10/government-canada-taking-action-reduce-plastic-pollution>
- G. Wong, personal communication, May 26, 2020.
- Healthcare Plastics Recycling Council. (2019). Common recyclable healthcare plastics. Retrieved from: <https://www.hprc.org/common-recyclable-healthcare-plasti#:~:text=Tyvek® is a common material utilized in sterile, be difficult to visually differentiate Tyvek® from paper.>
- Health Care Without Harm. (2020). Purchasing policies in hospitals. Retrieved from: <https://noharm-uscanada.org/issues/us-canada/purchasing-policies-hospitals>
- Health Care Without Harm. (2020). PVC and Phthalates. The issue. Retrieved from: <https://noharm-uscanada.org/issues/us-canada/pvc-and-phthalates>

- Health Care Without Harm. (2019). Strategic procurement in european healthcare. Retrieved from: https://noharm-europe.org/sites/default/files/documents-files/6171/2019-12-17_HCWHEurope_Strategic_Procurement_Web.pdf
- Health Facilities Management. (2018). Hospitals seek recycling solutions for medical plastics. Retrieved from: <https://www.hfmmagazine.com/articles/3365-hospitals-seek-recycling-solutions-for-medical-plastics>
- Krause, M. J., & Townsend, T. G. (2016). Life-cycle assumptions of landfilled polylactic acid underpredict methane generation. *Environmental Science & Technology Letters*, 3(4), 166-169.
- Kubowicz, S., & Booth, A. M. (2017). Biodegradability of plastics: Challenges and misconceptions.
- Landspítali. (2017). Environmental management at landspítali university hospital: Summary 2012-2017. Retrieved from: [https://www.landspitali.is/library/Sameiginlegarskrar/Gagnasafn/Rit-og-skyrslur/Umhverfismal/environmental_management_at_Landspitali_summary%202012-2017%20-%20Copy%20\(2\).pdf](https://www.landspitali.is/library/Sameiginlegarskrar/Gagnasafn/Rit-og-skyrslur/Umhverfismal/environmental_management_at_Landspitali_summary%202012-2017%20-%20Copy%20(2).pdf)
- Merriam Webster. (2020). Health care. Retrieved from: <https://www.merriam-webster.com/dictionary/health%20care>
- National Zero Waste Council. (2016). Circular economy business toolkit. Retrieved from: www.nzwc.ca/Documents/CircularEconomyBusinessToolkit.pdf
- Nature. (2016). Circular economy. Retrieved from: <https://www.nature.com/news/the-circular-economy-1.19594>
- Nordic Innovation. (2019). Nordic sustainable healthcare. Retrieved from: <https://www.diva-portal.org/smash/get/diva2:1346242/FULLTEXT01.pdf>
- Philips. (2020). Decoupling growth from resource consumption. Retrieved from: <https://www.philips.com/a-w/about/sustainability/circular-economy.html>
- Practice Greenhealth. (n.d.). Engaged leadership. Retrieved from: http://www.healthierhospitals.org/sites/default/files/IMCE/public_files/hh_engaged_leadership_fact_sheet.pdf
- Practice Greenhealth. (2020). Why sustainability. Retrieved from: <https://practicegreenhealth.org/why-sustainability>

Smart Prosperity Institute. (2018). Getting to a circular economy: A primer for canadian policymakers. Retrieved from:
<https://institute.smartprosperity.ca/sites/default/files/spipolicybrief-circulareconomy.pdf>

Smart Prosperity Institute. (2019). Report: A vision for a circular economy for plastics in canada: The benefits of plastics without the waste and how we get it right. Retrieved from:
<https://institute.smartprosperity.ca/sites/default/files/report-circulareconomy-february14-final.pdf>

S. Shyluk, personal communication, May 21, 2020.

TerraCycle. (2020). Zero waste box. Retrieved from:
<https://zerowastebboxes.terracycle.com/products/disposable-gloves-zero-waste-box>

Waste Weight Stream of LMHO. (2019).

World Business Council for Sustainable Development. (2018). Glossary. Retrieved from:
<https://www.ceguide.org/Glossary>

World Business Council for Sustainable Development. (2020). Putting companies in the driver's seat to their circular transition. Retrieved from: <https://www.nea.gov.sg/envision-magazine/issue17/mobile/index.html#p=60>

World Health Organization. (2018). Circular economy and health: Opportunities and risks. Retrieved from: https://www.euro.who.int/_data/assets/pdf_file/0004/374917/Circular-Economy_EN_WHO_web_august-2018.pdf?ua=1

Appendix

Researching a Circular Economy of Plastics in Health Care: Project Plan

Reinstituting the Reusable Laryngeal Mask Airway in Health Care: A Circular Economy of Plastic Approach

(See additional material uploaded by Scholar on the online Scholars Project Library).