DEVELOPING A DATA-DRIVEN BASELINE OF WASTE DIVERSION IN HEALTH CARE

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GreenCare™

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Cover photo courtesy of Jerald Walliser

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Introduction

Increase waste diversion has been one of the top priorities in health care organizations. By 2020, health care organizations in British Columbia's Lower Mainland aims to increase non-hazardous waste diversion rates at existing acute and residential care sites to 50%, decrease waste intensity rates at existing acute and residential care sites to 12kg/sqm in Providence Health Care and 10kg/sqm in Vancouver Coastal Health, and increase waste diversion rates in all new health care construction projects to 90% (GreenCare, 2018). To achieve these objectives, the Energy and Environmental Sustainability Team (EES), a business line of the Lower Mainland Facilities Management, which serves the four health care organizations in British Columbia's Lower Mainland: Fraser Health, Providence Health Care, Provincial Health Services Authority, and Vancouver Coastal Health was created in 2010 to conduct research, implement programs, and develop policies in the health care organizations. The EES team developed a Blue Bin program to reduce waste in landfills from three waste streams: mixed containers, mixed papers, and refundable beverage containers, and an Organics program has been launched in the cafeterias at selected sites.

Although the Blue Bin and Organics programs capture data from the major non-hazardous waste streams in health care organizations, other waste streams that have been recycled independently at each site have not been tracked. To acquire a full picture of the waste diversion, a comprehensive and accurate analysis of all waste streams at each site is fundamental. To address this issue, this project aimed to understand the recycling process and collect data on 13 waste streams at four acute health care sites: Vancouver General Hospital, Richmond Hospital, UBC Hospital, and St. Paul's Hospital. The 13 waste streams include batteries, reprocessed medical devices, Styrofoam, shrink wrap, construction waste, electronics, furniture, lighting, mattresses, paint cans, pallets, printer cartridge, and scrap metal. The data collection of each waste stream focused on the quantity being recycled each year, the frequency of pick-ups, and the contact information of the vendor. Moreover, this report will explain the feasibility of continuing to conduct a comprehensive analysis of all waste streams for other sites in the Lower Mainland, describe the challenges and barriers of quantifying the yearly mass of each waste stream, and provide suggestions for new recycling programs targeting these waste streams.

Background

Among the multitude of environmental problems in the world, the volume of solid waste has reached an alarming level. According to Statistics Canada, 24.9 million tons of solid waste was disposed in landfills or being incinerated in 2016. Non-residential sources of waste for disposal was 14.7 million tons. This enormous amount of waste ending up in landfills or being incinerated

every year can lead to air emissions, land disturbance, or water pollution. One solution to reduce solid waste in landfills is to divert waste by recycling and composting.

Among the different sources of solid waste in landfills, the health care industry is one of the major sources that generate significant amounts of solid waste. In 2001, hospitals and other health facilities in Canada generated approximately 1% of the total solid waste (Kagoma, Stall, Rubinstein, & Naudie, 2012). To raise awareness of the waste issue, the World Health Organization emphasized that health facilities need to adopt waste reduction, composting, and recycling practices, and to reduce or eliminate the incineration of medical waste (WHO, 2008). Aligning with the global standards of sustainable development, the EES Team aims to reduce the environmental impact of the health facilities across the four Lower Mainland health care organizations. Since 2016, the Blue Bin program has been implemented across all health organization owned and operated acute and residential care sites.

The Blue Bin Program increased waste diversion rates at acute and residential care sites by an average of 17% from 2011 to 2018 (EPAR, 2017). Apart from the waste streams covered by the Blue Bin and Organics Programs, other waste streams can also be recycled at health facilities. At selected sites, there are recycling programs for batteries, electronics waste, Styrofoam, and shrink wrap. However, these recycling programs have not been tracked. Therefore, the purpose of this project is to collect data on the 13 waste streams that have not been tracked at four acute care sites.

Research Approach

To collect data on the 13 waste streams for each site, the initial stage was to review and scrutinize the existing data files that contain the major waste streams to gather useful data for this project. At the second stage, a series of in-person interviews were conducted with the facilities, maintenance, and operations (FMO) manager at each site to gather new data. The interview focused on the waste streams that have not been tracked. The targeted waste streams were batteries, reprocessed medical devices, Styrofoam, shrink wrap, construction waste, electronics, furniture, lighting, mattresses, paint cans, pallets, printer cartridge, and scrap metal.

For each waste stream, the FMO manager was asked whether there is a recycling program. If there is a recycling program, which vendor is in charge of collecting the waste, how often does the vendor pick up the waste, and what amount of waste is collected each time. In case of lacking information on a specific waste stream, the FMO manager was asked to refer a contact person who manages the waste stream at the site. Follow-up interviews were conducted with the contact person, either through email or by phone. The same interview format was followed. In certain cases, a request for data was sent to the vendor to collect the necessary data.

Findings

Vancouver General Hospital (VGH)

By adding the data of other waste streams, the waste diversion rate increased from 34% to 37% (see Appendix A). A detailed description of each waste stream is in the section below. The total annual weight of each waste stream is summarized in Table 3: Annual weight of other waste streams at VGH.

Batteries

Small size batteries are recycled by Call2Recycle. The annual weight of small size batteries collected by Call2Recycle was 1061.4kg in 2018. In addition to the small size batteries, large lead batteries are recycled by Capital Salvage. The annual weight of lead batteries is 10,000 lbs (4535.9 kg). The total annual weight of batteries is 5597.3 kg. Data was provided by Bernard Busse (bernard.Busse@vch.ca), the biomedical technologist.

Reprocessed Medical Device

Reprocessed medical devices are collected by Stryker Sustainability Solutions. The total annual weight of reprocessed medical devices is 6,323 lb (2868 kg). Data was provided by Stryker Sustainability Solutions.

Styrofoam

Styrofoam has been collected by West Coast Plastic Recycling since May 2019. West Coast Plastic Recycling picks weekly (usually on Friday afternoon). In total, there are four recycling bags located in the Tunnel level of VGH. Each bag is approximately 3.4 m3 in size. On average, one bulk bag weights 79 lbs (36 kg). This number is derived from the two pickups in June and July by West Coast Plastic Recycling (see Appendix B). All four bags are filled every two weeks. The total annual weight was calculated using the number of bags (4 bags) multiply by the weight of each bag (36 kg), and then multiply by the number of pickups (26 weeks). The total annual weight of Styrofoam is 3744 kg. Data was provided by Berenice Vega (office@westcoastplasticrecycling.com), the office Administrator at West Coast Plastic Recycling Inc. and Tricia Mcdonnell (tricia.mcdonnell@cgc-healthcare.com), the Environmental Service Manager.

Shrink Wrap

Shrink wraps are recycled by West Coast Plastics Recycling. Information was provided by Val Tepes (val.tepes@vch.ca), the senior FMO manager and James Reen

(james.Reen@fraserhealth.ca), the support service manager. According to West Coast Plastic Recycling, no shrink wrap has been picked up for the last few months

Construction Waste

Construction waste is not managed by VGH. The suppliers bring their bins and manage their wastes. Information was provided by Val Tepes.

Electronics

Old electronics are donated to the Electronic Recycling Association. Old electronics include printers, scanners, personal computer, laptop, UPS device, audio equipment, monitors, and cables. The total annual estimate of old electronic equipment is six to eight pallet size boxes. The total annual weight was calculated using the median number of pallet size boxes (7 boxes) multiply by the holding capacity of a 48"x40' pallet size (2,087kg; C.H. Robinson Worldwide Inc., 2019). The annual weight of electronics is 14,609 kg. Retired medical devices are donated to Korle Bu. Korle Bu ships the retired medical devices to Africa for re-use purpose. The total annual estimate of retired medical devices is one or two shipping container. The total annual weight was calculated using the median number of shipping containers (1.5 containers) multiply by the payload capacity of a 40' dry container (27,600kg; DSV-Global Transport and Logistics, 2019). The annual weight of retired medical devices is 41,400kg. The total annual weight of all electronics is 56,009 kg. Data was provided by Bernard Busse.

Furniture

Furniture is recycled by Inner City Construction every month. There are four roll-off bins (one 20" and three 30"). The total weight in January 2019 was 6300 kg. Assuming the same amount are recycled every month, the total annual weight of furniture is 75,600 kg. Data was provided by Manish Nigam (manish.nigam@vch.ca), the Business System & Performance Manager.

Lighting

Lighting materials are recycled by LightRecycle on call. The annual weight of each lighting category is listed in Table 1. Data from 2013 to 2019 is included inAppendix A . The total annual weight of lighting materials is 1458.6 kg. Data was provided by Wayne Chisholm (wayne@productcare.org), the logistics & services manager at Product Care Recycling and Ross Thompson (ross.thompson@vch.ca), the maintenance worker.

Table 1: Lighting materials recycled at VGH in 2018

Category	Weight per box (kg)	Number of boxes	Total weight (kg)
Bulb	20.4	4	81.6

4’ Ply-Plywood	79.4	0	0
Gaylord	226.8	4	907.2
4’ Lg tube	9.1	3	27.3
8’ tube	29.5	15	442.5
	Total	26	1458.6

Mattresses

Data was not available. James Reen has not replied.

Paint Cans

Paint cans are recycled by Stericycle every month. On some occasions, the suppliers recycle paint cans. Twenty 1-gallon paint cans are estimated to be recycled every month. The total annual weight was calculated using the number of paint cans recycled in one year (240 cans) multiply by the weight of an empty 1-gallon paint can (0.34 kg; ICC Compliance Center Inc., 2019). The total annual weight of paint cans is 81.6 kg. Data was provided by Val Tepes.

Pallets

Data was not available. Randy Thomas (randy.thomas@vch.ca) has not replied.

Printer Cartridge

Data was not available. Randy Thomas (randy.thomas@vch.ca) has not replied.

Scrap Metal

Scrap metal is collected by Capital Salvage. The annual weight of each scrap metal category is listed in Table 2. The total annual weight of scrap metals is 6,990 Kg. Data was provided by Bernard Busse.

Table 2: Scrap metal recycled at VGH in 2018

Category	Annual Weight (lbs)	Annual Weight (kg)
Copper wire	3,000	1360.8
Stainless steel	250	113.4
Aluminum	160	72.6
Low grade scrap metal	12,000	5443.1
Total	15,410	6,990

Summary Table

Table 3: Annual weight of other waste streams at VGH

	Batteries	Reprocessed medical devices	Styrofoam	Shrink Wrap	Construction waste	Electronics	Furniture	Lighting	Mattresses	Paint cans	Pallets	Printer cartridge	Scrap metal
Is it recycled?	Yes	Yes	Yes (since May, 2019)	Yes	No	Yes	Yes	Yes	N/A	Yes	N/A	N/A	Yes
Estimate of annual weight (kg)[1]	5597.3	2868	3744	N/A	N/A	56009	75600	1458.6	N/A	81.6	N/A	N/A	6990
Vendor	Call2 Recycle	Stryker Sustainability Solutions	West Coast Plastic Recycling	West Coast Plastic Recycling	Suppliers use their own bins	Electronic Recycling Association & Korle Bu	Inner City Construction	Light Recycle	N/A	Stericycle or Suppliers	N/A	N/A	Capital Salvage
Data provider	Bernard Busse	Stryker Sustainability Solutions	Tricia Mcdonnell	James Reen	Val Tepes	Bernard Busse	Manish Nigam	Wayne Chisholm	James Reen	Val Tepes	Randy Thomas	Randy Thomas	Bernard Busse

[1] The annual weight was converted to kilogram and calculated based on a prototype. A detailed description of the conversion for each category is included in the section above.

Richmond Hospital (RH)

By adding the data of other waste streams, the waste diversion rate increased from 50% to 52% (see Appendix B). A detailed description of each waste stream is in the section below. The total annual weight of each waste stream is summarized in Table 4: Annual weight of other waste streams at RH.

Batteries

Small size batteries are collected by Call2Recycle. The annual weight of small size batteries was 697.4 kg in 2018. In addition to the small size batteries, large batteries used for medical devices are recycled by Regional Recycling Richmond. Tyler Gibson, (tyler.gibson@vch.ca), the Biomedical Engineering Supervisor, collects used batteries and old electronics (i.e., non-reusable medical devices), and brings them to Regional Recycling Richmond twice a year. Each time, the amount of batteries and electronics recycled fills up the trunk of a small pickup truck. One method to estimate the weight of large battery is to use the payload capacity of a small pickup truck which is approximately 1000 pounds (453.5 kg) including passengers (McGrath, 2008). Thus, assuming the weight of two passengers is 150 kg, the payload capacity is 303.5 kg without passengers. The total annual weight for batteries and non-reusable electronics is 617 kg (303.5 kg * 2 visits per year). A second method is to derive the weight based on data collected from VGH. The ratio of large batteries per m^2 at VGH is 4535.9 kg/259840 m^2=0.0175 kg/m^2. The weight of large batteries at RH is estimated to be 0.0175 kg/m^2 * 34076 m^2 = 595 kg. By taking the average of the weight derived from the two methods, the weight of large batteries is approximately 606 kg per year. Thus, the total annual weight of batteries is 1303.4 kg. Data was provided by Tyler Gibson.

Reprocessed Medical Device

Reprocessed medical devices are collected by Stryker Sustainability Solutions. The total annual weight of reprocessed medical devices is 868 lb (394 kg). Data was provided by Stryker Sustainability Solutions.

Styrofoam

Styrofoam is not currently recycled. Data was provided by Tom So (tom.so@vch.ca), the FM&O manager, and Jill Liu (jill.liu3@vch.ca), the Business Initiatives and Support Services Manager at RH.

Shrink Wrap

Shrink wraps are recycled by West Coast Plastic Recycling on call. According to West Coast Plastic Recycling, no shrink wrap has been picked up for the last few months. Data was provided by

Berenice Vega (office@westcoastplasticrecycling.com), the office Administrator at West Coast Plastic Recycling Inc. Susan Ho (susan.ho@phsa.ca), the Site Inventory & Distribution Customer Service Rep and Alan Woolverton (alan.woolverton@hssbc.ca), the In-Hospital Replenishment Team Lead are the contacts at RH.

Construction Waste

Construction waste is not managed by RH. The contractors bring their mixed garbage bins and manage their wastes. Data was provided by Tom So, Ronald Francis (ronald.francis@fraserhealth.ca), the senior project manager, and Karen Smith (karen.smith3@fraserhealth.ca), the project manager.

Electronics

Old medical devices are donated to a non-profit organization at RH. On average, a dozen medical devices were donated per year. The type of medical devices was not obtained. Data was provided by Tyler Gibson. Given that the weight of different medical devices varies significantly, data from SPH is used to derive the weight of electronics at RH. Data from SPH is more reliable than data from VGH because it was provided by the vendor. The ratio of electronics per m^2 at SPH is 3631 kg/111921 m^2=0.032 kg/m^2. The weight of electronics at RH is estimated to be 0.032 kg/m^2 * 34076 m^2 = 1090.4 kg. The total annual weight of electronics is estimated to be 1090.4 kg.

Furniture

Furniture is recycled by Inner City Construction every month. There is one 30” roll-off bin. The monthly weight in January 2019 was 1,360 kg. Assuming the same amount are recycled every month, the total annual weight of furniture is estimated to be 16,320 kg. Data was provided by Manish Nigam.

Lighting

Lighting was recently replaced by LED lighting at RH. No lighting waste will be generated in the next years. Data was provided by Tom So.

Mattresses

Old mattresses are not recycled. Data was provided by Tom So.

Paint cans

There is no paint shop at RH. For small projects, the contractor recycles the paint cans. Data was provided by Tom So.

Pallets

Plastic pallets are returned to the warehouse for daily reuse. Wooden pallets are removed twice a month or as needed by a pre-arranged company for pick up. The quantity is not tracked. Data was provided by Susan Ho.

Printer Cartridge

Printer cartridges are recycled by Grand & Toy. The quantity is not tracked. Data was provided by Susan Ho.

Scrap Metal

Scrap metal is collected by the contractor or ends up in the garbage.

Summary Table

Table 4: Annual weight of other waste streams at RH

	Batteries	Reprocessed medical devices	Styrofoam	Shrink Wrap	Construction waste	Electronics	Furniture	Lighting	Mattresses	Paint cans	Pallets	Printer cartridge	Scrap metal
Is it recycled?	Yes	Yes	No	Yes	No	Yes	Yes	N/A (Use LED lights)	No	N/A	Yes	Yes	No
Estimate of annual weight (kg)	1303	394	N/A	N/A	N/A	1090	16320	N/A	N/A	No paint shop	N/A	N/A	N/A
Vendor	Call2 Recycle & Regional Recycling Richmond	Stryker Sustainability Solutions	N/A	House-keeping	Suppliers use their own bins	Non-profit organization	Inner City Construction	N/A	N/A	N/A	N/A	Grand & Toy	N/A
Data provider	Call2 Recycle & Tyler Gibson	Stryker Sustainability Solutions	Tom So	Susan Ho	Tom So	Tyler Gibson	Manish Nigam	Tom So	Tom So	Tom So	Susan Ho	Susan Ho	Tom So

UBC Hospital (UBCH)

By adding the data of other waste streams, the waste diversion rate increased from 41% to 43% (see Appendix A). A detailed description of each waste stream is in the section below. The total annual weight of each waste stream is summarized in Table 6: Annual weight of other waste streams at UBCH.

Batteries

Batteries are collected by Vancouver Battery on call. The batteries are collected about 6 times per year and about 400 lbs (181.4 kg) per pickup. The batteries collected are a combination of sealed lead-acid (about 75%), alkaline, and lithium. The total annual weight is 1089 kg. Data was provided by Danny Wong (danny@vancouverbattery.com).

Reprocessed medical devices

Reprocessed medical devices are collected by Stryker Sustainability Solutions. The total annual weight of reprocessed medical devices is 1,537 lb (697 kg). Data was provided by Stryker Sustainability Solutions.

Styrofoam

Styrofoam is not recycled. Data was provided by Paul Armstrong.

Shrink Wrap

Shrink Wrap is not recycled. Data was provided by Paul Armstrong.

Construction Waste

Construction waste is not managed by UBCH. The contractors bring their mixed garbage bins and manage their wastes. Data was provided by Paul Armstrong.

Electronics

Electronics are recycled, but the quantity was not tracked. Data was provided by Paul Armstrong.

Furniture

Furniture is recycled by Vancouver South Transfer Station every month. There is one 40” roll-off bin. The monthly weight in January 2019 was 1,570 kg. Assuming the same amount are recycled every month, the total annual weight of furniture is estimated to be 18,840 kg. Data was provided by Manish Nigam.

Lighting

Lighting tubes and bulbs are recycled. The recycling box of lighting bulbs is approximately $1m^3$. The recycling box of lighting tubes is approximately $0.28m^3$ (0.7m in length x 0.2 in width x 2m in height). The annual weight of each lighting category is listed in Table 5. Data from 2015 to 2019 is included inAppendix A . The total annual weight of lighting materials is 247.9 kg. Data was provided by Wayne Chisholm (wayne@productcare.org), the logistics & services manager at Product Care Recycling.

Table 5: Lighting materials recycled at UBC in 2018

Category	Weight per box (kg)	Number of boxes	Total weight (kg)
Bulb	20.4	1	20.4
4’ Ply-Plywood	79.4	0	0
Gaylord	226.8	0	0
4’ Lg tube	9.1	25	227.5
8’ tube	29.5	0	0
	Total	26	247.9

Mattresses

Old mattresses are not recycle. Data was provided by Paul Armstrong.

Paint cans

Paint cans are collected by Environmental Service Facilities on UBC campus. Approximately 60 to 70 paint cans are recycled every year. The total annual weight was calculated using the median number of paint cans recycled in one year (i.e., 65) multiply by the weight of an empty 1-gallon paint can (i.e., 0.34 kg; ICC Compliance Center Inc., 2019). Thus, the total annual weight of paint cans is 22.1 kg. Data was provided by Paul Armstrong.

Pallets

Pallets are not recycled at UBCH. On some occasions, the delivery truck driver picks up the pallets. Data was provided by Paul Armstrong.

Printer Cartridge

Printer cartridge is recycled in a small box. The quantity was not tracked. Data was provided by Paul Armstrong.

Scrap Metal

Scrap metal is collected by North Shore Metal Recycling twice a year. The total weight is estimated to be 1200 lbs (544 kg) per year. The scrap metal includes copper pipes, stainless steels, and brass pipes. Data was provided by Paul Armstrong.

Summary Table

Table 6: Annual weight of other waste streams at UBCH

	Batteries	Reprocessed medical devices	Styrofoam	Shrink Wrap	Construction waste	Electronics	Furniture	Lighting	Mattresses	Paint cans	Pallets	Printer cartridge	Scrap metal
Is it recycled?	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Estimate of annual weight (kg)	1089	697	N/A	N/A	N/A	N/A	18,840	247.9	N/A	22.1	N/A	N/A	544
Vendor	Vancouver Battery	Stryker Sustainability Solutions	N/A	N/A	N/A	N/A	Vancouver South Transfer Station	Light Recycle	N/A	Environmental Service Facility at UBC	N/A	N/A	North Shore Metal Recycling
Data provider	Paul Armstrong	Stryker Sustainability Solutions	Paul Armstrong	Paul Armstrong	Paul Armstrong	Paul Armstrong	Manish Nigam	Paul Armstrong	Paul Armstrong	Paul Armstrong	Paul Armstrong	Paul Armstrong	Manish Nigam

St. Paul's Hospital (SPH)

By adding the data of other waste streams, the waste diversion rate increased from 38% to 39% (see Appendix A . A detailed description of each waste stream is in the section below. The total annual weight of each waste stream is summarized in Table 8: Annual weight of other waste streams at SPH.

Batteries

Small size batteries are recycled by Call2Recycle. The annual weight of small size batteries collected by Call2Recycle was 834.6 kg in 2018. Large size batteries are currently in storage. A follow-up on the recycling process of large size batteries is necessary to obtain data.

Reprocessed medical devices

Reprocessed medical devices are collected by Stryker Sustainability Solutions. The total annual weight of reprocessed medical devices is 5,255 lb (2,384 kg). Data was provided by Stryker Sustainability Solutions.

Styrofoam

Styrofoam is collected by West Coast Plastics Recycling on call. According to West Coast Plastic Recycling, no Styrofoam has been picked up for the last few months. Data was provided by Berenice Vega (office@westcoastplasticrecycling.com), the office Administrator at West Coast Plastic Recycling Inc.

Shrink Wrap

Shrink wrap is collected by Waste Management. A request for data was sent to Waste Management.

Construction Waste

Construction waste is not managed by SPH. The contractors bring their mixed garbage bins and manage their wastes. Data was provided by Dave Marier.

Electronics

Electronics are collected by Urban Impact twice a year. The total weight in 2018 is 3,631 kg. The details are included in the table below. Data was provided by Urban Impact's customer service group (customerservice@urbanimpact.com).

Pick-up Date	Weight (kg)
July 9, 2019	1677
December 27, 2018	1671

June 19, 2018	1960

Furniture

Furniture is collected by Inner City Construction twice a month. There is one 30" roll-off bin. The monthly weight in January 2019 was 2,230 kg. Assuming the same amount are recycled every month, the total annual weight of furniture is estimated to be 26,760 kg using the monthly weight multiply by 12 months. Data was provided by Manish Nigam.

Lighting

Lighting materials are recycled by LightRecycle on call. The annual weight of each lighting category is listed in Table 5. Data from 2013 to 2019 is included inAppendix A . The total annual weight of lighting materials is 711.4 kg. Data was provided by Wayne Chisholm (wayne@productcare.org), the logistics & services manager at Product Care Recycling.

Table 7: Lighting materials recycled at SPH in 2018

Category	Weight per box (kg)	Number of boxes	Total weight (kg)
Bulb	20.4	9	183.6
4' Ply-Plywood	79.4	0	0
Gaylord	226.8	0	0
4' Lg tube	9.1	58	527.8
8' tube	29.5	0	0
	Total	67	711.4

Mattresses

Mattresses are recycled by Canadian Mattresses. A request for data was sent to Canadian Mattresses.

Paint cans

Data was not available.

Pallets

Pallets are recycled by Nick's Pallets. The contact information of Nick's Pallets is unavailable online.

Printer Cartridge

Printer Cartridge is recycled by Grand & Toy. A request for data was sent to Grand & Toy.

Scrap Metal

Scrap metal is collected by North Star Metal Direct every month. The monthly weight in January 2019 was 2,370 kg. The total annual weight of scrap metal is estimated to be 28,440 kg using the monthly weight multiply by 12 months. Data was provided by Manish Nigam.

Summary Table

Table 8: Annual weight of other waste streams at SPH

	Batteries	Reprocessed medical devices	Styrofoam	Shrink Wrap	Construction waste	Electronics	Furniture	Lighting	Mattresses	Paint cans	Pallets	Printer cartridge	Scrap metal
Is it recycled?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes
Estimate of annual weight (kg)	835	2384	N/A	N/A	N/A	3631	26760	711.4	N/A	N/A	N/A	N/A	28440
Vendor	Call2Recycle	Stryker Sustainability Solutions	Westcoast Plastics	Waste Management /Urban Impact	N/A	Urban Impact	Inner City Construction/ Waste Management	Light Recycle	Canadian Mattress	N/A	Nick's Pallets	Grand & Toy	North Star Metal Direct
Data provider	Call2Recycle	Stryker Sustainability Solutions	Dave Marier	Dave Marier	Dave Marier	Urban Impact	Manish Nigam/Dave Marier	Dave Marier	Dave Marier	N/A	Dave Marier	Dave Marier	Manish Nigam

Summary

Across the four visited sites, the waste diversion rate has significantly increased with additional waste streams. Specifically, the waste diversion rate increased by 3% at VGH, 2% at RH, 2% at UBCH, and 1% at SPH. These results reflect the importance of collecting data on waste streams besides the Blue Bin and Organics programs.

Moreover, this project aims to illuminate the process of data collection for each waste streams and identify the potential barriers. Among the 13 waste streams, batteries have two subcategories: small and large size. Small size batteries are collected by Call2Recycle, and a copy of data can be obtained from Call2Recycle. Large size batteries (e.g., lead batteries) are not collected by Call2Recycle, and each site has its method to recycle them. Regulating the vendor for large size batteries is necessary to facilitate data collection. Reprocessed medical devices' data is provided by Stryker Sustainability Solutions across all four sites. Styrofoam has been recycled at VGH and SPH. Shrink wrap has been recycled at VGH, RH, and SPH. Styrofoam and shrink wrap are mostly picked up by West Coast Plastic Recycling. Creating Styrofoam and shrink wrap recycling programs across all sites could be useful. Construction waste is managed by the contractors rather than the site. An ongoing project works with the contractors to track the recycling process of construction wastes. Electronics are currently recycled by the staffs at each site. Standardizing the vendors across sites could help to obtain the data.

Furniture data is included in Manish Nigam's data file. One caution is that furniture at some sites is sent to an incinerator. Developing a recycling/donation program for furniture is necessary. Most sites collaborate with LightRecycle to recycle lighting waste. A copy of the categories and the quantity of the lighting waste collected by LightRecycle is available on request. Switching to LED lighting products is an alternative option to reduce lighting waste given the longevity of LED lighting products. Mattresses are not recycled given the impossibility to reuse. Paint cans are only recycled at sites that own a paint shop. Empty printer cartridges are collected by companies that exchange them. Scrap metal data at some sites is included in Manish Nigam's data file. Other sites use different vendors. Given that VCH has implemented new regulations on the recycling process of scrap metal, standardizing the vendor for scrap metal is feasible. To sum up, large size batteries, electronics, furniture, lighting, and scrap metal are the five categories that could be tracked in the future. Standardizing the vendors for these categories across sites will be helpful to manage the waste.

There are two general observations in this project. First, the FMO manager is the best initial contact person to initiate the data collection. Although the FMO manager might not have the exact quantity of each waste stream being recycled per year, but the FMO manager could

provide the list of vendors collecting each waste stream at the site. Second, vendors are the most reliable source to obtain data on the yearly quantity and the frequency of pick-ups. Local vendors are faster in replying requests and sharing data than international companies. Collaborating with recycling companies in BC could facilitate data collection and support local businesses.

In future projects, other methods could be tested to collect data that is missing. The first method is to request a list of newly purchased items in a month from the inventory department. Normally, newly purchased items replace old items. Thus, the quantity of waste being generated in a month can be derived from the number of items being purchased in a month. The second method is to build a regression model that use the square footage, patient day, or staffed beds at each site to predict the quantity of waste generated at a site. There are two limitations to this method. First, it relies on a large dataset. In the current projects, only four sites were investigated. With data from more sites, the prediction will be more reliable. Second, it is based on the assumption that the larger the site is, the more waste is generated. The waste generated at one site also depends on the services that it provides, such as the number of operation rooms. Thus, using this method to predict the quantity of each waste stream at a new site needs to be cautious. The third method is to perform a one-month waste audit to examine how much waste is generated in a month, and how frequent each waste stream is picked up by the vendor. A downside of this method is that it requires a considerable amount of effort and time.

In conclusion, collecting data of other waste streams besides the Blue Bin and Organics program clarifies the waste diversion, and provides a broader view of the recycling process at each site. Despite several challenges during the data collection period, there are strategies to overcome these obstacles.

Recommendations

Recommendation to obtain data at a new site:

- Contact the FMO manager of each site to obtain the list of vendors
- If possible, ask the FMO manager to estimate the annual quantity for each stream
- Request the data from the vendors

Other general recommendations:

- Implement a recycling program for the waste streams besides the Blue Bin and Organics
- Require a yearly report from the vendors in the contract agreement
- Collaborate with the vendors and the site staffs to develop a method to track the quantity of waste before being removed
- If possible, standardize the vendors across the sites

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Appendices

Appendix A

Updated waste diversion rate table

Site	Type	Facility Area	Total weight (diversion)	Total weight (diversion plus)	Total diverted (r+o)	Total diverted plus	Blue Bin Diversion	Diversion Plus
SPH	Acute	111921	1500183.208	1534504.208	568693.208	603014.208	38%	39%
RHS	Acute	34076	778170.400	797288.800	391850.400	410968.800	50%	52%
UBCH	Acute	68705	698971.664	719867.664	285307.864	306203.864	41%	43%
VGH	Acute	259840	2715735.004	2861093.504	920062.504	1065421.004	34%	37%

Appendix B

WESTCOAST
PLASTIC RECYCLING INC
#215 7080 RIVER RD RICHMOND, V6X 1X5, CANADA
toll free: 1.866.660.1664 | office: 604.247.1664 | fax: 604.247.1674 | www.westcoastplasticrecycling.com

COMPANY: **Vancouver General Hospital**

ADDRESS: 899 West 12th

Date of Service	Physical Count	Commodity	Ticket Number	lbs/Diverted
6/25/2019	1 Bulk Bag	Styrofoam	Westcoast Ticket No. 56037	78
7/5/2019	3 Bulk Bags	Styrofoam	Westcoast Ticket No. 59682	239
SITE TOTAL				**317**

Appendix C

Lighting materials collected at Vancouver General Hospital by LightRecycle

Reference tables

CATEGORIES	IB PER BOX	KG PER BOX
Bulb boxes	45	20.4
4’ Ply-Plywood box	175	79.4
4’ lg tube box	20	9.1
Gaylord boxes	500	226.8
8’ tube boxes	65	29.5

Vancouver General Hospital

Fulls Product Care

Cost Of Completing Each Commercial Lamps Pickup

Shipper: LVEU - Brookfield JCI -Diamond Center-VGH

Date Picked Up	BOL No.	Depot No.	Consignee	Fulls Bulb	Fulls 4'Ply	Fulls Gayl	Fulls Fibr	Fulls 4'Lg	Fulls 8'Lg	M/T's Bulb	M/T's 4'Ply	M/T's Gayl	M/T's Fibr	M/T's 4'Lg	M/T's 8'Lg	M/T's Pall
Mar 1,2013	6617		Nu-Life Industries - CLOSE			3										
Mar 8,2013	6732		Nu-Life Industries - CLOSE			3										
Mar 15,2013	6782		Nu-Life Industries - CLOSE			2						4				
May 8,2014	10639		Nu-Life Industries - CLOSE	4												
Feb 11,2019	26552		Contact Environmental	14				65								
Total Shipments:		5		18.0		8.0		65.0		0		4		0		0
					0.0		0.0		0.0		0		0		0	

Fulls Product Care

Cost Of Completing Each Commercial Lamps Pickup

Shipper: LVEU - Vancouver General Hospital (Vcr Coastal Health)

Date Picked Up	BOL No.	Depot No.	Consignee	Fulls Bulb	Fulls 4'Ply	Fulls Gayl	Fulls Fibr	Fulls 4'Lg	Fulls 8'Lg	M/T's Bulb	M/T's 4'Ply	M/T's Gayl	M/T's Fibr	M/T's 4'Lg	M/T's 8'Lg	M/T's Pall
Jul 2,2013	7771		Nu-Life Industries - CLOSE	10						10		3			1	
Feb 21,2014	9973		Nu-Life Industries - CLOSE			2				5						
Aug 25,2014	11497		Nu-Life Industries - CLOSE	7		2				16		2				
Nov 7,2014	12213		Nu-Life Industries - CLOSE	1		2				2		2				
Mar 2,2015	13245		Nu-Life Industries - CLOSE	5	3	1				2		1				
Jul 21,2015	14435		Nu-Life Industries - CLOSE	2		2				4		2				
Nov 24,2015	15503		Nu-Life Industries - CLOSE	3		1										
Mar 22,2016	16752		Nu-Life Industries - CLOSE	2		2			1							
Aug 2,2016	17959		Nu-Life Industries - CLOSE	2		2				4		2				
Apr 1,2017	20302		Nu-Life Industries - CLOSE	2		3		2	9	2		2				
Nov 20,2017	22376		Nu-Life Industries - CLOSE	5		3		8	7	8		6				
May 30,2018	24188		Nu-Life Industries - CLOSE	4		4		3	15	16		5				
Jan 16,2019	26293		Contact Environmental	2		4			7	15		5				
Total Shipments:		13		45.0		28.0		13.0		84		30		0		0
					3.0		0.0		39.0		0		0		1	

UBC Hospital

Fulls Product Care

Cost Of Completing Each Comr

Shipper: LVEU - UBC Hospital (Vancouver Coastal Health)

Date Picked Up	BOL No.	Depot No.	Consignee	Fulls Bulb	4'Ply	Gayl	Fibr	4'Lg	8'Lg
Oct 23,2015	15266		Nu-Life Industries			1			
May 17,2016	17372		Nu-Life Industries	1					
Jan 13,2017	19517		Nu-Life Industries					27	
Aug 1,2017	21369		Nu-Life Industries	1				24	
Jun 22,2018	24408		Nu-Life Industries	1				25	
Feb 6,2019	26531		Contact Environmental					10	1
Jun 13,2019	27622		Contact Environmental			1		7	1
Total Shipments:		7		3.0		2.0		93.0	
					0.0		0.0		2.0

St Paul's Hospital

Fulls Product Care

Cost Of Completing Each Comr

Shipper: LVEU - St Paul's Hosptial / Providence Health Care

Date Picked Up	BOL No.	Depot No.	Consignee	Fulls					
				Bulb	4'Ply	Gayl	Fibr	4'Lg	8'Lg
Jul 25,2013	7980		Nu-Life Industries						
Mar 3,2015	13266		Nu-Life Industries	12				33	
Nov 2,2015	15253		Nu-Life Industries	9					
Mar 9,2016	16722		Nu-Life Industries	3					
Sep 9,2016	18324		Nu-Life Industries	2				57	
Jan 4,2017	19393		Nu-Life Industries	1				35	
Apr 12,2017	20420		Nu-Life Industries	9				52	
Sep 22,2017	21845		Nu-Life Industries	8				53	
Apr 10,2018	23722		Contact Environmental	7				30	
Jul 18,2018	24621		Contact Environmental	2				28	
Nov 6,2018	25628		Contact Environmental					41	
Jan 9,2019	26230		Contact Environmental	5				26	
Jun 5,2019	27534		Contact Environmental	4				15	
Total Shipments:		13		62.0		0.0		370.0	