Resource for Greening General Medical and Surgical Hospitals
Pollution Prevention Information

Version 1.0
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Greening General Medical and Surgical Hospitals

Toronto's ChemTRAC program includes an Environmental Reporting and Disclosure Bylaw (Municipal Code Chapter 423) that requires local businesses to track and report their use and release of 25 priority substances. The ChemTRAC program provides an opportunity for you to identify strategies for improving your environmental performance. Strategies include those that reduce the use and release of the 25 priority substances. Strategies may also reduce the use and release of other chemicals that may have a health and/or an environmental impact. This Greening Resource for Medical and Surgical Hospitals will help you understand the chemicals that you are using and find ways to reduce or eliminate their use. For additional resources, including a Guide to Reporting, visit http://www.toronto.ca/chemtrac/.

General Medical and Surgical Hospitals

This business sector is made up of hospitals that are responsible for providing diagnostic and medical treatment to in-patients subject to a wide variety of diseases or medical conditions. These facilities also provide a number of additional services that include diagnostic x-ray series, clinical laboratory services, pharmacy services and out-patient services.

Priority Substances

Toronto Public Health has identified 25 substances of priority health concern that are commonly used and released by businesses in the City of Toronto. As part of ChemTRAC, the Environmental Reporting and Disclosure Bylaw requires businesses and facilities to track and report on any of the listed priority substances that a facility manufactures, uses or releases to the environment if the amounts are equal to or above the reporting limits. In addition to the priority substances, general medical and surgical hospital facilities commonly use and release other chemicals of concern that may have a health and/or an environmental impact that are not subject to the by-law.

Medical and Surgical Hospitals may use and produce some of these priority substances and other chemicals of concern. Each of these chemicals may have an impact on human health and/or the environment. Below are the priority substances and other chemicals of concern that may be used or produced by your facility and its operation.

Substances that may be used or produced by your hospital and its general operations

Chemical Sources	Priority Substances Tracked by ChemTRAC	Other Chemicals of Concern*

Pharmacies may use or produce:	• Heavy Metals
	  - Mercury
	  - Cadmium
	  - Chromium
	• Chloroform
	• Formaldehyde
	• Volatile Organic Compounds[1] (VOCs) (solvents)
		• Arsenic
		• Dichlorodifluromethane
		• Trichloromonofluoromethane
		• Thimerosal (mercury containing)

Central Sterile Reprocessing and Distribution (CSRD) may use or produce:	• VOCs (xylene, toluene)
	• Formaldehyde[2]
	  - Glutaraldehyde
	  - Ortho-phthalaldehyde
	• Chloroform
	• Heavy Metals
	  - Mercury
	  - Lead
		• Ethylene oxide (a common gas-phase disinfectant that is widely used in hospitals to sterilize heat-sensitive tools and equipment)
		• Bio-hazardous waste

Surgical procedures may use or produce:	• Heavy Metals - Lead • Chloroform • Formaldehyde • Methylene chloride • Trichloroethylene • Nitrous oxides • VOCs (xylene, toluene)	• Phenol • Collodion • Bio-hazardous waste • Compressed gases

Waste treatment may produce:	• Heavy Metals
	  - Cadmium
	  - Lead
	  - Mercury
	• Solvents
	• PAHs
	• Particulate Matter 2.5[3] ($PM_{2.5}$)
		• Radioactive waste

Laboratories and Diagnostics	Please refer to Toronto Public Health's *Resource for Greening Medical Laboratories*	
Laundry	Please refer to Toronto Public Health's *Resource for Greening Commercial Launderers*	

Notes:

* Chemicals that may have a health and/or an environmental impact.

1. VOCs are emitted as gases from certain solids or liquids. Smog forms when VOCs are combined with nitrous oxides (NOx) in sunlight.
2. Glutaraldehyde and Ortho-phthalaldehyde are industry specific sub-forms of formaldehyde which are used in sterilization processes specific to medical facilities.
3. Particulate matter (PM) consists of airborne particles in solid or liquid form (e.g., dust). $PM_{2.5}$ is airborne particulate matter with a mass median diameter less than 2.5 µm.

Understanding Your Company's Impacts: Medical and Surgical Hospitals

In medical and surgical hospitals, there are several activities or processes that may contribute to the use and release of priority substances and other chemicals of concern. The use and release of chemicals depends on the type of process, as well as the equipment and chemicals that are used.

The day-to-day operation of hospitals consists of a variety of procedures that differ based on hospital size, specialty and location. It addition to medical treatment and surgical procedures, hospitals typically provide laundry services, pharmaceutical services and laboratory services for patients. Central sterile reprocessing and distribution units provide an essential service and are commonly found in hospital facilities. Additionally, waste treatment facilities are common within medical facilities and are responsible for the treatment of various chemicals of concern.

Given the variety of processes that are performed in hospitals, many different chemicals are used. The following document will summarize the main sources of pollution in each of the processes or departments listed below:

Pharmacy Services (Figure 1)

Chemical waste is generated through expired, unused or partially used pharmaceutical drugs and treatments. Chemotherapy products and their associated containers must be managed with care and disposed of as hazardous waste, such as radioactive isotopes for diagnostics.

Central Sterile Reprocessing and Distribution Units (CSRDU) (Figure 2)

CSRDU units are responsible for providing sterilized surgical instruments to various hospital departments. Priority substances are most likely to be found in the form of sterilization and disinfecting chemicals, along with wastewater from steam sterilizers (autoclaves) and chemical treatment (steris, sterrad) units.

Surgical Procedures (Figure 3)

The equipment and instruments used during surgery often contain batteries, which are a significant source of heavy metal in hospitals. Anesthesia services may generate waste gases and produce used gas cylinders that require specialized disposal procedures. Hazardous chemicals such as formaldehyde or formalin, which are used for preservation of tissue samples, are also a concern.

Waste Treatment (Figure 4)

Waste treatment may take place onsite or it may be outsourced to a third party. The primary chemicals of concern are released through air emissions generated from incinerators and autoclaves used in the disposal of solid and bio-hazardous waste.

Laboratory Services

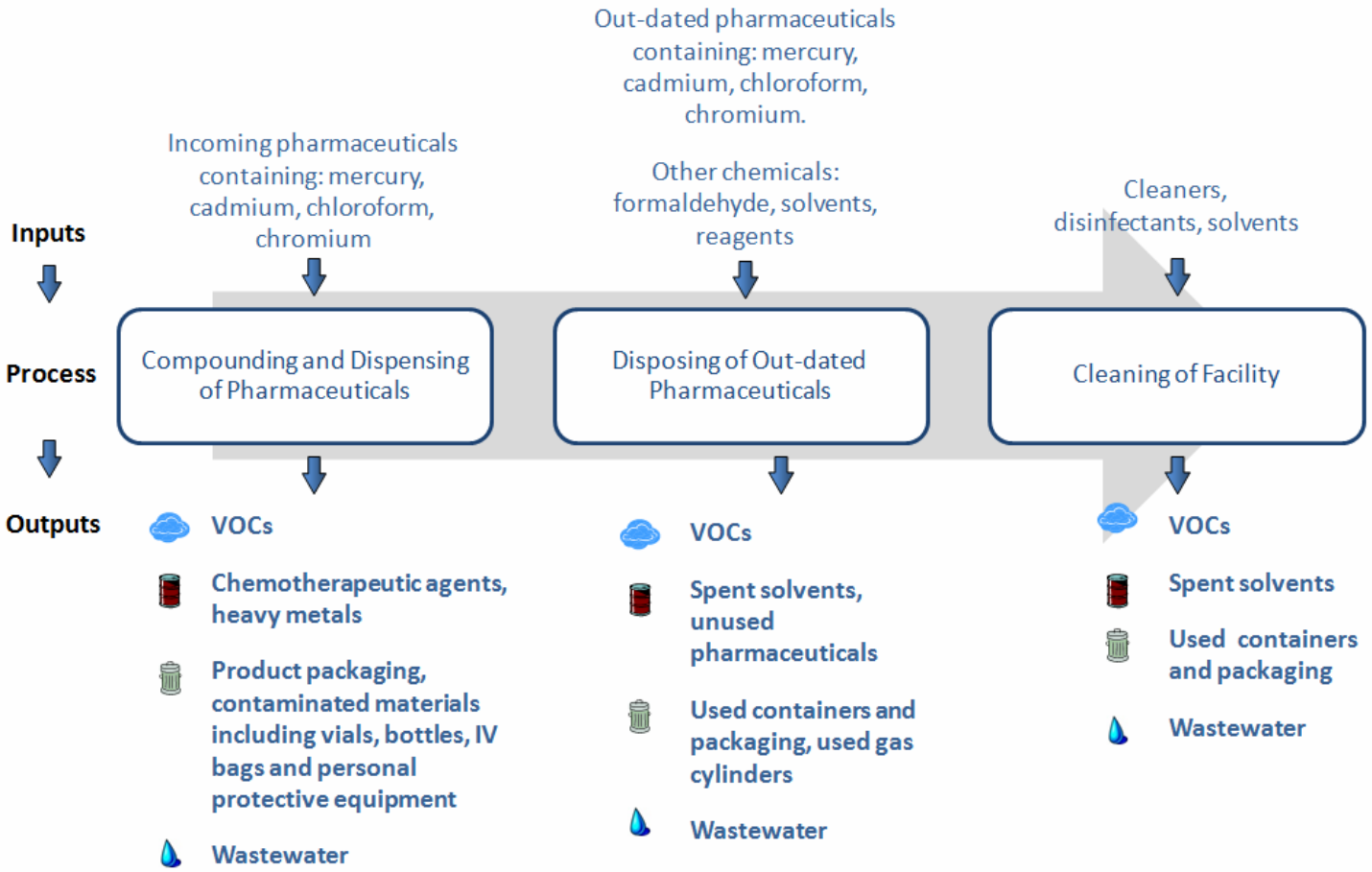
Given the variety of processes that are performed in medical laboratories, many different chemicals are used. By volume, xylene (a volatile organic compound or VOC) and formalin (an aqueous solution of formaldehyde) are the most common chemicals used in medical laboratories. Air emissions are also a concern, as chemicals and VOCs evaporate during use. Water emissions are another primary concern, since chemicals are often diluted prior to sewer disposal. Please refer to Toronto Public Health's *Resource for Greening Medical Laboratories* for detailed information regarding pollution prevention in medical laboratories.

Laundry Services

It is common to contract laundry services to off-site locations, though such facilities may still exist within some hospitals. Industrial detergents and disinfectants are used when processing linens that may be contaminated by blood and other bio-hazardous wastes. Please refer to Toronto Public Health's *Resource for Greening Commercial Launderers* for detailed information regarding pollution prevention in laundry facilities.

The following diagrams show the raw materials that may go into each process and the pollution that comes out of each process. This guide outlines the general processes for medical and surgical hospitals. Your facility may have more specialized processes or only engage in some of these processes; however, it is possible that these priority substances and chemicals of concern may still be present. Symbols show whether the wastes typically go to air, landfill, sewer systems and/or treatment facilities (as liquid or hazardous wastes).

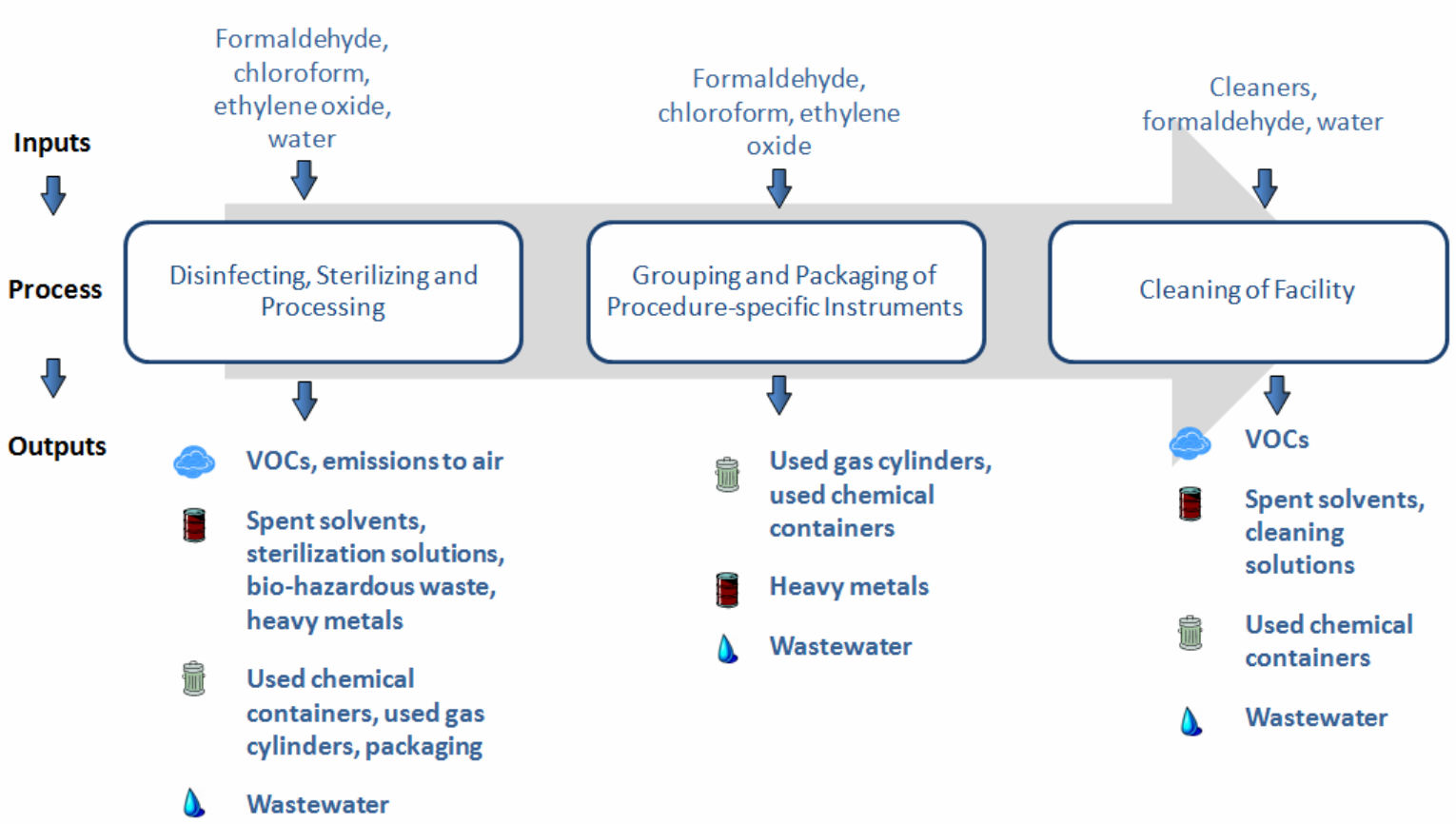
Figure 1: Pharmacy Processes



Symbols used in the flow diagram

Air emissions | Landfill wastes | Wastewater (sewers) | Liquid or hazardous wastes

Figure 2: Central Sterile Reprocessing and Distribution Processes



Symbols used in the flow diagram

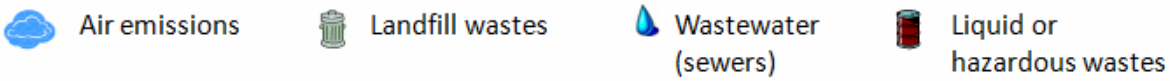
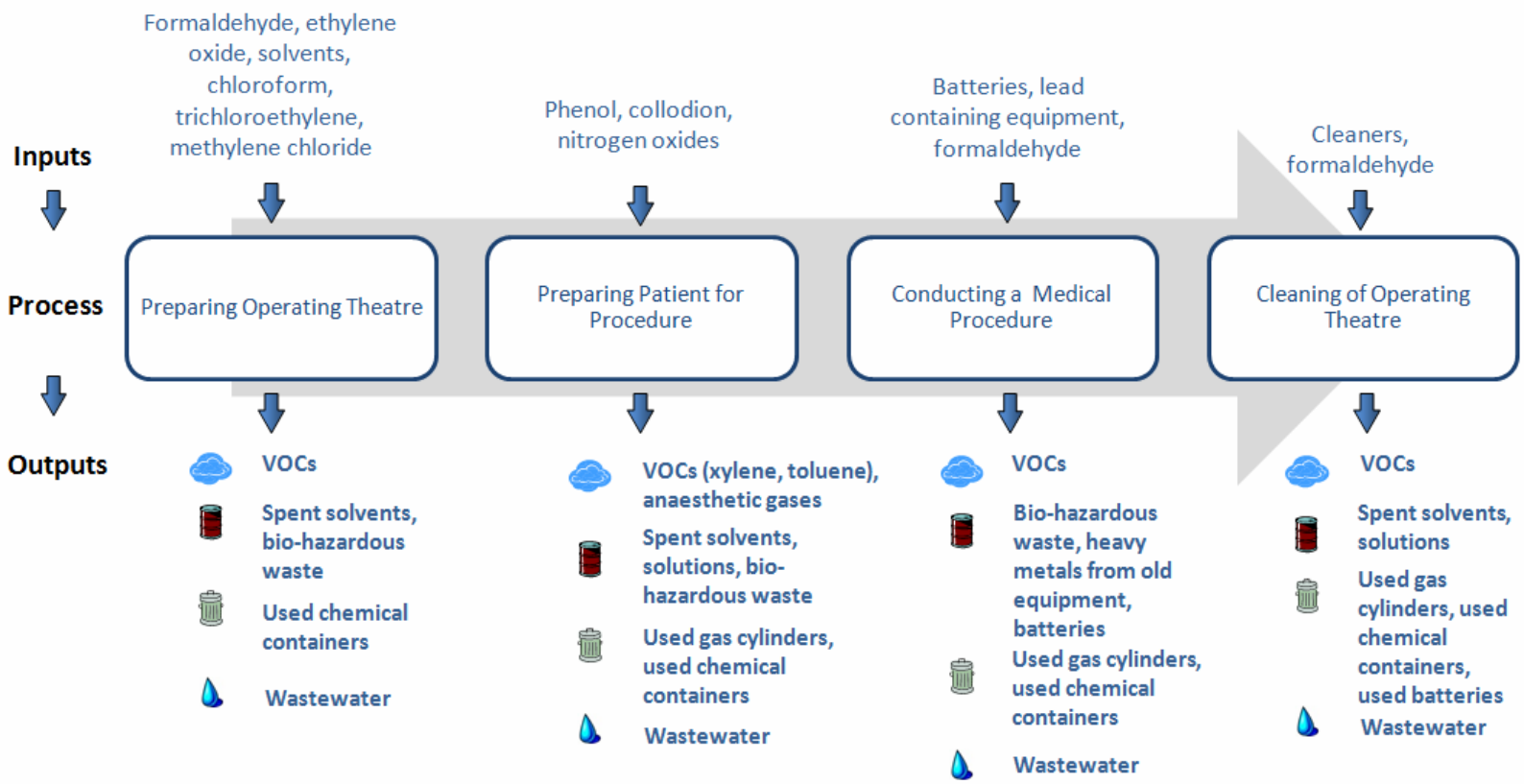


Figure 3: Surgical Procedure Processes



Symbols used in the flow diagram

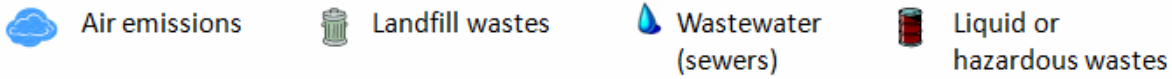
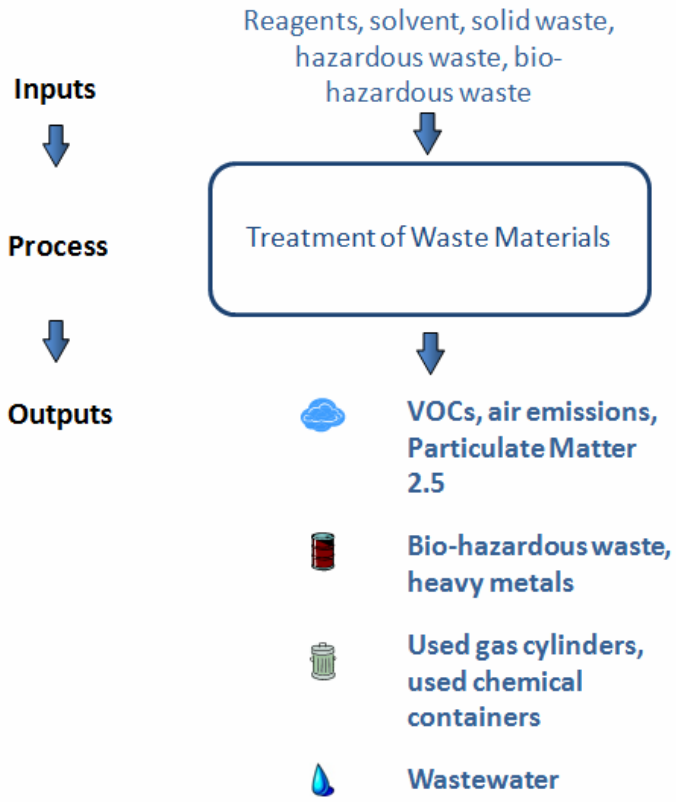
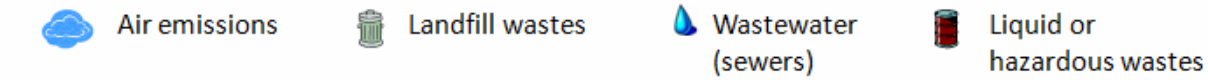


Figure 4: Waste Treatment Processes



Symbols used in the flow diagram



Pollution Prevention Steps You Can Take

This resource identifies steps you can take to reduce or eliminate your use of the priority substances and other chemicals of concern, and to prevent pollution in medical and surgical hospitals.

The pollution prevention measures identified in this information sheet can reduce costs and/or increase profits. 

Pollution Prevention Assessments – A Good First Step

Before you go too far with any given measure, you may want to do a Pollution Prevention Assessment of your business. You may need an outside expert to help. A typical Pollution Prevention Assessment will include mapping process flows, reviewing equipment uses, evaluating the way you use and store chemicals, evaluating the way you use energy, as well as reviewing waste handling practices and discharges. This assessment helps you to identify many pollution prevention opportunities (and any regulatory compliance issues) and decide which steps to take first.

Pollution Prevention - A Key to Good Management

Good management of your chemical purchases, chemical use and waste disposal is very important. You can improve your environmental performance through Pollution Prevention by:

- identifying how you are using the priority substances and other chemicals of concern that may have a health and/or an environmental impact
- figuring out how much you are using of each chemical and estimating the related emissions (see the earlier description for more information on how to estimate chemical use and emissions)
- discussing the options to reduce or to eliminate these chemicals and, where feasible, taking action. Actions could include:
    - using a different product
    - changing how you apply or clean up the chemical product/waste
    - training staff on how best to apply and clean up the chemical product/waste, or
    - installing new technology
    - maintaining equipment to ensure that leaks and general efficiencies are managed
- tracking the amount of chemicals you use and see if it goes down over time, and
- reviewing progress and identifying whether or not you need to make changes to the company's practices and procedures.

Changes you could make in your facility

The following table lists many options to help you reduce or stop using the priority substances and other chemicals of concern. Some measures will cost more than others, and some will be easier to implement than others. Employees can implement certain measures by making minor shifts in their day-to-day approaches; others will require management to invest in new technologies.

The table provides a quick and simple way to take stock of what measures your business has already put into place and those measures that your business could apply. In completing the table, you are

encouraged to prioritize the actions you would take. While it is not exhaustive, the table identifies many pollution prevention opportunities for hospitals. When assessing the options, please consider your facility-specific conditions and how each option might affect pollution releases to the air, land and water.

The table identifies three general types of options and distinguishes each with a symbol:

Low-cost, good operating procedures – These measures involve operational and managerial changes that can reduce chemical use. They include simple changes to normal practices, process improvements, as well as training and good housekeeping opportunities. This measure does not need new technology purchases.

Choosing an alternative chemical – These measures involve replacing traditional products (such as solvents and cleaning products) with products that have less harmful properties. The ease and cost of these measures depends on the product and the process used.

New technology or system – These measures involve the installation of a new system, machine or process. The cost varies depending on the technology / system.

See ***More Resources*** for a list of additional resources related to pollution prevention in medical and surgical hospitals.

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Pharmacy Services							
Select products with less packaging. Any packaging that comes in contact with a chemical of concern must be treated as hazardous waste.		☐	☐	☐	H	M	L
Select products without preservatives whenever possible.		☐	☐	☐	H	M	L
Minimize the use of thimerosal (contains mercury). Check manufacturers' website and group purchasing organization (GPO) to see if mercury free alternatives are available.		☐	☐	☐	H	M	L
Consider single dose containers that do not need a preservative. Alternatively, if single dose containers are not available, consider purchasing drugs with the longest possible shelf life available to reduce the amount of unused or wasted product.		☐	☐	☐	H	M	L
Maximize the use of opened chemotherapy vials.		☐	☐	☐	H	M	L
Examine the size of containers relative to use and ensure packaging reflects the amount of medication dispensed.		☐	☐	☐	H	M	L
Use non-PVC containing IV sets when incineration is the required form of disposal (i.e., bio-hazardous waste).		☐	☐	☐	H	M	L
Centralize the chemotherapy compounding location to reduce the amount of contaminated holding, sorting and preparing items.		☐	☐	☐	H	M	L
Review inventory controls to minimize outdated products.		☐	☐	☐	H	M	L
Monitor the expiry dates of emergency syringes and supplies. Once general crash cart supplies are within three months of expiration, transfer these items to the emergency department for rapid use.		☐	☐	☐	H	M	L
Use pharmaceutical dispensing labels when prescribing in-patient medications to reduce the amount of unused medication returned to the pharmacy for destruction and disposal.		☐	☐	☐	H	M	L
Central Sterile Reprocessing and Distribution (CSRD)							
Monitor and treat water discharged from autoclaves (steam sterilizers).		☐	☐	☐	H	M	L
Reduce duplicate items in admissions kits.		☐	☐	☐	H	M	L
Utilize sharps containers only for the prescribed items, reducing the need to replace and dispose of the hard container. Collect sharps in leak-proof, puncture-resistant, cadmium-free containers.		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Use cadmium-free red bags to collect bio-hazardous waste.		☐	☐	☐	H	M	L
Ensure that formalin or formaldehyde has been decanted from specimens prior to disposal.		☐	☐	☐	H	M	L
Optimize the use of ethylene oxide as a sterilizing agent.		☐	☐	☐	H	M	L
Eliminate the use of mercury-containing instruments and chemicals.		☐	☐	☐	H	M	L
Reuse and adapt lead-shielding material for other uses within the radiology department.		☐	☐	☐	H	M	L
Replace formaldehyde-based disinfectants (such as glutaraldehyde and ortho-phthalaldehyde) with a solution of peracetic acid, acetic acid and hydrogen peroxide when possible.		☐	☐	☐	H	M	L
Store formaldehyde-based cleaning solutions and specimens in secondary containment or on secured shelving and away from sinks.		☐	☐	☐	H	M	L
Use alternative methods of sterilization instead of formaldehyde (such as solutions of peracetic acid, acetic acid and hydrogen peroxide; steam; sonic sterilization).		☐	☐	☐	H	M	L
Purchase formalin in a variety of bottle sizes, which allows the technician to select the most appropriate size, reducing the amount used and waste generated.		☐	☐	☐	H	M	L
Distill chemicals to separate xylene and formaldehyde from liquids so that they may be reused and/or recycled.		☐	☐	☐	H	M	L
Whenever possible, replace mercury-containing equipment with equipment that does not contain mercury (e.g., replace mercury thermometers with alcohol (red) and/or digital thermometers).		☐	☐	☐	H	M	L
Minimize the strength of formaldehyde solutions.		☐	☐	☐	H	M	L
Surgical Procedures							
Use reverse osmosis water treatment to reduce dialysis cleaning demands.		☐	☐	☐	H	M	L
Use calibrated solvent dispensers for routine tests.		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Substitute electronic sensing devices for mercury-containing devices.		☐	☐	☐	H	M	L
Employ low leakage work practices to reduce the amount of wasted anesthetic gas (e.g., use a selective adsorption canister to allow for GHG emission reductions)		☐	☐	☐	H	M	L
Maintain anesthetic equipment properly to avoid leaks.		☐	☐	☐	H	M	L
Maintain and inspect ethylene oxide sterilizers regularly.		☐	☐	☐	H	M	L
Use physical instead of chemical cleaning methods.		☐	☐	☐	H	M	L
Use reusable or rechargeable batteries wherever possible.		☐	☐	☐	H	M	L
Waste Treatment							
Optimize the use of incineration to help reduce air emissions.		☐	☐	☐	H	M	L
Collect and recycle solvents.		☐	☐	☐	H	M	L
Send mercury-containing products/instruments for reclamation.		☐	☐	☐	H	M	L
Return gas cylinders to vendor for recycling.		☐	☐	☐	H	M	L
Return chemical containers for reuse where possible.		☐	☐	☐	H	M	L
Neutralize acid waste with basic waste.		☐	☐	☐	H	M	L
Food Services							
Use dry caustic peeling to peel fruits and vegetables and minimize caustic solution use and wastewater production.		☐	☐	☐	H	M	L
Maintain deep-frying oil at the standard operating temperature (180℃) to increase the life of the oil being used and to reduce air emissions.		☐	☐	☐	H	M	L
Place catch pans or other containment devices near hydraulic lifts, liquid drum storage or dry product storage to contain overflows and leaks.		☐	☐	☐	H	M	L
Pre-soak soiled surfaces prior to cleaning to loosen dirt or food residues and to minimize water and cleaning product usage.		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Substitute less harmful cleaning products, such as water-based biodegradable cleaners.		☐	☐	☐	H	M	L
Clean equipment immediately after use to prevent food from hardening on equipment and to reduce the amount of water and cleaning product needed.		☐	☐	☐	H	M	L
Use dry (waterless) cleaning methods, such as sweeping prior to water clean-up, to reduce water and cleaning product usage.		☐	☐	☐	H	M	L
Use low-pressure foam cleaning (foam soak, followed by low pressure rinse) to minimize detergent, water and energy use.		☐	☐	☐	H	M	L
Use clean-in-place systems and program systems to use only the amount of water and detergent required for particular cleaning tasks.		☐	☐	☐	H	M	L
Use high pressure, low volume spray washes to reduce water usage and wastewater.		☐	☐	☐	H	M	L
Use compressed air to clean equipment rather than water and cleaning products.		☐	☐	☐	H	M	L
Clean equipment with steam to reduce water and cleaning product usage.		☐	☐	☐	H	M	L
Store cleaners, disinfectants and pesticides away from food preparation areas.		☐	☐	☐	H	M	L
Send greases to a recycling facility.		☐	☐	☐	H	M	L
Facility Maintenance, Management and Good Housekeeping							
Purchasing and Inventory							
Review suppliers' products regularly and select the most environmentally-responsible products when available.		☐	☐	☐	H	M	L
Keep an accurate inventory of products used (including chemical name, manufacturer, and MSDS sheet).		☐	☐	☐	H	M	L
Order product containers sized for minimum storage time to reduce waste from expired products.		☐	☐	☐	H	M	L
Work with suppliers to take back unused product.		☐	☐	☐	H	M	L
Apply in-house procedures for the safe receipt and handling of chemicals used for cleaning and equipment repair and maintenance.		☐	☐	☐	H	M	L
Cleaning							
Substitute cleaning products for less harmful cleaning products, such as water-based biodegradable cleaners (no-VOC or low-VOC) or use recyclable solvents.		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Keep track of solvent use by process to identify sources of excessive use and waste.		☐	☐	☐	H	M	L
Improve manual cleaning practices: • Only use as much solvent/cleaning agent as needed; do not excessively soak rags or cloths in solvent. • Use a spray bottle or plunger.		☐	☐	☐	H	M	L
Either launder towels on-site to recover solvent, or collect and send to an industrial laundry facility off-site.		☐	☐	☐	H	M	L
Do not allow rags to dry before being placed in collection cans. Keep lids on cans to stop the VOCs from going into the air.		☐	☐	☐	H	M	L
Regularly maintain and clean equipment to reduce cleaning effort, to extend equipment life, and to reduce solvent use.		☐	☐	☐	H	M	L
Solvent recovery							
Reuse solvents or purchase solvents from a company that will pick up and recycle the spent solvent.		☐	☐	☐	H	M	L
Storage							
Store chemicals according to need, with minimum inventory kept on hand.		☐	☐	☐	H	M	L
Do not store hazardous material near floor drains.		☐	☐	☐	H	M	L
Store chemicals according to manufacturer's recommendations.		☐	☐	☐	H	M	L
Use secondary containment for liquid storage.		☐	☐	☐	H	M	L
Keep solvent, chemicals, stain, etc. containers tightly covered at all times. Storing liquids properly reduces air emissions and waste products.		☐	☐	☐	H	M	L
Eliminate all open buckets. Provide solutions in easily-used, closed containers.		☐	☐	☐	H	M	L
Date containers when opened to ensure you use them before products expire. Recycle empty containers.		☐	☐	☐	H	M	L
Mark all containers to identify the contents to avoid improper handling or disposal.		☐	☐	☐	H	M	L

Pollution Prevention Opportunities	Type of Activity	Is the opportunity in place? Yes	No	N/A	If 'No', indicate the level of priority for action (High, Medium or Low)		
Training							
Ensure employees are properly trained (WHMIS).		☐	☐	☐	H	M	L
Train workers to follow the standard work procedures (such as cleaning and set up), good housekeeping, and correct material handling methods to make sure all operators follow the same steps to reduce chemical use and waste.		☐	☐	☐	H	M	L
Ensure that personnel know the constituents of each reagent used, as well as the proper disposal method.		☐	☐	☐	H	M	L
Spills							
Use spigots and pumps when dispensing new materials and funnels when transferring wastes to storage containers to reduce possibilities of spills.		☐	☐	☐	H	M	L
Develop a spill response plan and post it so that it is available for all employees.		☐	☐	☐	H	M	L
Make spill kits available at the chemical storage rooms or racks for easy access.		☐	☐	☐	H	M	L
Train workers in emergency spill response.		☐	☐	☐	H	M	L
Other							
Ask employees for pollution prevention suggestions.		☐	☐	☐	H	M	L

Contact us to provide your feedback on this resource or to suggest any additional pollution prevention resources (email chemtrac@toronto.ca or call 416-338-7600).

More Resources

General Resources

California Environmental Protection Agency. 1998. Pollution Prevention Guide for Hospitals.
http://www.c2p2online.com/documents/P2guideforhospitals.pdf

- Extensive guidance on waste minimization throughout medical facilities and laboratories including radiology and radiation therapy.
- Summary of the potential cost savings associated with waste minimization.
- Case studies to illustrate examples.

Canadian Pollution Prevention Information Clearing House (CPPIC). 2010. Home Page.
http://www.ec.gc.ca/cppic/En/index.cfm

- The CPPIC provides a comprehensive list of pollution prevention resources for Canadian sectors and industries, such as best management practices, fact sheets and sector profiles. Conduct a 'Sector Search' to find resources most relevant to your industry (Hospitals are found under the 'Health Care and Social Assistance' sector link).

Environmental Protection Agency. 2005. Profiles of the Healthcare Industry.
http://www.gha.org/Regulatory/EPAFiles/EPAProfile.pdf

- Summarizes the primary sources of pollution and pollution prevention opportunities.
- Categorizes pollution prevention opportunities by waste type.

Hancock, Trevor. 2001. The Canadian Coalition for Green Health Care. Doing Less Harm – Assessing and Reducing the Environmental and Health Impact of Canada's Health Care System.
http://www.c2p2online.com/documents/CCGHC_DoingLessHarm.pdf

- Summary of waste reduction strategies.
- The business case for greener hospitals.

Practice Green Health.
http://www.practicegreenhealth.org/educate/

- An industry website dedicated to sharing information around sustainable hospital practices offering technical guidance to reduce the environmental impacts of medical facilities.

Food Services

ARAMARK Canada Ltd. 2009. Strategies to Reduce Waste in Patient Food Services.
http://greenhealthcare.ca/downloads/H2010102%20Waste%20Reduction%20Research%20Paper.pdf

- Outlines waste reduction strategies in the food services sector of healthcare. There are tools in this guide which would be of use to hospital managers:
    - Waste production survey
    - List of waste reduction strategies

Environmental Protection Agency. 1998. Case Study: Food Discard Recovery
http://www.epa.gov/osw/wycd/food/food2.pdf

- The document summarizes the cost savings resulting from the implementation of a pre-consumer food discard program at Fletcher Allen Hospital in Burlington, Vermont.

Pharmacies

Hospitals for a Healthy Environment. 2006. Managing Pharmaceutical Waste: A 10-Step Blueprint for Health Care Facilities In the United States.
http://www.h2e-online.org/docs/h2epharmablueprint41506.pdf

- An in-depth document which details the challenges and solutions to reducing waste produced through the pharmaceutical functions at hospitals.
- This guide offers step by step implementation strategies and is aimed at the operations manager.

Smith, Charlotte. Journal of the Pharmacy Society of Wisconsin. 2002. MANAGING PHARMACEUTICAL WASTE – What Pharmacists Should Know.
http://www.h2e-online.org/docs/h2epharmablueprint41506.pdf

- A summary of the waste streams generated from pharmacies and potential sources of chemicals of concern.
- Suggested management methods for hazardous waste generated.
- Listing of chemicals of concern generated through pharmacy operations.

Central Sterile Reprocessing & Distribution Unit

Pacific Northwest Pollution Prevention Resource Centre. 2004. P2 for Hospital Sterilizers: P2 Opportunities.
http://www.pprc.org/hubs/subsection.cfm?hub=1008&subsec=13&nav=13&CFID=2813115&CFTOKEN=90825344

- Provides a detailed list of the pros and cons of alternative sterilization options.

Waste Management

Minnesota Office of Environmental Assistance. 1992. Waste Source Reduction: Hospital Case Study
http://www.bvsde.paho.org/bvsacd/cd37/12388.pdf

- Case study of Itasca Medical Centre.
- Report of quantifiable savings and waste diversion rates.

Environmental Protection Agency. 1990. Guides to Pollution Prevention – Selected Hospital Waste Streams.
http://www.c2p2online.com/documents/hospitalwastestreams.pdf

- Description of the hospital waste profile and associated waste minimization options.
- Includes waste minimization worksheets.

Medical Industry Waste Prevention Round Table Website Resource List.
http://www.pprc.org/mirt/topics/chemmgmt.cfm

- Detailed web resource which links to a number of documents which outline chemical minimization and substitution.

Solid and Hazardous Waste Education Centre – Waste Education Series. University of Wisconsin. Hospital Waste Reduction Checklist.
http://www3.uwm.edu/Dept/shwec/publications/cabinet/pdf/425-9602.pdf

- Provides a checklist for operations managers.
- Waste reduction activities are outlined for each type of problem in a number of different hospital departments including: Medical Waste Administration; Materials Management; Housekeeping; Facilities; Laboratories; Central Sterilization; Hemodialysis; Radiology; Radiation Therapy; Nursing and Patient Care; Physicians; Pharmacy.