

## Safe Handling and Disposal of Antineoplastic and Other Drugs

Antineoplastic and cytotoxic drugs used for cancer chemotherapy and *in vivo* and *in vitro* research can be mutagens, teratogens, or carcinogens, and cause serious health effects when not handled properly. Risk varies with the specific drug and its concentration, as well as with the frequency of use and duration of exposure. Concern has therefore been raised regarding potential hazards to personnel who handle these drugs.

Follow the precautions identified here when working with these materials to minimize the exposure and thus the risk. Everyone who works with antineoplastic or chemotherapeutic agents must be aware of the health and physical hazards of the agents; the appropriate work practices and personal protective equipment used to mitigate the hazards; emergency procedures and the signs and symptoms associated with accidental exposure. This information can be found on the Safety Data Sheet (SDS). Lab staff must read Safety Data Sheets (SDS) prior to working with antineoplastic agents to understand the risks and steps they need to take to reduce their risk of exposure.

Both federal and state laws regulate the disposal of hazardous wastes. These wastes are generally referred to as "RCRA-regulated" wastes because they possess specific properties and their disposal is regulated under the federal Resource Conservation and Recovery Act, 1976. They become wastes when they are either spent (i.e. a partially full vial, left overdose, etc.) or are intended for disposal (i.e., unused but expired) and must be managed in compliance with both federal and state statutes.

### Responsibilities

- Environmental Health and Safety is responsible for:
  - Evaluating Risk Assessments for antineoplastic and other hazardous drugs and making recommendations where appropriate
  - Investigating accidental exposures
  - Maintaining employee exposure records
  - Aiding in spill/contamination clean up or providing guidance to lab staff
- Deans, Directors and Department Heads are responsible for:
  - Ensuring departmental compliance with all procedures outlined in this policy
- Principle Investigators/Supervisors' responsibilities include:
  - Ensuring compliance with this policy in their labs
  - Conducting Risk Assessments to evaluate the hazards of antineoplastic drugs
  - Developing SOPs that identify the Engineering Controls, Administrative Controls and PPE to be implemented to mitigate the risks of using these hazardous drugs
  - Arranging for immediate emergency response for chemical spills and injuries
  - Maintaining Safety Data Sheets (SDS) for the hazardous drugs used in the work area

- Notifying EH&S when there is a change in equipment or procedure to determine if an updated Risk Assessment is required. Changes in processes or other controls may inadvertently increase the risk of exposure.
- Lab personnel are required to:
  - Understand and comply with all the provisions of this program
  - Report accidents, possible exposures or unsafe conditions to their supervisor
  - Wear personal protective equipment (PPE) and use engineering controls identified in the lab's written Standard Operating Procedures (SOP's) to ensure their personal safety

### Hazardous Drug Safety Guidelines

Work with these drugs must take place during normal business hours, 8:30 am – 4:30 pm. No after-hours or weekend work is permitted. If something goes wrong, staff will be available to assist you.

This section provides general guidelines to be followed when working with hazardous drugs. Labs using these drugs must develop and implement procedures in written, lab-specific Standard Operating Procedures (SOP's).

- Engineering Controls
  - All hazardous drug work will be conducted in a chemical fume hood or exhausted biosafety cabinet (BSC).
  - If used, the BSC shall be certified annually by a company that follows the NSF/ANSI 49 testing protocol for certification.
  - The blower on the BSC shall always be left on when in use.
  - BSC's shall be decontaminated at the end of each 7-hour work shift and immediately following a spill. Decontamination will consist of surface cleaning with a detergent solution such as Simple Green, followed by thorough rinsing with clear water. There is no single accepted method of chemical deactivation for all agents.
- Administrative Controls
  - SOP's describing methods for working safely with antineoplastic and other hazardous drugs shall be in place
  - Mixing of hazardous drugs will take place in a designated work area that is clearly identified as such
  - Proper signage to identify the area shall include the words "Hazardous Drug Use/Storage/Waste Area"
  - SDS's for the drugs used shall be available in the lab and read prior to beginning work. SDS shall be appended to the SOP's.
  - Hazardous drug spill guidelines shall be available in the work area

- Personal Protective Equipment (PPE)
  - Use specially designed chemotherapy gloves which are thicker than nitrile gloves used for research. Double gloving is required
  - Gloves should be changed once per hour and immediately when contaminated, torn, or punctured
  - A protective solid-front barrier gown with long sleeves and closed elastic or knit cuffs shall be worn when working with antineoplastic agents. Cuffs must be tucked under gloves to ensure there is no skin exposure
  - Safety glasses/ goggles (ANSI approved) shall be worn when handling any of these drugs

#### **Precautions for Agent Preparation (reconstitution and dilution)**

- Line the work area with absorbent matting to make clean-up easier if there is a spill
- All agent preparation shall be performed in a chemical fume hood or exhausted biosafety cabinet
- Wear a solid-front barrier gown with long sleeves and elastic or knit cuffs
- Wear double chemotherapy gloves. Chemotherapy gloves provide the greatest protection and must be worn.
- When double gloving, place one glove under the gown cuff and one over the outer glove. Change outer glove immediately if it becomes contaminated. Both gloves should be changed if the outer glove is torn, punctured, or overtly contaminated with the drug; and every hour during preparation
- Dispose contaminated disposable items (i.e. gloves used for preparation, absorbent pads) in the yellow Trace waste sharps container. At the end of your experiment, pack the yellow Trace container in a biohazard waste box for disposal through the Regulated Medical Waste program.

#### **Precautions for Administration of Antineoplastic Agents**

- Wear double chemotherapy gloves for procedures involving administration of drugs
- Change gloves when there is contamination, a tear or puncture; or after every hour of performing tasks
- Wear a solid-front barrier gown when administering drugs
- Wear safety goggles or a full-face shield
- Use Luer-Lock syringes to prevent the needle from becoming detached once the plunger is under pressure
- Dispose of all waste appropriately. Follow the disposal procedures outlined below.

- Wash hands between glove changes and upon completion of tasks.

## Spills and Decontamination

- Line the work area with absorbent matting to make clean-up easier if there is a spill
- When absorbent matting is used inside a BSC, anchor it carefully to prevent it from blocking the BSC grills and altering the directional flow of the protective air curtain
- Limit access to the immediate area until decontamination has been completed
- A second person will be helpful if there is a spill and must be present when any member of lab staff is working with these materials
- Spills inside the BSC and small amounts outside the BSC:
  - Labs should have a Chemo spill kit available in the lab for emergency response. EHS can supply these, call EH&S at 874-2592 or email your request to [srm@etal.uri.edu](mailto:srm@etal.uri.edu)
  - You will also need at least one clear plastic bag large enough to contain the clean-up debris (to be disposed as solid hazardous waste), twist ties, URI hazardous waste labels, Simple Green or similar cleaner
  - Clean up spills immediately wearing proper PPE and following the lab's Chemo Spill Clean-up SOP
  - Follow URI protocols for proper handling and disposal of hazardous drugs
  - Contaminated areas shall be thoroughly cleaned with a detergent such as Simple Green and then rinsed with fresh water
  - All contaminated cleanup materials shall be properly labeled for disposal as hazardous waste. Please refer to the waste section for details.
- Spills outside of the BSC and large volumes:
  - Alert others to leave the area
  - Leave the lab area immediately, closing the door behind you
  - Call URI Public Safety Dispatch at (401) 874-4910 for assistance with spill clean-up
  - If there is an exposure, call URI Health Services at (401) 874-2246 to consult with the Occupational Health Nurse on staff
- Decontamination procedure for skin or eye exposure:
  - Immediately remove gloves and barrier gown. Turn the gown inside out to prevent further contact with drugs that might be on the outer surface
  - Rinse the affected skin area for a minimum of 15 minutes. Use the safety shower if the spill is extensive or covers the lower body
  - If there is an eye exposure, immediately flood affected eye with water under the eyewash for fifteen minutes
  - Call URI Health Services at (401) 874-2246 to consult with the Occupational Health Nurse

## Hazardous Waste Determination

Waste that should be managed as hazardous waste under RCRA regulations must either:

- a. Be listed in EPA regulations or
- b. Exhibit certain characteristics

Thus, a pharmaceutical waste may be considered a hazardous waste under RCRA hazardous waste regulations if:

- The drug or its sole active ingredient is specifically listed on:
  - The P List: Acutely Hazardous Waste
  - The U List: Discarded Commercial Products or
- The waste exhibits one or more hazardous waste characteristics (ignitability, corrosivity, reactivity, or toxicity).

Pharmaceutical Name	No.	Pharmaceutical Name	No.
Arsenic trioxide	P012	Phentermine (controlled substance)	P046
Epinephrine	P042	Physostigmine	P204
Nicotine	P075	Physostigmine salicylate	P188
Nitroglycerin	P081	Warfarin >0.3%	P001

**Table 1. Examples of Active Pharmaceutical Ingredients that are Considered Hazardous under RCRA (P-Listed)**

Pharmaceutical Name	No.	Pharmaceutical Name	No.
Azaserine	U015	Mitomycin C	U010
Chloral hydrate	U034	Paraldehyde	U182
Chlorambucil	U035	Phenacetin	U187
Chloroform	U044	Phenol	U188
Cyclophosphamide	U058	Reserpine	U200
Daunomycin	U059	Resorcinol	U201
Dichlorodifluoromethane	U075	Selenium sulfide	U205
Diethylstilbestrol	U089	Streptozotocin	U206
Hexachlorophene	U132	Trichloromonofluoromethane	U121
Lindane	U129	Uracil mustard	U237
Melphalan	U150	Warfarin <0.3%	U248
Mercury	U151		

**Table 2. Examples of Active Pharmaceutical Ingredients that are Considered Hazardous Under RCRA (U-Listed)**

***Complete P and U Lists can be found at:***

<http://www.gpo.gov/fdsys/pkg/CFR-2012-title40-vol27/xml/CFR-2012-title40-vol27-sec261-33.xml>

- **If the agent is not a listed hazardous waste, then the researcher must make a hazardous waste determination to ascertain if the agent has RCRA hazardous waste characteristics.**
  - Ignitability: The presence of a flammable solvent is the most common reason agents meet this characteristic. Strong oxidizers, such as silver nitrate and potassium permanganate, in drug formulations may also meet this definition.
  - Corrosivity: applies to strong acids and strong bases. Glacial acetic acid and sodium hydroxide are two common ingredients in drugs.
  - Reactivity: an agent having a sole active ingredient that would be considered reactive and not is not a listed waste under the RCRA regulations
  - Toxicity: The toxicity characteristic identifies waste that could potentially, and is likely, to leach higher concentration than allowed by regulatory limits.
  - Examples of toxic chemicals/heavy metals that have pharmaceutical uses are listed below:

Chemical Name	Threshold Level	Chemical Name	Threshold Level
Arsenic	5.0 mg/L	m-Cresol	200.0 mg/L
Barium	100.0 mg/L	Lindane	0.4 mg/L
Cadmium	1.0 mg/L	Mercury	0.2 mg/L
Chloroform	6.0 mg/L	Selenium	1.0 mg/L
Chromium	1.0 mg/L	Silver	5.0 mg/L

### Waste Collection and Disposal

- Antineoplastic and other drug waste must be disposed of in accordance with URI's chemical waste policies and procedures. Containers must be properly labelled with a URI hazardous waste label in the SAA.
- Separate and contain waste solutions and solids of antineoplastic drugs from other hazardous chemical waste. Do not commingle these wastes, i.e. do not add them to containers with other lab wastes. Special black RCRA containers will be provided. Call EH&S to discuss your lab's specific needs (401) 874-2592.
- Place used syringes directly in a red sharps container only if the particular drug has been 100% used in the task. To dispose syringes using this method, no residual drug can be visible in the syringe. Do not re-cap needles and syringes.
- If the syringe still contains any volume of the drug, even as little as 0.1 ml, the syringe must be disposed of as hazardous chemical waste in a special black Bulk waste container. Do not dispose of it in a sharps container. Call EH&S at (401) 874-2592 to discuss your lab's needs.

- Collect antineoplastic or other drugs that contain a sole active ingredient which is included on the *P-list* (acutely toxic chemicals) separately from all other agents. Do not commingle P-listed waste with other waste; store P-listed waste in its own collection container in the lab's SAA.

NOTE: Per RCRA regulations, you can only have 1 qt of P-listed waste in your SAA at a time. An empty P-Listed chemical container also counts toward that 1 qt total.

It is critical that labs using these materials consult directly with EH&S to identify which P-listed chemicals will be used and properly identify the proper disposal methods.

- Do not dispose reagent chemicals, stock solutions, or any other liquids in a biowaste box. Submit a hazardous waste pick-up request using the online EHS form at [web.uri.edu/ehs/online-pickup/](http://web.uri.edu/ehs/online-pickup/) when a waste container is full or no longer being used.

## **REFERENCES**

**1. Preventing Occupational Exposure to Antineoplastic and Other Hazardous Drugs in Health Care Settings 2004**

<http://www.cdc.gov/niosh/docs/2004-165/>

**2. NIOSH List of Antineoplastic and Other Hazardous Drugs in Healthcare Settings 2016**

<https://www.cdc.gov/niosh/docs/2016-161/pdfs/2016-161.pdf>

**3. Weighing Toxic Powders**

<https://web.uri.edu/ehs/wp-content/uploads/sites/2063/Weighing-Toxic-Powders-Safely-7-24-2024.pdf>