Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
Receiving, unpacking, and placing in storage	All types of hazardous drugs	No, unless a leak is observed or suspected	NA*	NA*	No (Single pair of gloves)	No, unless a leak is observed or suspected	Consider protective sleeves; add additional protection if a leak is observed or suspected	No, unless a leak is observed or suspected
Transportation within facility	Intact tablets or capsules, manufacturers' prefilled syringes	No	NA*	Transport in containers that minimize the risk of breakage or leakage; Double-bag or place in a sealed container	No (Single pair of gloves)	No	No	No
	Cut or crushed tablets or capsules (in containers); powders, liquids, or creams; in-house filled syringes	No	NA*	Transport in containers that minimize the risk of breakage or leakage; Double-bag or place in a sealed container	Yes	No	No	No

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
Compounding‡	Oral liquid drug	Yes§	NA*	NA*	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control
	Topical drug	Yes§ (Note: some drugs such as carmustine, thiotepa, and mechlorethamine are volatile)	NA*	NA*	Yes¶	Yes	Hair and shoe covers. Add eye and face protection, if not done in a ventilated engineering control	Yes, if not done using a ventilated engineering control
	Injections withdrawn from a vial	Yes§	Yes, when dosage form allows	NA*	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control
	Mixing injections from a vial	Yes§	Yes, when dosage form allows	NA*	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
Administering	Solution for irrigation	Yes§	Yes, when dosage form allows	NA*	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control
	Powder/solution for aerosol treatments	Yes§	Yes, when dosage form allows	NA*	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control
	Intact tablets or capsules from unit dose package	NA*	NA*	NA*	No (Single glove)	No	Eye and face protection if vomit potential**	No
	Crushing or manipulating tablets or capsules	Yes§	NA*	Consider crushing tablets in a pill pouch	Yes¶	Yes	Hair and shoe covers; Add eye and face protection, if not done in a ventilated engineering control	Yes, if not using a ventilated engineering control
	Cut, crushed, or uncoated tablets or capsules	NA*	NA*	NA*	Yes	Yes	Eye and face protection if vomit potential**	No

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
	Subcutaneous or intramuscular injections from manufacturer's supplied prefilled syringe or injector	NA*	NA*	NA*	No (Single glove)	Yes	Eye and face protection if liquid likely to splash**	No
	Subcutaneous or intramuscular injections from a prepared syringe or injector	NA*	NA*	NA*	Yes	Yes	Eye and face protection if liquid likely to splash**	No
	Intravenous injections from prepared syringes††	NA*	Yes, when dosage form allows	NA*	Yes	Yes	Eye and face protection if liquid that could splash**	No
	Intravenous solution for infusion	NA*	Yes, when dosage form allows	NA*	Yes	Yes	Eye and face protection if liquid that could splash**	No
	Ophthalmologic applications	NA*	Yes, when dosage form allows	NA*	Yes	Yes	Eye and face protection if liquid likely to splash**	No

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
	Oral liquid drug: PO*/feeding tube/NG* tube	NA*	NA*	NA*	Yes	Yes	Eye and face protection if liquid likely to splash**	Yes, if inhalation potential
	Topical drug (ointment, cream)	No (Note: some drugs such as carmustine, thiotepa, and mechlorethamine are volatile and may need to be administered in an enclosure)	NA*	NA*	Yes	Yes	Eye and face protection if liquid likely to splash**	Yes, if inhalation potential
	Irrigation solution, bladder instillation, HIPEC*, limb perfusion	NA*	Yes, when dosage form allows	NA*	Yes	Yes	Eye and face protection	Yes

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
	Powder/ solution for inhalation/ aerosol treatment	Yes, when applicable; Note that some treatments may need to be administered in an enclosure	Yes, when dosage form allows	NA*	Yes	Yes	Eye and face protection if liquid that could splash**	Yes, full facepiece or PAPR* with combination particulate/ chemical cartridges if inhalation potential
Disposal and Cleaning	Drugs and metabolites in body fluids	NA*	NA*	Fold soft materials (sheets, hygiene care products) inward to prevent leakage Place in sealed bags	Yes	Yes	Eye and face protection if liquid could splash	Yes, if inhalation potential

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
	Drug-contaminated waste	NA*	NA*	Avoid creating dust; Place in sealed bags; Use caution when closing bags; Pushing waste down may force hazardous drug dust up into face.	Yes	Yes	Eye and face protection if liquid could splash	Yes, if inhalation potential
Routine Cleaning	All types of hazardous drugs	NA*	NA*	Use wet wiping methods; Avoid creating dust; Disinfection, deactivation, or decontamination agents may be necessary; Place in sealed bags for disposal	Yes	Yes	As needed‡‡	As needed‡‡

(Continued)

Table of Control Approaches for Safer Handling of Hazardous Drugs, by Activity and Formulation

		Control Approaches						
		Engineering Controls			Personal Protective Equipment			
Activity	Formulation	Ventilated engineering control (BSC or CACI)*	Closed system drug transfer device	Other	Double chemotherapy gloves (ASTM rated)	Protective gown (impervious, single use)	Eye, face, hair, sleeve, and shoe protection	Respiratory protection†
Spill cleanup	All types of hazardous drugs	NA*	NA*	Limit access to area. Use absorbent pads for liquid spills; Disinfection, deactivation, or decontamination agents may be necessary; Avoid creating dust; Place in sealed bags	Yes	Yes	Yes, as needed	Yes, full facepiece or PAPR* with combination particulate/chemical cartridges may be needed

Note. The Table of Control Approaches provides general approaches that should be adapted to facility-specific conditions. For more detailed information on safe handling practices, see the reference list for this table [ASHP 2006; NIOSH 2004a, 2008; ONS 2011, 2018; OSHA 2016; Power and Cyne 2018].

*__Abbreviations:__ BSC: biological safety cabinet; CACI = compounding aseptic containment isolator; CSTD = closed system drug-transfer device; CVE = containment ventilated enclosure; HIPEC = hyperthermic intraperitoneal chemotherapy; NA = not applicable; NG = nasogastric; PAPR = powered air-purifying respirator; PO = per os (by mouth).

†Respiratory protection must be selected on the basis of the hazardous drug and its physical form (particulate, vapor, etc.) and other exposure factors. For general activities, a N95 may suffice. Use a surgical N95 respirator if there is potential for splashes of bodily fluids or liquid drugs. When performing activities such as cleaning the BSC or CACI or responding to large spills, a combination particulate/chemical cartridge respirator may be needed.

‡Compounding is the process of combining, mixing, or altering ingredients by or under the direct supervision of a licensed pharmacist or physician to create a prescribed medication tailored to the needs of an individual patient. See FDA: https://www.fda.gov/drugs/human-drug-compounding/section-503a-federal-food-drug-and-cosmetic-act and https://www.fda.gov/drugs/human-drug-compounding/compounding-and-fda-questions-and-answers.

§For nonsterile preparations, a ventilated engineering control such as a fume hood, Class I BSC or CVE is sufficient if the ventilated engineering control exhaust is either (1) HEPA-filtered and appropriately exhausted to the outside of the building (preferred) or (2) filtered with redundant HEPA filters in series and recirculated back into the C-SCA. Although these activities are recommended in ventilated engineering controls, they may not be possible under some treatment scenarios (e.g., time-sensitive activities in the emergency department). If the activity is performed in a ventilated engineering control that is used for sterile intravenous preparations, a thorough cleaning and disinfecting is required following the activity.

¶Sterile gloves are required for aseptic drug preparation in a BSC or CACI.

[**]Needed if the patient might resist (infant, unruly patient, patient predisposed to spitting, patient with difficulty swallowing, or veterinary patient) or if the formulation is hard to swallow.
[††]Intravenous tubing already attached and primed.
[‡‡]Activities such as cleaning floors may not require eye or respiratory protection but cleaning a BSC or CACI may require it.

8.2 Control Approaches by Activity and Formulation

This section restates the information found in the previous Table of Control Approaches that should be adapted to facility-specific conditions. For more detailed information on safe handling practices, see the reference list for the table [ASHP 2006; NIOSH 2004a, 2008; ONS 2011, 2018; OSHA 2016; Power and Coyne 2018].

Receiving, unpacking, and storing all types of hazardous drugs

Controls: Use a designated area and restrict access to only authorized personnel. No controls necessary unless a leak or spill is observed or suspected. Open damaged containers inside of a fume hood, Class 1 BSC, or HEPA-filtered enclosure.

PPE: Single pair of chemotherapy gloves. Consider the use of sleeve covers. Add a protective gown, shoe covers, eye protection, and respiratory protection (N95 or combination particulate/chemical cartridge respirator) if a leak or spill is suspected.

Transportation within facility

Intact tablets or capsules, manufacturers' prefilled syringes

Controls: Transport in containers that minimize the risk of breakage or leakage. Double-bag or place in a sealed container.

PPE: Single pair of chemotherapy gloves.

Cut or crushed tablets or capsules, powders, liquids, creams, or in-house filled syringes

Controls: Transport in containers that minimize the risk of breakage or leakage. Double-bag or place in a sealed container.

PPE: Double chemotherapy gloves.

Compounding

Oral liquid drugs

Controls: Ventilated engineering control (fume hood or Class 1 BSC, CVE, or CACI).

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if compounding is done outside of the ventilated engineering control. Hair and shoe covers should be worn.

Topical drugs

Controls: Ventilated engineering control (fume hood or Class 1 BSC, CVE, or CACI). Note that carmustine, thiotepa, and mechlorethamine are volatile.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if compounding is done outside of the ventilated engineering control. Hair and shoe covers should be worn.

Preparation of subcutaneous/intramuscular injections from a vial

Controls: Ventilated engineering control (Class II or III BSC or CACI). Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if not handling in a ventilated engineering control. Hair and shoe covers should be worn.

Preparation of intravenous solutions by withdrawing or mixing from a vial or ampule

Controls: Ventilated engineering control (Class II or III BSC or CACI). Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if not handling in a ventilated engineering control. Hair and shoe covers should be worn.

Irrigation solutions

Controls: Ventilated engineering control (Class II or III BSC or CACI). Use a CSTD if the dosage form allows.

PPE: Double chemotherapy gloves, a protective gown, and sleeve covers. Add eye and face protection and respiratory protection (N95) if not handling in a ventilated engineering control. Hair and shoe covers should be worn.

Powder/solution for aerosol treatments

Controls: Ventilated engineering control (Class II or III BSC or CACI). Use a CSTD if the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if not handling in a ventilated engineering control. Hair and shoe covers should be worn.

Administering

Intact and coated tablets and capsules

PPE: Single pair of chemotherapy gloves. Add eye and face protection if there is the potential to contact vomit or if patient may resist or is predisposed to spitting.

Crushing or manipulating tablets or capsules

Controls: Ventilated engineering control (fume hood or Class 1 BSC or CVE). Consider crushing tablets in a tablet (pill) pouch.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and respiratory protection (N95) if compounding is done outside of the ventilated engineering control. Hair and shoe covers should be worn.

Cut or crushed tablets or capsules or uncoated tablets

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if there is the potential to contact vomit or if patient may resist or is predisposed to spitting.

Subcutaneous/intramuscular injections from a manufacturer's prefilled syringe or injector

PPE: Single pair of chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash.

Subcutaneous/intramuscular injections from a prepared syringe or injector

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash.

Intravenous injections from a prepared syringe

Controls: Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash.

Intravenous solutions for infusion

Controls: Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash.

Ophthalmologic applications

Controls: Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash.

Oral liquid drugs by mouth/feeding tube/nasogastric tubes

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if there is the potential for the liquid to splash, to contact vomit, or if patient may resist or is predisposed to spitting. Add respiratory protection (N95) if there is an inhalation potential.

Topical drugs

Controls: Volatile compounds may need to be administered in an enclosure.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if administering a liquid that is likely to splash. Add respiratory protection (N95) if inhalation is possible from volatile drugs.

Irrigation solution administration via bladder/HIPEC/limb profusion

Controls: Use a CSTD when the dosage form allows.

PPE: Double chemotherapy gloves, protective gown, eye and face protection, and respiratory protection (N95).

Powder/solution for inhalation/aerosol treatment

Controls: Some treatments may need to be administered in an enclosure. If patient is not intubated, use a demistifier or other air purification system. Use a CSTD if the dosage form allows.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if the liquid could splash, and respiratory protection with combination particulate/chemical cartridges, full facepiece, or PAPR if there is an inhalation potential.

Disposal and cleaning of body fluids

Controls: Fold soft materials (linens, hygiene care products) inward to prevent leakage. Use absorbent pads for liquids. Place in sealed bags.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if a liquid could splash and respiratory protection (N95) if there is an inhalation potential.

Disposal and cleaning of drug-contaminated waste

Controls: Dispose of contaminated wastes in a sealed and labeled container. Avoid creating dust. Place in sealed bags for disposal. Use caution when closing bags; pushing waste down may force hazardous drug dust up into the face.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection if a liquid could splash and respiratory protection (N95) if there is an inhalation potential.

Routine cleaning

Controls: Use wet wiping methods. Avoid creating dust. Disinfection, deactivation, or decontamination agents may be necessary. Place in sealed bags for disposal.

PPE: Double chemotherapy gloves and a protective gown. Add eye and face protection and a combination particulate/chemical cartridge respirator when cleaning the BSC or CACI.

Spill cleanup

Controls: Limit access to spill area. Use absorbent pads for liquids. Disinfection, deactivation, or decontamination agents may be necessary. Avoid creating dust. Place in appropriate sealed bags for disposal.

PPE: Double chemotherapy gloves, protective gown, eye and face protection, and respiratory protection (N95 or combination particulate/chemical cartridge respirator).

9 Additional Considerations for Handling Hazardous Drugs

No single approach can protect healthcare workers against all hazardous drugs in all tasks. These steps, however, can lessen the chance of exposure to hazardous drugs:

- Label, tag, or mark all containers of hazardous drugs with the identity of the material and hazard warnings.
- Use unopened, intact tablets and capsules whenever possible and clinically appropriate.
- Do not cut or crush tablets or capsules, or otherwise manipulate them, if possible. This might produce powder that can contaminate workplace surfaces.
  - When such manipulations are necessary, perform them within a ventilated enclosure or augment the control of generated aerosols by using supplementary controls such as glove bags or tablet (pill) pouches that contain the hazardous drug during and after the crushing process.
  - When clinically appropriate, add liquid or moist products to crushed hazardous drug products as soon as possible after crushing to avoid the potential of subsequent aerosol dissemination.
    - Use drugs in liquid forms when possible to avoid crushing tablets or opening capsules [ONS 2018].
    - Wear PPE and use exposure controls as appropriate for the task.

The information provided herein applies to healthcare facilities such as hospitals and clinics and to nontraditional settings such as homes and veterinary clinics.

9.1 Home Healthcare

Although only limited experimental studies on home healthcare have been done, here are additional considerations for handling hazardous drugs in home settings:

- Provide overall basic education and related precautions to protect home healthcare workers, patient family members, and caregivers from indirect or direct exposure to hazardous drugs, including during spill management.
- Use gloves when caring for patients.
- Suggest that family members use gloves when handling laundry or cleaning within or around toilets [Meijster et al. 2006].

- Close the lid before flushing the toilet after each use by patient, for 48 hours after receipt of chemotherapy. If available, have the patient use a separate bathroom from family members [ONS 2014].
- Conduct double washing of linens and wash them separately from other family laundry [ONS 2018].

9.2 Veterinary Clinics

A 2014 study showed that veterinary medicine and animal care workers were exposed to hazardous drug concentrations 15 times higher than human healthcare personnel, partly because of how chemotherapy is administered in animals versus humans. Cost, time, inconvenience, and discomfort are just some of the barriers veterinary medicine and animal care workers report for not using safety measures in their practices [Klahn 2014]. Chemical contamination of hazardous drugs on surfaces were observed from NIOSH field evaluations in seven veterinary hospitals and clinics visited during 2017–2018 [NIOSH 2019, 2021a,b,c,d,e,f]. The NIOSH Workplace Solutions document *Safe Handling of Hazardous Drugs for Veterinary Healthcare Workers* provides considerations for the administration of hazardous drugs in a veterinary setting [NIOSH 2010]. The Workplace Solutions document suggests the same hierarchy of controls (engineering controls, administrative controls, and PPE), with some specific suggestions such as these:

Engineering Controls

- Use dedicated cages, kennels, or stalls with dedicated drains for animals undergoing treatment with hazardous drugs. Avoid the use of sprayers or pressure washers to clean the cages, kennels, or stalls of treated animals to minimize the aerosolization of hazardous wastes.
- Place single-use disposable pads beneath animals receiving hazardous drug injections/infusions.

Administrative Controls

- Ensure that hazardous drugs are prepared or administered only by trained personnel in designated areas that are limited to authorized personnel.
- Post a sign to warn employees that they are working in an environment where hazardous drugs are handled.
- Warn employees who are pregnant, breastfeeding, or of reproductive age of the potential health effects of hazardous drugs, especially during the first trimester when a person may not know they are pregnant.
- Clean scissors and other tools, such as razors, after each use with animals receiving chemotherapy.