Continuing Education

United States Pharmacopeia Compounding: What You Need to Know!

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Learning Objectives:

- Describe the different categories of compounding.
- List the responsibilities of compounding personnel
- Describe the cleansing, garbing, and protective equipment used by personnel
- Discuss basic cleaning and disinfecting technique
- Discuss proper procedures in cleaning and disinfecting areas where hazardous materials are handled to decrease exposure to hazardous material

Introduction

Compounding in pharmacy practice has evolved over the years and new laws and regulations have been implemented due to contamination that have placed patients at risk of harm. H.R. 3204 – the Drug Quality and Security Act was passed in response to the New England Compounding Center meningitis outbreak.[1,2] The Compounding Quality Act stated that technicians must be under the direct supervision of a pharmacist when making a compound. The objective of this article is to highlight portions of the USP 795, 797, and 800 that apply to the duties of a pharmacy technician. This will include nonsterile and sterile compounding as well as the handling of hazardous drugs, which is scheduled to go into effect on July1, 2018.

USP Chapter 795[3]

The purpose of this chapter is to provide guidance to compounders on good practices when preparing nonsterile formulations. This chapter will highlight categories of nonsterile compounding, responsibilities of a compounder, principles of compounding, compounding process, and documentation. Below are definitions for terms and abbreviations that will be used throughout this discussion.

Important Terms Defined:

- **BUD:** Beyond use date. The date after which quality of a compounded product cannot be guaranteed.
- **Compounder:** A professional authorized by the appropriate jurisdiction to perform compounding pursuant to a prescription or medication order by a licensed prescriber.
- **Compounding:** The preparation, mixing, assembling, altering, packaging, and labeling of a drug, drug-delivery device, or device in accordance with a licensed practitioner's prescription, medication order, or initiative based on the practitioner/patient/pharmacist/ compounder relationship in the course of professional practice. Compounding includes the following:
  - Preparation of drug dosage forms for both human and animal patients
  - Preparation of drugs or devices in anticipation of prescription drug orders based on routine, regularly observed prescribing patterns
  - Reconstitution or manipulation of commercial products that may require the addition of one or more ingredients
  - Preparation of drugs or devices for the purposes of, or as an incident to, research (clinical or academic), teaching, or chemical analysis
  - Preparation of drugs and devices for prescriber's office use where permitted by federal and state law
- **Hazardous Drug:** Any drug identified by at least one of the following six criteria:
  - Carcinogenicity: The ability or tendency to produce cancer
  - Teratogenicity or developmental toxicity
  - Reproductive toxicity in humans
  - Organ toxicity at low doses in humans or animals
  - Genotoxicity: The property of chemical agents that damages the genetic information within a cell causing mutations, which may lead to cancer.
  - New drugs that mimic existing hazardous drugs in structure or toxicity [for examples see current National Institute

for Occupational Safety and Health (NIOSH) publications]

- **Manufacturing:** The production, propagation, conversion, or processing of a drug or device, either directly or indirectly, by extraction of the drug from substances of natural origin or by means of chemical or biological synthesis. Manufacturing may also include any packaging or repackaging of the substance(s) or labeling or relabeling of containers for resale by pharmacies, practitioners, or other persons.
- **Stability:** The extent to which a preparation retains, within specified limits and throughout its period of storage and use, the same properties and characteristics that it possessed at the time of compounding (see *Stability Considerations in Dispensing Practice* {1191}, the table *Criteria for Acceptable Levels of Stability*)

Categories of Nonsterile Compounding:

There are three types of nonsterile compounding simple, moderate, and complex. Each type is associated with different levels of experience, training, and physical facilities used in the compounding process.
Criteria to determine overall classification include:

- Degree of difficulty or complexity of the compounding process
- Stability information and warnings
- Packaging and storage requirements
- Dosage forms
- Complexity of calculations
- Local versus systemic biological disposition
- Level of risk to the compounder
- Potential for risk of harm to the patient

Simple nonsterile compounding requires making a preparation that has a USP compounding monograph, appears in a peer reviewed journal article that contains specific quantities of all components, compounding procedure, equipment, and stability data for that formulation with appropriate BUDs. This can also include reconstituting or manipulating commercial products that may require the addition of one or more ingredients as directed by the manufacturer. Examples would include captopril oral solution, indomethacin topical gel, potassium bromide oral solution, and veterinary products.

Moderate nonsterile compounding requires special calculations or procedures to determine quantities of components per preparation or per individualized dosage unit. Examples would include morphine sulfate suppositories, diphenhydramine hydrochloride troches, and mixing two or more manufactured cream products when the stability of the mixture is unknown.

Complex nonsterile compounding requires special training, environment, facilities, equipment, and procedures in order to ensure appropriate therapeutic outcomes. Examples would include transdermal dosage forms, modified release preparations, and some inserts and suppositories for systemic effects.

Responsibilities of the Compounder:

All compounders are responsible for compounding preparations of acceptable strength, quality, and purity and are responsible to dispense the finished preparation with appropriate labeling and packaging of the product. This must be done in compliance with the requirements established by the applicable state agencies, state boards of pharmacy, federal law, and other regulatory agencies. Individuals who engage in compounding of drug or dietary supplements shall be proficient in compounding as well as continually expanding their compounding knowledge. Individuals should be familiar with the contents of Pharmaceutical Compounding-Nonsterile preparations 795, Pharmaceutical compounding –Sterile Preparations 797, Pharmaceutical dosage forms 1151, Pharmaceutical Calculations in Prescription Compounding 1160, Quality Assurance in Pharmaceutical Compounding 1163, Prescription Balances and Volumetric Apparatus 1176, Stability Considerations in a

Dispensing Practice 1191, Written Prescription Drug Information-Guidelines 1265, as well as all compounding laws that pertain to them, guidelines, and standards.[3-10]

When compounding many protocols should be followed in order to ensure the quality of the product being produced. Listed below are general principles of compounding that should be followed before the compounding of a product begins. This will be useful as a general guideline that should be followed by all personnel in all compounding practices.

General Principles of Compounding:

- Personnel must be appropriately trained to be capable and qualified to perform their assigned duties.
- Compounding ingredients of appropriate identity, quality, and purity must be purchased from a reliable source.
- All equipment used in compounding must be clean, properly maintained, and used appropriately
- The compounding environment is suitable for its intended purpose and procedures are in place to prevent cross-contamination.
- Only authorized personnel are allowed in the immediate vicinity of the drug compounding operations.
- Quality assurance must be in place in order to ensure processes are carried out as intended or specified and that they are reproducible.
- Compounding conditions and procedures are adequate for preventing errors. Areas for sterile compounding shall be separated from and distinct from nonsterile compounding area.
- Checks must be in place in order to ensure correction of failures or problems in compounding, testing, or the preparation itself.

Next is listed the procedure that should be followed while compounding to ensure quality of the product being produced.

Compounding Process:

- Dose, safety, and intended use of the preparation has been evaluated for suitability.
- A master formulation record must be made before compounding a preparation.
- Compounding must be done in a clean, sanitized, and designated area.
- Only one preparation should be compounded at one time.
- Appropriate equipment must be selected for each compound. Equipment must be clean, functional, and properly used.
- Each compound must be labeled with a correct BUD.
- All compounding personnel must maintain good hand hygiene and wear appropriate clothing for protection and prevention of cross contamination.
- Preparations must be made in accordance with official standards.
- Each step of compounding must be verified by the compounder to ensure expected qualities of the finished preparation.
- Final preparations must be assessed using factors such as weight, adequacy of mixing, clarity, odor, color, consistency, pH, and analytical testing as appropriate. All preparations should be recorded on the Compounding Record.
- The preparation is packaged as recommended.
- The Master Formulation Record and the Compounding Record need to be reviewed by the compounder to ensure errors have not occurred.
- Preparation is then delivered to the patient.

Packaging and Drug Preparation Containers

The container used depends on the physical and chemical of the preparation compounded. Compounders should consider container-drug interactions for substances that have sorptive or leaching properties. Containers must be stored off the floor, handled and stored to prevent contamination, and rotated so that the oldest stock is used first. Containers shall be stored in a

manner that allows inspection and cleaning of the storage area.

Compounding Documentation

All compounders who dispense prescriptions must comply with record-keeping requirements of their state boards of pharmacy. If a preparation is made according to the manufacturer's labeling instructions then further documentation is not required. All other preparations require further documentation. These records should be retained for the same amount of time that is required for any prescription in written or machine-readable form and should include a Master Formulation Record and a Compounding Record.

Training

As mentioned previously it is the responsibility of the compounder that a training program has been implemented and that continually expands the employee's knowledge. Compounding personnel should be evaluated at least annually. For recommended quality control procedures, see USP Chapter (1163).[7]

Steps in the Training Procedure should include:

- All compounding employees should read and familiarize themselves with the USP 795 chapter.
- Compounders should familiarize themselves with procedures related to compounding including equipment, personnel, actual compounding, evaluation, packaging, storage, and dispensing.
- All personnel who compound hazardous drugs shall be trained in the storage, handling, and disposal of these drugs.
- All training activities shall be documented.

USP Chapter 797[4]

Another important aspect of compounding is sterile compounding, which primarily deals with the compounding of parenteral, ophthalmic, and bronchial preparations, as well as baths and soaks for live organs and tissues for donation. These preparations, by nature of the need for sterility, require much more stringent regulations in the compounding process compared to non-sterile preparations. As a reminder, this is not meant to be a comprehensive review of USP 797; rather, the goal is to highlight those portions that most apply to the duties of a pharmacy technician. Full text and training materials are available from USP and should be used by compounding facilities to train their staff. Before diving too deep into the rules regarding sterile compounding, it would be beneficial to establish some definitions for terms and abbreviations that will be frequently used throughout this discussion.

ISO Classification of Particulate Matter in Room Air

In sterile compounding, much attention is paid to the quality of air in the compounding environment, as poor air quality can lead to contamination of the compounded products. In this chapter, International Organization of Standardization (ISO) air quality is referenced frequently, so it is helpful to go ahead and define what each level means for ease of reference throughout the rest of this article.

ISO levels are determined by the number of particles that are 0.5 µm or larger per m^3 of air. The lower the ISO classification, the lower the number of particles and the cleaner the air. The breakdown is as follows:

- **ISO 8:** 3,520,000 particles/m^3
- **ISO 7:** 325,000 particles/m^3
- **ISO 6:** 35,200 particles/m^3
- **ISO 5:** 3,520 particles/m^3
- **ISO 4:** 352 particles/m^3
- **ISO 3:** 35.2 particles/m^3
- **ISO 2:** 3.52 particles/m^3
- **ISO 1:** 0.352 particles/m^3

While going through the discussion of the setup of sterile compounding rooms and quality requirements, these will be the values referenced for each aspect of the compounding environment.

Important Terms Defined

While the list of important terms in Chapter 797 is longer than that which is found here, these terms are the ones that will be most important for this discussion. Most will pertain to the compounding environment and equipment used.

- **BUD:** Beyond-use date. The date after which quality of compounded product cannot be guaranteed.
- **CSPs:** Compounded sterile products.
- **Ante-area:** this is the area directly outside the main compounding area where handwashing and garbing take place. This is also the area where supplies and equipment are gathered for use in the compounding area. ISO class 8 air is required for an ante-room.
- **Buffer area:** this is the location of the compounding area. It contains whatever device that is used to make CSPs. ISO class 7 air is required for a buffer area.
- **Primary Engineering Control (PEC):** this is the actual device, found in the buffer area, where CSPs are made. ISO class 5 air is required within a PEC. The PEC also contains the **Direct Compounding Area (DCA)**, which is the area where the critical sites are exposed to the ISO class 5 air. Examples of PECs that can be used for sterile compounding are:
  - **Biological Safety Cabinet (BSC):** a cabinet with unidirectional air flow designed to not only protect the CSP from contamination but the personnel from the CSP. A BSC contains laminar flow and uses HEPA filters for both product and environmental protection.
  - **Compounding Aseptic Isolator (CAI):** an isolator meant to be used for pharmaceutical compounding. Air should pass through a HEPA filter if this isolator is used; otherwise, air control cannot be guaranteed.
  - **Compounding Aseptic Containment Isolator (CACI):** an isolator meant to protect personnel from exposure to high levels of drug during the compounding process. Again, HEPA air filtration is required to use a CACI.
  - **Laminar Airflow Workbench:** a cabinet with unidirectional air flow designed to protect the CSP from contamination during the compounding process
- **Critical Site:** this is any area where liquid transfers take place. This can include injection ports on fluid bags, rubber stopper on vials, the openings of glass ampules, and hubs of needles. These areas are also at risk of contamination during the compounding process, be it through contact with air or moisture as well as touch contamination. The longer the compounding process takes, the greater the danger of contamination at these critical sites.
- **Media-Fill Test:** this is used to make sure that all personnel who are involved in sterile compounding are using proper technique and that the products that they make are free of antimicrobial contamination. It is designed to simulate the most difficult compounding conditions at all risk levels of compounding. There are various levels of testing, depending on the risk level of preparations made in the facility.

Responsibilities of Compounding Personnel

As compounders, there are certain responsibilities when it comes to CSPs. Chapter 797 covers these responsibilities in full detail, but for this discussion each point will be summarized and pertinent aspects regarding tech responsibilities in sterile compounding are presented. The responsibility of the compounder contains fourteen points:

1. Assure that personnel are skilled and trained in sterile compounding and the documentation required. These skills include:
   a. Performing hand cleansing and disinfection of nonsterile compounding surfaces
   b. Appropriate application of protective garb
   c. Achieve and maintain sterility of CSPs in an ISO 5 environment

   d. Identify, weigh, and measure ingredients
   e. Manipulate sterile products in an aseptic manner, use appropriate sterilization methods in the PEC, and label and quality inspect CSPs
2. Assure that ingredients used are correct and of appropriate quality and purity.
3. Assure that any ingredient that has been opened and will be used again is stored appropriately and not used outside the sterile compounding environment.
4. Assure that any CSP that was made with non-sterile water is sterilized within six hours of the compound being finished.
5. Assure that any sterilization method used maintains the appropriate strength of the compounded product as well as the physical integrity of the packaging.
6. Assure that all equipment used to measure or mix ingredients is clean, accurate, and effective.
7. Assure that all added substances in CSPs used for injection are inspected for potential harm, and that they do not affect the bioavailability of the active ingredient.
8. Assure that the packaging used for a CSP is appropriate and that it will preserve the strength and sterility of the product.
9. Assure that the compounding environment maintains the sterility or pre-sterility of the CSP.
10. Assure that the labels for CSPs are complete, and include the ingredients used, the amounts or concentrations used, and the final concentrations of the CSP. Clarity of the finished product should also be assured before use.
11. Assure that correct BUDs are used based on either direct testing or by using BUDs listed in reliable literature sources.
12. Assure that all processes for compounding CSPs conform to the correct sequence and quality for that CSP.
13. Assure that any deficiencies in the compounding process are easily identified and corrected by quality inspection measures.
14. Assure that compounding processes are separated from post-compounding quality inspection, as well as making sure these inspections take place before the CSP is dispensed.

CSP Microbial Contamination Level

There are three levels of potential contamination when deal with CSPs, and the requirements for compounding them are all different; however, the requirements for higher levels of risk will cover all those levels that are lower. In other words, if you are set up to compound high-risk CSPs, you will be prepared to compound both medium- and low-level CSPs. Below are the three levels and examples of CSPs that fall into each category.

- **Low-Risk Level:** these compounds are those that involve transfer, measuring, and mixing manipulations with no more than three commercially manufactured sterile products. They also require no more than two entries into any sterile container or package. Some examples of this level CSP include:
  - Taking a volume of sterile fluid from one container and transferring it into another container, as in the preparation of an IV drip.
  - Simple measuring of no more than three injectable drugs which are then placed in a fluid bag for infusion.

- **Medium-Risk Level:** a compound can be considered medium-risk if it requires the use of multiple small doses of a sterile product, such as single dose vials, which are combined to make one CSP which will then be used multiple times for one patient or on multiple different patients. Compounds that require complex manipulations other than single-volume transfer or those that take a long time to make are also considered medium-risk level compounds. Some examples of this level CSP would include:
  - Total parenteral nutrition (TPN) compounding, whether in an automated machine or by hand.

- Filling an injection or infusion reservoir with more than three drug products and removing residual air from said reservoir
- Taking the contents of multiple single dose vials of a sterile drug product and adding them to a fluid bag for infusion.

- **High-Risk Level:** these are compounds that are made from non-sterile products. These can be bulk powders, non-sterile water or saline, or non-sterile products, like oral products, that are not intended for sterile use. For obvious reasons, these are at the highest risk of contamination and should not be administered to a patient without some form of sterilization taking place beforehand. This often is accomplished by use of a filter with a sterilizing grade membrane of pore size 0.22 µm or 0.2 µm. These filters have been shown to retain 100% of a culture of 10^7 microorganisms per square centimeter of the membrane surface under a pressure no less than 30 psi. Drugs can also be sterilized via autoclave if the active ingredient or other ingredients can tolerate it. Some examples of this level CSP would include:
  - Dissolving bulk powder to make a solution that will be sterilized.
  - Sterile ingredients being exposed to room air quality less than ISO Class 5 for more than one hour
  - Using non-sterile devices to mix and measure sterile ingredients before final sterilization is performed
  - Using a bulk powder under the assumption that it has not been contaminated and that its potency is at least 95% of that listed on the label.

For each risk level there are certain quality assurance measures that should be taken. For low-risk level compounds, these include proper disinfection and air quality testing of the PEC as well as the buffer zone, visual confirmation of proper use of compounding garb by personnel, confirmation that all ingredients used were in date and correct for the specified compound, and a visual inspection of the CSP to make sure there is no settling of ingredients or particle formation within the compound and that there are no leaks in the container. Media fill test specifications are outlined in USP Chapter 797, but will not be covered here. The requirements for both medium- and high-risk compounds are the same as for low-risk, but the media fill testing increases in difficulty as the risk level increases.

Beyond-use dating is given in Chapter 797, and should be used in the absence of actual sterility testing. For each level of risk, the BUD information changes, and storage conditions of the finished product also affect the BUD. Table 1 lists the recommended BUDs for each risk level as well as typical storage conditions, and also assuming that all compounds are made entirely in ISO Class 5 level air quality.

Table 1: Beyond Use Dates for Sterile Compounds

Risk Level	Room Temperature (23 C)	Refrigeration (less than 8 C)	Freezing (-25 C to -10 C)
Low	48 hrs	14 days	45 days
Medium	30 hrs	9 days	45 days
High	24 hrs	3 days	45 days

Immediate-Use CSPs

A final classification of compounded product is immediate-use. This is intended for emergency need and should only be used in such conditions. This could include drugs for CPR, ER therapy, diagnostic agents, or situations where delay in therapy puts the patient at greater risk than if they were exposed to a potentially contaminated product. Only those products that are low-risk level products may be compounded as immediate-use products, and these products are exempt from the criteria needed for low-risk level compounding if they meet the following requirements:

- Compounding only requires a simple transfer of no more than three commercially prepared non-hazardous sterile products from their original containers with no more than two entries into the package.
- The process of compounding the product is continuous and does not exceed one hour, unless it is required by the directions for preparation.
- Aseptic technique is followed during preparation and the CSP is under continuous supervision until it is given to the patient.
- Administration begins no later than one hour after the **START** of the compounding process.
- The CSP should be labeled with the patient's name, the ingredients used and their quantities, the name of the compounder, and the one-hour BUD time, unless it is administered completely by the person who compounds it immediately after the preparation is finished.
- The CSP will be discarded if infusion has not begun within the one-hour BUD indicated on the label.

Personnel Cleansing and Garbing

An important part of making sure that CSPs are safe for patients is correct hand cleansing and garbing. These provide a barrier between the compounder and the product and reduce the risk of contamination by hair or skin cells shed by the compounder. All personnel who will be participating in the preparation of CSPs should be properly trained and evaluated before being allowed to work in the buffer area and PEC. Finger-tip glove tests and media fill tests should be performed on all compounding personnel at least annually for low- and medium-risk compounding, and at least every 6 months for high-risk compounding. These tests will be performed in the PEC after proper washing and garbing have been performed.

The process of cleansing and garbing is designed to go from dirtiest to cleanest, starting with donning of shoe covers and ending at last with the donning of sterile gloves. Following the outlined process in USP 797 will help minimize the risk of contamination of the CSP. The process, as outlined by USP 797:

- Apply shoe covers, followed by hair/facial hair covers, followed by face masks/eye shields
  - If personnel have shoes dedicated to sterile compounding, they can be used in place of shoe covers.
  - Eye shields are optional unless one is compounding with hazardous or irritant products.
- Debris is removed from under fingernails using a nail pick, and hands are washed up to the elbow for 30 seconds. Surgical scrub brushes need not be used. Soap can be either antibacterial or non-antibacterial.
- Hands are rinsed thoroughly and dried either with a lint-free, non-shedding towel, or under an air hand dryer.

- A non-shedding gown, preferably disposable, is donned at this time. If the gown is non-disposable, it must be appropriately laundered for use in a sterile compounding environment.
- The buffer area is entered, and a waterless, alcohol based surgical hand scrub with persistent activity is applied and allowed to dry.
- Sterile gloves are donned using aseptic technique, and compounding can now be performed.
    - If gloves become contaminated, or if compounding activities go on for an extended period of time, sterile 70% isopropyl alcohol can be used to disinfect the gloves, but only if the gloves have been tested and approved for use with 70% isopropyl alcohol.
- Upon leaving the compounding area, a clean disposable gown may be retained and used again during the compounders shift. After this time it should be disposed of and a new gown used.
- These same guidelines shall apply to compounding of high-risk products before the final sterilization takes place.

Cleaning and Disinfecting the Compounding Area

A clean compounding area is essential for safe compounding of sterile products. Proper cleaning of the ante-area, buffer zone, and PEC are an important part of reducing contamination in SCPs. USP 797 has given specific guidelines for cleaning these areas.

When cleaning in the PEC and buffer zone, personnel should be fully washed and garbed as if they were going in to compound. If there is heavy soiling of the PEC surface or of the counters or floors, a pre-wash with water should be performed before disinfection. The choice of disinfecting agent will be determined by the facility. Some examples of agents used are dilute chlorhexidine, dilute hydrogen peroxide, and sterile 70% isopropyl alcohol. When cleaning the PEC, wiping should occur from top to bottom and from front to back. Areas that have been wiped should not be re-wiped with the same towel as this could cause contamination. Floors and walls should be cleaned with disinfecting agents as well and should be cleaned after the PEC has been cleaned.

The frequency of cleaning for the PEC depends on how often it is used in the space of the day. It should be cleaned at the beginning of each shift, before a preparation is to be compounded, every 30 minutes of continuous compounding, when there is a spill during compounding, and if there has been a contamination during the compounding process. Table 2 highlights the minimum requirements for cleaning in the sterile compounding area:

Table 2: Cleaning Requirements for the Compounding Area

Compounding Site	Minimum Requirement
ISO 5 PEC	At the beginning of each shift, before each batch, not longer than 30 minutes following the previous surface disinfection when ongoing compounding activities are occurring, after spills, and when surface contamination is known or suspected
Counters and Easily Cleanable Work Surfaces	Daily
Floors	Daily
Walls	Monthly
Ceilings	Monthly
Storage Shelving	Monthly

USP Chapter 800[11]

USP Chapter 800, titled Hazardous Drugs- Handling in Healthcare Setting, was released in December 2017 and is anticipated to become official on December 1, 2019. This section details the quality standards required for hazardous drugs (HDs) in regards to the storage, compounding, handling, and disposal of sterile and non-sterile products. Persons who may potentially come in contact with hazardous drugs include pharmacists, pharmacy technicians, nurses, physicians, physician assistants, home healthcare workers, veterinarians, and veterinary technicians. The protective measures outlined below have been shown to reduce hazardous drug exposure.[12] This summary will detail different types of exposure, personal protective equipment (PPE), and maintaining areas housing hazardous drugs.

There are several ways healthcare workers can be exposed to hazardous drugs. The types of exposure activities that create the opportunity for exposure are described below in Table 3. A description of the types of exposure will help health care workers identify when could possibly be exposed and when to be alert.

Table 3: Types of Exposure

Activity	Potential
Receipt	• Contacting HD residues present on drug containers, individual dosage units, outer containers, work surfaces, or floors
Dispensing	• Counting or repackaging tablets and capsules
Compounding	• Crushing or splitting tablets or opening capsules • Pouring oral or topical liquids from one container to another • Weighing or mixing components • Constituting or reconstituting powdered or lyophilized HDs • Withdrawing or diluting injectable HDs from parenteral containers • Expelling air or HDs from syringes • Contacting HD residue present on PPE or other garments • Deactivating, decontaminating, cleaning, and disinfecting areas contaminated with or suspected to be contaminated with HDs • Maintenance activities for potentially contaminated equipment and devices
Administration	• Generating aerosols during administration of HDs by various routes (e.g., injection, irrigation, oral, inhalation, or topical application) • Performing certain specialized procedures (e.g., intraoperative intraperitoneal injection or bladder instillation) • Priming an IV administration set
Patient-care activities	• Generating aerosols during administration of HDs by various routes (e.g., injection, irrigation, oral, inhalation, or topical application) • Performing certain specialized procedures (e.g., intraoperative intraperitoneal injection or bladder instillation) • Priming an IV administration set
Spills	• Spill generation, management, and disposal
Transport	• Moving HDs within a healthcare setting
Waste	• Collection and disposal of hazardous waste and trace contaminated waste

Adapted from USP 800 table 1

Personal Protective Equipment

Personal protective equipment (PPE) is worn to protect those handling hazardous drug from unnecessary and possibly dangerous exposure. The required and common forms of personal protective equipment include gloves, gowns, covers (head, hair, shoe, and sleeve), eye protection, face protection, and respiratory protection. Chemotherapy gloves must be worn when handling any hazardous drugs. The user should inspect gloves for physical defects and discard gloves with any holes, tears or weak spots. Users should change chemotherapy gloves every 30 minutes (unless specified differently by the manufacturer) and gloves should also be changed if they are torn or punctured while handling hazardous drugs. Once the user is done handling hazardous drugs then gloves should be discarded and hands should be washed with soap and water.

Health care professionals must wear gowns that are both disposable and resistant to permeation by hazardous drugs. The gown must close in the back and cannot be substituted with lab coats, scrubs or isolation gown as the garments are generally not resistant to hazardous drugs. While in the hazardous areas gowns must be changed every 2-3 hours or once a spill occurs, which ever happens first. Along with gowns, head, hair and shoe covers must be worn in designated areas. It should be noted that in designated areas a second pair of shoe covers may be required. Face and eye protection will protect eyes and mucous membranes from irritation. Once manipulations are completed all personal protective equipment should be considered contaminated and should therefore be discarded in an appropriate waste container before the wearer returns to common areas. Performing activities outside areas designated for hazardous material while wearing contaminated equipment could expose others to hazardous materials.[13]

Deactivating, Decontaminating, Cleaning, and Disinfecting

Areas where hazardous drugs are handled must be maintained by deactivating, decontaminating, cleaning, and disinfecting (sterile compounding) the areas routinely. Persons maintaining these areas must do while wearing the above mentioned personal protective equipment. The cleaning steps are detailed in Table 4. This table provides information on the cleaning process, the reason for each step, and the materials needed to complete the cleaning step.

Table 4: Cleaning Steps

Cleaning Step	Purpose	Example Agents
Deactivation	Render compound inert or inactive. This prevents the hazardous compound from causing harm before being removed.	Environmental Protection Agency (EPA)-registered oxidizers (e.g., peroxide formulations, sodium hypochlorite, etc.)
Decontamination	Remove Hazardous Residue. Once the compound is deactivated the area need to be decontaminated.	Materials that have been validated to be effective for HD decontamination, or through other materials proven to be effective through testing, which may include alcohol, water, peroxide, or sodium hypochlorite
Cleaning	Remove Organic and Inorganic Material	Germicidal detergent
Disinfection (sterile compounding)	Destroy microorganisms. Microorganisms can cause contamination of sterile compounds and lead to patient infections.	EPA-registered disinfectant and/or sterile alcohol as appropriate for use

Adapted from USP 800 table 5

Conclusion

In summary, there are many rules and regulations that must be observed when compounding medications. Pharmacy technicians have a vital role in the compounding of pharmaceutical preparations, and need to be familiar with these rules and regulations. This article was designed to review with technicians the portions of USP chapter 795 and 797 as they pertain to the technician's role, as well as help prepare them for the advent of chapter 800. Health care providers must observe these guidelines, not only for the safety of the patient, but also to protect themselves from unnecessary exposure to hazardous materials. Being knowledgeable of and consistent with these guidelines is essential for compounding safety.

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