Complete Summary

GUIDELINE TITLE

Safe handling of hazardous drugs.

BIBLIOGRAPHIC SOURCE(S)

Polovich M, Blecher CS, Glynn-Tucker EM, McDiarmid M, Newton SA. Safe handling of hazardous drugs. Pittsburgh (PA): Oncology Nursing Society (ONS); 2003. 56 p. [71 references]

GUIDELINE STATUS

This is the current release of this guideline.

This guideline updates a previous version: Safe handling of cytotoxic drugs: an independent study module. 2nd ed. Pittsburgh (PA): Oncology Nursing Society; 1997. 26 p.

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
QUALIFYING STATEMENTS
IMPLEMENTATION OF THE GUIDELINE
INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES
IDENTIFYING INFORMATION AND AVAILABILITY
DISCLAIMER

SCOPE

DISEASE/CONDITION(S)

Occupational exposure to hazardous drugs

GUIDELINE CATEGORY

Prevention

CLINICAL SPECIALTY

Nursing
Oncology

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Health Care Providers
Nurses
Other
Pharmacists

GUIDELINE OBJECTIVE(S)

To provide recommendations for the safe handling of hazardous drugs

TARGET POPULATION

Nurses and other healthcare workers who administer hazardous drugs in the care of their patients

INTERVENTIONS AND PRACTICES CONSIDERED

1. Assessment of risks of occupational exposure, including potential points of exposure and exposure routes
2. Engineering controls, including biologic safety cabinets, closed-system devices, and personal protective equipment (e.g., gloves, gowns, eye and facial protection)
3. Work practice controls/practices
4. Drug preparation of injectable and oral drugs
5. Safety measures (e.g., drug labeling, cleaning of biologic safety cabinet)
6. Drug administration
7. Post-administration practices including:
    - Handling of body fluids
    - Handling of linen
8. Disposal of hazardous drugs
9. Management of spills
10. Medical surveillance
11. Staff education and training

MAJOR OUTCOMES CONSIDERED

Adverse effects associated with occupational exposure to hazardous drugs

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches using the Cochrane Database of Systematic Reviews, Medline, CINAHL (Cumulative Index to Nursing and Allied Health), and Index Medicus.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The guideline document was reviewed by eight field reviewers.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Risks of Occupational Exposure

Refer to the original guideline document for discussion of potential risks of occupational exposure to hazardous drugs.

Potential Points of Exposure

Occupational exposure to hazardous drugs can occur when safe handling measures fail or when they are not used. Exposure may occur during drug preparation, transport, or administration; during the disposal process; when handling patient excreta; and in the event of spills. Routes of exposure include the following.

Inhalation of Aerosols and Drug Particles

Aerosolization can occur during any drug manipulation, such as when breaking open an ampoule, withdrawing a needle from a vial, transferring a drug from syringe to syringe or from a syringe to another container, or expelling air from a syringe containing a hazardous drug. Another potential source of aerosolization occurs when removing contaminated needles or blunt needle substitutes, which are used during drug preparation, from a syringe. Dust from tablets or powder from open or damaged capsules can be inhaled. Additionally, aerosols can be present when removing contaminated items, such as gloves, syringes, and vials, from the biologic safety cabinet (BSC) following preparation of drugs or during cleanup of spills.

Absorption of Drugs Through Direct Contact

Drug absorption can occur through direct contact with the skin, mucous membranes, or eyes. Absorption through mucous membranes and eyes is postulated to be from contact with contaminated hands. Healthcare providers are at highest risk for this type of exposure during drug spills if they do not wear personal protective equipment (PPE) while working with hazardous drugs. Recent data suggest that surface contamination may be more widespread than previously reported. Absorption may occur from touching cabinets, flooring, countertops, and other surfaces that have been unknowingly contaminated with a hazardous drug. Figure 2 in the original guideline document provides examples of potential sources of touch contamination. Accidental exposures also can occur when removing gloves, gowns, and other forms of PPE.

Ingestion

Drug ingestion can occur as a result of direct drug contact with food, beverages, chewing gum, food containers and utensils, or tobacco products. Ingestion also can occur when a contaminated hand comes in contact with the mouth. It is imperative to keep food, beverages, makeup, and smoking materials away from areas where hazardous drugs are prepared, stored, and administered. Healthcare

workers should thoroughly wash their hands after working with hazardous drugs and again before eating or drinking.

Injection Through Accidental Needle Sticks

Intramuscular and subcutaneous injections involve handling sharp objects, which may result in needle stick injury. Recapping needles is an unsafe practice that is not recommended. The use of safe-needle devices, needleless systems, dispensing pins, and closed-system devices reduces the likelihood of exposure by injection.

Drug Vaporization

Published data are available about the possibility of some hazardous drugs vaporizing. High-efficiency particulate air (HEPA) filters are not designed to trap drug vapors. Inappropriate venting of BSCs might result in the release of drug vapors into the work environment. Open drug containers and uncovered disposal containers also may result in exposure to drug vapors.

Hierarchy of Controls

Engineering Controls

Biologic Safety Cabinets

A class II type B or class III vertical airflow BSC is necessary to minimize exposure of personnel to cytotoxic agents during preparation and mixing of the agents. This type of laminar (vertical) airflow BSC provides protection for the product by filtering incoming air and protection for the healthcare worker by filtering the exhaust through a HEPA filter. These filters are not effective for volatile materials because they do not capture vapors and gases.

There are four main types of BSCs. All type II models have an open front, a downward airflow mechanism, and a HEPA filter.

- Type A cabinets recirculate approximately 70% of air through HEPA filters and direct it back into the cabinet. The remaining 30% is discharged through the HEPA filter and back into the preparation room. For this reason, it is not recommended to use this type of cabinet to prepare hazardous drugs.
- Type B1 cabinets have higher velocity air inflow, recirculate 30% of the cabinet air, and exhaust the rest to the outside through HEPA filters.
- Type B2 cabinets are the same as type B1 cabinets except no air is recirculated.
- Type B3 cabinets are similar to type A cabinets except instead of the remaining 30% of the air being recirculated back into the preparation area, it is vented to the outside.

Class III cabinets are totally enclosed with gas-tight construction. The entire cabinet is under negative pressure, and preparation of drugs is performed using attached gloves. All of the air is HEPA filtered.

The class II cabinets should remain in the "on" position so that the blower operates continuously to eliminate particles. If turned off, the BSC should first be cleaned and the front opening sealed with plastic and tape to prevent any contaminants from escaping. BSCs should be serviced and certified by a qualified technician at least every six months. In addition, a technician should check the BSC any time the cabinet is repaired or moved.

The BSC should be located in a room that is restricted to authorized personnel. No eating, drinking, smoking, chewing gum, application of cosmetics, or storage of food should occur in this area. The door to the area should be kept closed and labeled with a sign stating these guidelines.

Closed-System Devices

Refer to the original guideline document for a discussion of evidence related to the utility of closed-system devices.

Personal Protective Equipment

The use of PPE is one of the best ways for healthcare workers to prevent occupational exposure to hazardous drugs. Since the widespread use of PPE, employee exposure to hazardous drugs has decreased. Studies have demonstrated that gloves provide protection against skin contact with tested hazardous drugs, and preventing skin exposure decreases symptoms in people with occupational contact with hazardous drugs. The Oncology Nursing Society (ONS) defined PPE as gloves, gowns, respirators, facemasks, face shields, or goggles.

<u>Gloves</u>

Gloves should be worn during all hazardous drug-handling activities. Glove thickness, type, and time worn are major determinants of their permeability by hazardous drugs. Powder-free gloves are preferred because powder may absorb contaminants, leading to aerosolization and increased risk of touch contamination. Longer gloves that cover the gown cuff are preferred because they protect the wrist area from exposure. Thicker gloves tend to be less permeable to hazardous drugs than thinner ones, although differences in permeability have been found even within the same lot of gloves. Thus, double gloving is recommended for drug preparation activities. It is recommended to change gloves every hour and whenever contamination occurs. Visual inspection of gloves to assess for pinhole leaks is a prudent practice, as variability of glove integrity within lots has been identified.

When double-gloving, the inner glove should be placed under the gown sleeve, and the outer glove should be placed over the gown cuff. This technique ensures that skin on the wrist area is not exposed and facilitates correct sequencing (i.e., outer glove, gown, inner glove) during removal of PPE.

Traditionally, latex or surgical latex gloves were recommended for handling hazardous drugs because of their thickness and decreased permeability when compared with polyvinyl chloride (PVC) and other glove materials. Recent

concerns about latex sensitivity have prompted testing of newer glove materials. In one study, thin-gauge 0.0045-inch nitrile gloves demonstrated efficacy in preventing penetration by 11 antineoplastic drugs.

It has been demonstrated that a single layer of surgical and chemotherapy gloves were impermeable to five antineoplastic agents. In the same study, one glove was permeable to fluorouracil, which the author attributed to a break in the integrity of the glove rather than permeation. Despite the evidence that a single glove and thinner gloves may prevent penetration of antineoplastic agents, it remains prudent to double glove when preparing hazardous drugs.

In 1999, nitrile rubber, latex, polyurethane, and neoprene gloves were tested for drug permeation after 30, 60, 90, and 120 minutes of exposure to 18 antineoplastic drugs. The results showed that one nitrile rubber glove was permeable to thiotepa at 30 minutes, but the other 11 gloves were not permeable to thiotepa. The authors speculate that there was a pinhole leak in the one glove. Permeability of less than or equal to 1% was found for carmustine at 90 minutes in one latex glove, for paclitaxel at 60 minutes in one polyurethane glove, and for paclitaxel at 120 minutes in one neoprene glove. The nitrile rubber gloves were the thinnest (0.12 mm), and the latex gloves were the thickest (0.18 mm). Thus, the four types of gloves were impermeable to the 18 antineoplastic agents in most cases.

Another study tested 14 gloves (10 latex chemotherapy, 1 latex exam, and 3 nitrile) for permeability to three antineoplastic agents. Only two of the gloves, both latex chemotherapy gloves, were impermeable to all three drugs. All 14 gloves were impermeable to bischloroethylnitrosourea (BCNU or carmustine), whereas only two of the gloves were impermeable to etoposide. Clinicians need to review all current literature when evaluating which glove types to utilize in their clinical settings.

Still a different test studied the effect of isopropyl alcohol on the permeation of gloves exposed to antineoplastic agents. They found that the use of isopropyl alcohol for cleaning and decontaminating does not have a significant impact on the integrity of either latex or nitrile gloves during the limited study period of 30 minutes. This is an important finding, as alcohol is used routinely in the BSC during hazardous drug preparation.

Summary of gloves recommended for use in hazardous drug handling:

- Use good-quality gloves made of latex, nitrile, polyurethane, neoprene, or other materials that have been tested with hazardous drugs.
- Select powder-free gloves.
- Inspect gloves for visible defects.
- Wear double gloves for drug preparation.
- Change gloves every hour or immediately if damaged or contaminated.

<u>Gowns</u>

Gowns that provide adequate protection from hazardous drugs are disposable, made of a lint-free, low-permeability fabric. They should have a solid front (back closure) and knit or elastic cuffs. Laboratory coats and other cloth fabrics absorb

fluids, so they provide an inadequate barrier to hazardous drugs and are not recommended. The existing guidelines do not contain a recommendation for the maximum length of time that a gown should be worn. Because no recommendations are stated in the literature, at a minimum, change the gown every time it is contaminated or gloves are changed.

In a study of gowns, the permeability of six commercially available protective gowns was evaluated by splash testing them with 15 antineoplastic agents. Gowns with polyethylene or vinyl coatings provided adequate splash protection and prevented penetration of the antineoplastic agents. Unfortunately, they made the researchers feel warmer and were less breathable than the more permeable gowns. Two gowns made of polypropylene were permeable in less than one minute, leading the researchers to recommend that they not be used in hazardous drug handling.

Gowns always should be worn during chemotherapy preparation and when administering intravenous (IV) chemotherapy. Gowns also should be used during the administration of hazardous drugs by any other route, especially if splashing is possible. This represents a change in practice for many nurses but is necessary to provide adequate protection against exposure to hazardous drugs.

Gowns worn while preparing hazardous drugs should be removed before leaving the immediate BSC area, before the inner gloves are removed. Gowns worn while administering hazardous drugs should be changed when leaving the patient care area or immediately if contaminated. The practice of hanging up a gown between uses may lead to surface contamination and should be discontinued. Gowns are intended to be single use and should not be worn more than once.

Eye and Facial Protection

A plastic face shield should be worn in situations where eye, mouth, or nasal splashing or aerosolization is possible (such as during a bladder instillation of hazardous drugs). Goggles protect the eyes, but not the face, against spraying. Surgical masks do not provide respiratory protection and should not be relied upon for protection against aerosolized powders or liquids, such as during drug preparation. For drug preparation, the BSC provides eye and face protection. For drug administration, working below eye level greatly reduces the likelihood of eye and facial splashing.

Areas where hazardous drugs are handled should have a sink with an eye wash station. Two functionally equivalent and cost-effective alternatives to an eye wash station are an IV bag of 0.9% sodium chloride solution (normal saline) connected to IV tubing or an irrigation bag of water or normal saline with attached tubing.

Work Practice Controls

Another way to reduce occupational exposure to hazardous drugs is to utilize appropriate work practices. A critical examination of the existing work practices is necessary to identify potentials for exposure. Certain work practices can result in surface contamination with hazardous drugs, such as

- Exiting and reentering the BSC to obtain additional equipment without changing gloves
- Failing to wipe hazardous drug containers with a damp cloth to remove drug residue
- Inadequate cleaning of spills on equipment, such as infusion pumps
- Priming IV tubing with a hazardous drug instead of saline or priming tubing outside the BSC
- Inadequate hand washing after hazardous drug handling activities
- Contaminating hands and other areas while removing PPE

There are many possible causes of touch contamination. Direct observation of nurses´, pharmacists´, and others´ techniques of preparation, handling, and administration may yield information about potential sources of contamination. Unless actual sources of surface contamination are identified, they cannot be eliminated.

The following work practices are likely to result in decreased touch contamination.

- Prepare all hazardous drugs in one pharmacy or centralized drug preparation area.
- Designate one staff member who will work in the BSC preparing hazardous drugs for the day to reduce the number of individuals entering and exiting the BSC. Pharmacy technicians often implement this practice, but nurses who prepare hazardous drugs may not.
- Gather all necessary supplies before placing hands in the BSC.
- Change gloves every hour and whenever contamination occurs.
- Wash hands after removing gloves for any reason and prior to donning new gloves.
- Place waste generated in the BSC (e.g., outer gloves, vials, gauze) in a sealed plastic bag before removing it from the BSC.
- Discard the sealed bag containing used equipment in a puncture-proof hazardous drug waste receptacle placed immediately outside the BSC.
- Avoid reaching into sealed bags used to transport drugs without PPE. Visually examine the contents of the sealed bag. If visible leakage is present, do not open the outer bag. To reduce the risk of touch contamination, dose verification can occur at the administration site. For example, one registered nurse (RN) wearing PPE can remove the drug container from the bag while another nurse who need not wear PPE holds the order. This allows a double-check but minimizes the risk of touch contamination. An alternative is to use clear sealable bags for transport so that the doses can be verified without removing the drug containers from the bag. This practice might not be possible if ultraviolet light-blocking bags are used.
- Use locking connections on all IV delivery devices.
- Use and dispose of sharps carefully.
- Avoid spiking IV bags or bottles that contain hazardous drugs. Attach and prime all tubing in the pharmacy with nondrug solution before adding hazardous drugs.
- Avoid "unspiking" IV bags or bottles. Discontinue and discard infusion bags and bottles with tubing intact.
- Place hazardous drug disposal containers near the workspace.
- Keep the lid closed on hazardous drug disposal containers except for when placing contaminated materials into the containers.

- Clean BSC and countertops in mixing area with a two-step cleaning method, such as SurfaceSafe™ daily, once all other contaminated materials are removed from the area (see page 23 in the original guideline document).

Drug Preparation

General Information

All procedures for preparing hazardous drugs, such as reconstituting, mixing, and compounding, must take place in a BSC. The room in which the BSC is located should be restricted to authorized personnel during drug preparation activities. The area should not be used for other activities, such as eating, drinking, smoking, chewing gum, application of cosmetics, or storage of food items.

The effectiveness of the BSC in protecting the healthcare worker is related to the airflow. Although the cabinet is designed to direct airflow and potential drug contamination away from the worker, this is a very technique-dependent process. Workers should avoid moving their hands in and out of the cabinet during preparation activities because a disturbance in the airflow may result in directing drug aerosols outside the cabinet. This should be kept in mind whenever there is the possibility of releasing drugs into the environment, such as when a hazardous drug container is open and during all drug-transferring activities.

Overcrowding should be avoided inside the BSC. Any items placed in the BSC, such as excess supplies, can block airflow and, thus, the containment properties of the cabinet. Place only those items necessary for drug preparation, a small disposable sharps container, and a heavy-duty zipper-lock bag (for disposal of syringes, vials, and gloves) in the BSC before beginning work. The practice of covering the working surface of the BSC with a plastic-backed, absorbent, disposable drape is no longer recommended. The drape can negatively affect the containment airflow of the BSC.

Use of a BSC does not eliminate the need for PPE. People working in the BSC must wear gloves and gowns during all drug preparation activities. Double gloves are recommended for drug preparation. When wearing double gloves, tuck the cuff of the inner glove under the gown sleeve and the cuff of the outer glove over the gown sleeve. Change the outer gloves immediately whenever contamination is suspected. Change both gloves if the outer glove is torn, punctured, or contaminated by an obvious spill. At the completion of each batch, the clinician should remove the outer gloves and seal them in a zipper-lock bag. Remove the gown before removing the inner pair of gloves.

Injectable Drugs

Aseptic technique is required for preparation of all parenteral drugs. Appropriate actions to provide safe products for patients are assumed and will not be addressed here.

Some newer hazardous drugs are being supplied in ampoules (e.g., busulfan, arsenic trioxide, alemtuzumab, tacrolimus.) When opening ampoules, tap down any drug from the top of the ampoule and wrap a sterile gauze pad around the

neck while breaking it to reduce the risk of injury from the sharp edges of the glass as well as drug contamination from spilling. A filtering device must be used to prevent glass particles from being drawn into the syringe. Using a filtering straw reduces the needle-stick risk associated with withdrawing the drug with a filter needle.

When withdrawing drugs from vials, use caution to avoid pressure buildup inside the vial that can result in spills. Needleless dispensing devices with hydrophobic filters often are used, although no evidence is available to support their effectiveness. These devices, if used, should be attached to one vial only and discarded with the empty vial.

Use syringes with Luer lock connections, as this reduces the risk of accidental separation. When adding diluent to a vial, use the negative pressure technique. Inject slightly less air into the vial than required to maintain negative pressure. Pierce the septum with the needle or access device, or attach the syringe to the dispensing device. Pull back on the syringe plunger to create negative pressure in the vial, release the plunger, and slowly allow the diluent to be drawn from the syringe into the vial. This should avoid generating positive pressure or leaking drug around the needle or access device.

Draw up the appropriate dose. Keep the access device (pin or needle) in the vial while measuring the dose. When separating the syringe from the vial, clear the drug from the neck of the vial. The access device should be suspended in air. Remove the drug from the neck of the syringe by pulling back slightly on the plunger, being careful not to draw extra air into the syringe. Then separate the syringe from the vial using a slow, steady motion, while gripping the plunger to prevent the drug from being sucked back into the vial or released into the environment. Close the syringe with a cap that has a locking connection.

Select appropriate syringes for the dose and avoid overfilling. Syringes that are more than three-fourths full increase the risk of separation of the plunger and spillage of the drug. Do not transport drug-filled syringes with needles attached.

When a closed system (such as PhaSeal) is used properly, it may reduce the release of hazardous drugs into the environment when withdrawing them from vials. Closed systems are currently not available for use with ampoules.

There is a risk of releasing drugs into the environment when priming IV tubing with drug solution into a cytotoxic waste container or gauze pad, priming tubing with normal saline and attaching the tubing to the drug container, or spiking the bag with a secondary set and lowering the bag to back-fill from the primary set. Attach the delivery tubing to the bag or bottle and eliminate air from the administration set *before* adding the drug. The practice of spiking and priming in the BSC eliminates two chances for exposure for nurses who would otherwise perform these activities at the time of administration. One study reported a 25% rate of leakage during the connection of tubing to an infusion bag. A risk of leakage also exists during the connection of the tubing to the patient side of the IV tubing when the tubing is primed with drug-containing solution.

Priming in the BSC requires communication between the person preparing the drug and the person administering the drug so the appropriate administration set

is selected. Practice settings that use multiple IV pumps and controllers might find this problematic. Some institutions have elected to attach a secondary set to all IV bags or bottles that contain hazardous drugs. Secondary sets are compatible with most IV tubing with a proximal port and a needleless connector.

As an alternative, using a closed system eliminates the exposure risk associated with spiking and priming tubing. A connector is attached to the bag before the drug is added. The connector allows IV delivery tubing to be connected at the administration site before opening the flow of solution. This dry-spike connection allows priming of IV tubing using the back-priming technique and is an effective containment practice.

Wipe down the outside of the drug container with moist gauze. Wipe entry ports with alcohol and apply a cap. Seal the drug syringe or container with the attached tubing in a plastic zipper-lock bag that will contain any spilled drug if the container leaks.

Oral Drugs

Unit dose packaging is the preferred method of providing oral hazardous drugs; however, not all hazardous drugs are available in that form. Although the active drug is contained in the core of some tablets, with the tablet surrounded by inactive substances, it is difficult to ascertain which products are manufactured in that manner. Powder from tablets or damaged capsules might represent an exposure risk. Any handling of tablets or capsules should be done wearing gloves, with the assumption that exposure is possible.

Crushing tablets or opening capsules for administration through feeding tubes is an inappropriate practice. Liquid formulations should be used. Compounding should take place in the BSC to avoid the risk of inhalation of hazardous drug powder. For such preparation, a gown and gloves are required. Drugs should be delivered in the final dose and form for administration whenever possible to minimize exposure risk.

Safety Measures

Drug Labeling

All hazardous drugs must be labeled in order to identify them. A label on the drug container itself and on the outside of the bag used for transport should alert the handler that special precautions are required. Attach a warning label stating, for example, "CAUTION: HAZARDOUS DRUG. HANDLE WITH GLOVES. DISPOSE OF PROPERLY."

All items used in the preparation of hazardous drugs are considered contaminated and should be discarded in a hazardous waste container. Discard needles and other sharps in the small sharps container inside the BSC. Discard empty vials, used syringes, drapes, and other items used in drug preparation in the zipper-lock bag. Remove the outer gloves and place them in the zipper-lock bag. Place the sharps container and zipper-lock bag from the BSC into the hazardous waste container placed outside the BSC. Carefully remove the gown and then the inner

gloves to avoid contaminating skin and clothing. Discard PPE in the hazardous waste container, and wash hands before leaving the preparation area. Gloves and gowns should not be worn outside the drug preparation area.

Cleaning of the Biologic Safety Cabinet

Cleaning of the BSC should be performed at the end of a session of preparation activities, such as at the end of a shift or day of work, depending on the volume of hazardous drug preparation. Traditionally, a cleansing agent followed by ethanol has been used to clean and disinfect work surfaces of the BSC; however, ethanol does not deactivate hazardous drugs. Many drug manufacturers recommend sodium hypochlorite (bleach solution) to inactivate cytotoxic drugs. Sodium thiosulfate solution inactivates the bleach, thus reducing the potential for corrosion of work surfaces. Oxidation from the bleach followed by nucleophilic substitution from sodium thiosulfate result in the chemical degradation and mutagenic inactivation of many commonly used chemotherapy drugs.

A product called SurfaceSafe is the only commercially available product containing these chemicals in the recommended concentrations. It consists of a kit of two packaged pads that are designed to be used on surfaces in and around mixing and administration areas.

Decontamination of the BSC should be performed on a regular basis (e.g., weekly, monthly) and whenever there is a spill in the BSC. The operator should wear PPE, including gown, gloves and utility gloves, mask, face shield, and hair covering. The decontamination process involves lifting all removable parts for cleaning and disinfecting. All parts should be decontaminated within the cabinet, not removed for cleaning. Treat all cleaning and rinsing solution as contaminated waste. Discard all PPE in a hazardous waste container.

Drug Administration

Administering hazardous drugs by any route naturally involves risk of exposure. The following guidelines apply to all practice settings.

- Perform all work below eye level.
- Have access to a spill kit.
- Use administration sets, needles, and syringes with locking connections.
- Gather all supplies for drug administration, including those shown in Table 3 in the original guideline document.
- Inspect the delivery bag and its contents prior to handling. Don PPE before reaching into the delivery bag to remove the drug container.

IV Infusions

Safe practices to follow when administering IV hazardous drugs begin with hand washing. Don gloves, a gown, and, if there is a risk of splashing, a face shield. Gloves should cover the elastic or knit cuff of the gown. Spiking of IV bags may be performed in the BSC before the addition of the hazardous drugs or at the site of administration using a dry-spike extension and backflow technique. Securely attach the IV tubing to the patient's venous access device or, if using a secondary

set, to the primary tubing. Use a disposable plastic-backed absorbent liner under the connection site, if necessary. Dispose of gown, gloves, and liner by sealing them in a plastic bag and discard them in a hazardous drug disposal container. At the conclusion of the infusion, wash hands and don appropriate PPE. Remove the bag or bottle containing the hazardous drug with the tubing attached. Place all contaminated material along with PPE into a sealable plastic bag, and dispose of it in a puncture-proof, leak-proof container. Don gloves and decontaminate equipment used during administration (e.g., infusion pump, bedside table). Wash hands thoroughly.

IV Injections

Place a plastic-backed absorbent pad under the patient's arm to absorb leaks and prevent drug contact with the patient's skin. Although needleless systems reduce the risk of needle sticks, there is a risk of droplets leaking at connection points. Wrap sterile gauze around injection ports during IV push procedures to reduce the potential for spraying drug into the environment when attaching or removing the syringe. At the completion of administration, place contaminated materials along with PPE in a sealable plastic bag and dispose of it in a puncture-proof, leak-proof container. Don gloves and decontaminate equipment used during administration. Wash hands thoroughly.

Intramuscular or Subcutaneous Injection

Syringes should have locking connections and be less than three-fourths full. Wash hands and don gloves before removing the syringe from the delivery bag. Remove the cap and connect a sterile needle of the appropriate size for administering the drug. Do not expel air from the syringe or prime the needle. After administering the drug, do NOT recap, clip, or crush the needle. Place the syringe with the needle attached directly into a puncture-proof container specifically designed for hazardous waste. Remove PPE and seal in a plastic bag. Dispose of it in the appropriate container. Don gloves and decontaminate equipment used during administration. Wash hands thoroughly.

Oral or Topical Agents

Tablets or capsules may produce dust that can be inhaled, and ointments or other compounded topical agents may splatter and come in contact with skin or mucous membranes. All manipulation of tablets, such as crushing or mixing with food or fluids, or compounding of topical agents should be performed inside the BSC. Wash hands and don gloves before removing the drug from the delivery bag. PPE should include a face shield if there is a potential for sprays, aerosols, or splattering of the hazardous agent. Protect the work area with a plastic-backed absorbent pad, if necessary. Seal all materials used in the administration of these agents in plastic bags and dispose of as hazardous waste. Remove PPE, seal in a plastic bag, and dispose of in appropriate container. Don gloves and decontaminate equipment used during administration. Wash hands thoroughly.

Intracavitary

Intracavitary administration includes, but is not limited to, the instillation of hazardous drugs into the bladder, peritoneum, chest, or any other body cavity.

These procedures may represent a significant opportunity for exposure because the drug delivery equipment used is not designed to protect healthcare workers. Select equipment with locking connections whenever possible. Don gloves, a gown, and a face shield. Place plastic-backed absorbent pads under the patient. Wrap sterile gauze around the connection to reduce the potential for spraying drug into the environment when attaching or removing the tubing or syringe.

For intraperitoneal (IP) administration, hazardous drugs are delivered either through an IP port or an external catheter. When using an IP port, use IV tubing with locking connections. Anchor the needle to the port septum as securely as possible. When using an external catheter for IP drug delivery, use an adapter that will accommodate a locking connection, if possible. After drug delivery and prescribed dwell time, attach the drainage bag to the connection and lower it to collect the residual solution. Handle the residual solution as contaminated body fluid, wearing a gown, gloves, and face shield. Dispose of all materials used in the administration as hazardous waste. Remove PPE, seal in plastic bag, and dispose of in appropriate container. Don gloves and decontaminate equipment used during administration. Wash hands thoroughly.

For bladder administration, the hazardous drug is usually provided in a catheter-tip syringe for direct instillation through a Foley catheter. Take care to prevent leaks and sprays from a loose connection or from excessive pressure during drug delivery. Clamp the catheter after instilling the drug to minimize backflow of the drug during connection to the drainage system. After the drug delivery and prescribed dwell time, open the clamp and collect the residual solution in the drainage bag. Handle the urinary drainage as contaminated body fluid, wearing a gown, gloves, and a face shield. Dispose of all materials used in the administration as hazardous waste. Remove PPE, seal in a plastic bag, and dispose of in an appropriate container. Don gloves and decontaminate all equipment used by the patient during administration. Wash hands thoroughly.

Aerosolized Drugs

When administering aerosolized hazardous drugs, a National Institute for Occupational Safety and Health (NIOSH)–approved respirator should be worn. This should be a closed inhalation system in accordance with NIOSH respirator guidelines.

Post-Administration Issues

Body Fluids

Variable amounts of drugs and metabolites are excreted in the urine, stool, and other body excreta of patients receiving hazardous drugs. Forty-eight hours is a standard time frame recommended for precautions to be implemented because the majority of drugs will be excreted within this time. However, for some drugs, the excretion may be delayed as long as seven days in the urine and seven days in the stool. Although 48 hours is a well-accepted duration for precautions, Table 4 in the original guideline document lists specific time frames for many hazardous drugs based on their specific excretion patterns. Some practice settings may prefer to adapt drug-specific time frames for instituting protective precautions.

Implement standard precautions for 48 hours after completion of therapy when handling the body fluids or linens of patients who have received hazardous drugs. Use is specified of latex or other appropriate gloves and a gown whenever handling body fluids, particularly urine, of a patient who has received hazardous drugs. A face shield must be worn whenever splashing is possible.

In a survey of 824 nurses from 10 hospitals, it was reported that while handling excreta of patients being treated with antineoplastic drugs, 66% of nurses wore gloves, 16% wore a gown, and 3% donned a disposable impervious gown with cuffed sleeves and a back closure. In another study, glove use among nursing staff was 92% to prepare antineoplastic drugs, 82% to administer them, 89% to clean up spills, and 75% to handle patient excreta. When nurses do not follow standard precautions, they are placing themselves at risk for hazardous drug exposure.

In addition to donning PPE, nurses and their colleagues should investigate other ways to reduce exposure to hazardous drugs found in body fluids. Such measures may include

- Utilizing patients' weights rather than intake and output to monitor fluid status.
- Weighing urinary output collected in drainage bags, rather than measuring volume, to reduce the risk of splashing when transferring urine into a second container before disposal.
- Encouraging men to sit on toilet seats rather than standing to reduce the risk of aerosolization and droplet transfer.
- When feasible, encouraging use of toilets rather than urinals and bedpans so that excreta can be disposed of immediately.
- When applicable, collecting drainage of pleural fluids, ascites, and other body fluids in a closed system that can be disposed of intact.
- If possible, using disposable ostomy pouches rather than rinsing and reusing them.
- Protecting the skin of incontinent patients from their own excreta. The metabolites of drugs found in the urine or stool may be damaging to the skin. Cleanse the skin with soap and water and apply a moisture barrier to the perineal and perirectal areas following each urination or stool. Apply a clean disposable diaper.

The literature has suggested that toilets be double flushed, with the lid down, for 48 hours following the administration of hazardous drugs. No published research has established that double flushing is an effective practice. Some healthcare organizations have deemed the practice unnecessary because hospital toilets have powerful, high-pressure flushing mechanisms. Many institutional toilets do not have a lid, which may lead to increased aerosolization during flushing.

Some nurses are reluctant to teach patients to double flush at home to avoid placing unnecessary fears on the patient or family. However, it seems prudent that nurses have a discussion with patients concerning the presence of hazardous drugs and their metabolites in the excreta. Nurses should determine whether small children might play in the toilet bowl or whether pets use it as a source of drinking water. One also could argue that anyone with a newer toilet with decreased gallons/flush should double flush. Once patients are aware of the

reason for double flushing, they will be better able to make an educated decision about the practice. Healthcare organizations also should examine possible benefits of instituting the practice.

Linen Handling

Healthcare workers and family members handling linens and other laundry items contaminated with urine, stool, and other excreta of a person receiving hazardous drugs should wear disposable gowns and gloves. Eye protection is necessary only if splashing is likely. After use, discard gloves and gowns in an appropriately labeled hazardous waste container.

Disposable or leak-proof items should be used when contamination with urine, stool, or other excreta is likely because of incontinence, vomiting, or draining fluids. Although no studies have examined this aspect of occupational exposure, several common-sense guidelines have been developed. Thus, disposable diapers are preferred over cloth diapers. Discard these items with other hazardous wastes by placing them in appropriately labeled plastic bags intended for hazardous waste disposable.

If bed linens or clothing become contaminated with urine, feces, or other excreta, pre-laundering before washing with other linens is recommended. This may be accomplished by placing the soiled, contaminated linens in an impervious laundry bag labeled "hazardous drug contamination." Laundry personnel wearing latex gloves and gowns will be alerted to pre-wash the laundry with detergent before mixing items with the general institution laundry. One alternative many organizations use is to treat all laundry as if it were contaminated with hazardous drugs or infectious wastes. In such circumstances, linens contaminated with urine, feces, and other excreta (from people who may or may not be receiving hazardous drugs) are placed together in a single leak-proof bag. Subsequently, personnel donning PPE from head to toe double wash all laundry. This situation treats all linens as contaminated, thus reducing the accidental exposure of laundry personnel to hazardous drugs and other contaminants.

Care providers in the home should take precautions to reduce their own exposure by wearing a gown and gloves and carrying the soiled items away from their bodies. Double washing also is recommended when linens are contaminated with urine, feces, or other excreta for 48 hours following completion of hazardous drug treatment. When possible, contaminated linens should be placed directly into the washing machine to reduce subsequent handling and its associated exposure potential. Another alternative is to place the contaminated laundry in a laundry bag or pillowcase until placed into the washer. Laundry should be washed twice with regular detergent in hot water in a washing machine. The contaminated laundry should be washed separately from other household laundry.

There are no clear guidelines for the management of contaminated mattresses, pillows, chairs, or other large items contaminated with excreta. In some settings, contaminated items such as pillows are discarded into appropriately labeled plastic bags or puncture-proof hazardous waste containers. In other settings, they may be double laundered. Organizations should consider developing procedures for such events, as they are bound to occur. Common sense dictates that the best

way to handle such situations is to use waterproof mattress covers, plastic-coated pillows, and vinyl or nonabsorbent chair cushions.

Disposal of Hazardous Drugs

Hazardous waste must be handled separately from other medical waste to ensure that those individuals handling the waste are protected from potential exposure. The U.S. Environmental Protection Agency (EPA) defined medical waste as "any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals."

Medical waste includes infectious (so-called "red-bag" waste) and noninfectious waste. It refers to biologic substances or wastes that come in contact with biologic substances.

Hazardous waste is defined by the EPA as waste that may "(i) Cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (ii) pose a substantial present or potential hazard to human health or the environment when it is improperly treated, stored, transported, disposed of, or otherwise managed."

Hazardous wastes are substances that are listed as toxic by the EPA or possess one or more of the following characteristics: acute toxicity, ignitability, corrosivity, or reactivity. Certain hazardous drugs become hazardous wastes when they require disposal. Several chemotherapy agents (e.g., chlorambucil, cyclophosphamide, daunomycin, melphalan, mitomycin C, streptozocin) are U-listed, meaning that the EPA regulates their handling from "cradle to grave." Many other hazardous drugs have characteristics similar to those listed drugs. Although their disposal is not subject to the same regulations, safe handling precautions still apply.

Hazardous drug waste containers must be available in all areas where hazardous drugs are prepared and administered. The waste containers should be puncture proof, have a lid that seals securely, and be labeled with an appropriate warning. The warning label identifies the contents as hazardous so that the individuals transporting the waste are alerted to the need for special handling. The container should be distinctly different from other types of waste containers (such as those used for infectious waste) and should be used only for hazardous drug waste. Plastic bags may be used to collect hazardous waste, such as the sealable bag that is used for drug transport, but these should then be placed inside a rigid waste container so that all waste is essentially "double bagged." Keep the lid closed on hazardous drug disposal containers except for when placing contaminated materials into the containers. These practices reduce the risk of drug vapors being released into the environment.

Any item that comes in contact with a hazardous drug during its preparation or administration is considered potentially contaminated and must be disposed of as hazardous waste. Such items include needles, syringes, empty drug vials, ampoules, IV tubing, IV bags or bottles, connecting devices, gauze, alcohol wipes, and paper drapes. Such items should be discarded intact to reduce the possibility

of dispersing drug droplets. For this reason, crushing or clipping needles is not recommended.

Sharp or breakable items must be placed in a puncture-proof container. Use of protected needle devices for intramuscular or subcutaneous injections of hazardous drugs is highly recommended. A disposal container should be present at the site of drug administration to eliminate the need to transport an exposed needle. This recommendation also applies when discontinuing an IV access device with an exposed needle.

PPE, such as gowns, gloves, or face shields, worn during drug handling should be disposed of in a hazardous waste container. Reusable items that have been contaminated should be handled while wearing PPE and cleansed with soap and water before returning to use.

Disposable items contaminated by body fluids of patients who have received hazardous drugs in the previous 48 hours are considered contaminated. Discard disposable items such as pads, diapers, urinals, bedpans, measuring devices, Foley catheters, and drainage bags in hazardous waste containers.

Avoid over-filling disposal containers. Healthcare workers should not reach into hazardous waste containers when discarding contact material. Seal waste containers when three-fourths full. Once sealed, notify the appropriate personnel to remove the waste containers from the preparation or administration area. Only individuals who wear appropriate PPE and who have been trained regarding the exposure risks should handle the hazardous drug waste containers.

Hazardous drug-related wastes should be handled separately from other hospital trash. Waste must be stored in a secure area in covered, leak-proof containers or drums with distinct labels such as "CAUTION: HAZARDOUS WASTE." Only licensed disposal contractors may transport hazardous waste from the facility for final disposal. Such contractors must meet local, state, and federal requirements as determined by the EPA. The actual disposal must be performed according to federal, state, and local ordinances. This normally is done in a state-licensed incinerator. All those involved in hazardous drug disposal must maintain records related to the transport and disposal.

Management of Spills

Great caution should be taken when handling hazardous drugs in order to prevent spills. However, some spills are inevitable. Spill kits must be available wherever hazardous drugs are stored, prepared, or administered. Anyone who handles hazardous drugs should know where to access a spill kit and how to clean up a spill.

Instruct patients to notify the nurse should a leak occur or if they are exposed to a hazardous drug. When patients receive chemotherapy at home, the patient and family members need to be informed of how to handle a spill. The patient and family should have a spill kit available, be instructed on how to use the kit to clean up the spill, and notify the nurse about the spill.

A small spill is considered to be one that is less than 5 ml or 5 g outside of a BSC. A large spill is greater than 5 ml or 5 g. The size of the spill does not refer to the magnitude of the hazard but rather the need for additional procedures in some facilities. Some institutions require notification of a "spill team" for large spills. When a large spill occurs, limit access to the area. Post a warning sign if necessary. Use a hazardous drug spill kit to clean up the hazardous agent. The personnel cleaning up a spill are required to wear PPE, including a gown, double gloves, respiratory protection, and an eye shield. A spill kit should include the following.

- 1 gown (disposable, nonpermeable, with back closure)
- 1 pair of shoe covers
- 2 pairs of appropriate thickness chemotherapy-type gloves
- 1 pair of utility gloves
- 1 pair of chemical splash goggles
- 1 respirator mask approved by NIOSH
- 1 disposable dustpan
- 1 plastic scraper
- 2 plastic-lined disposable towels
- 250 ml and 1 liter spill-control pillows (optional)
- 2 disposable sponges
- 1 puncture-proof container
- 2 large heavy-duty waste disposal bags
- 1 hazardous waste label

Procedure for Cleanup of Spills

Assess the hazardous exposure of any individual involved and isolate the individual from the spill. If the individual's clothing or skin has made contact with the hazardous agent, immediately wash the area with soap and water (see "Accidental Exposure" section). Only trained personnel should clean up a hazardous drug spill, and everyone administering hazardous drugs should be trained in spill cleanup. The following guidelines should be used when cleaning up a spill.

- Don PPE from the spill kit, including two pairs of gloves, a gown, and a face shield.
- Wear a NIOSH-approved respirator mask.
- Contain the spill using spill-control pillows or absorbent towels.

To clean a liquid spill on a hard surface, wipe up liquids using absorbent gauze pads or spill-control pillows. Pick up glass fragments by using a small scoop or by donning utility gloves over chemotherapy gloves. Place glass in the puncture-proof container using the designated scoop. Place waste materials in the heavy-duty waste disposal bag and label the bag with the hazardous waste label. Clean the spill area three times, beginning with the least contaminated area and finishing with the most contaminated area. Use a detergent solution followed by water. Remove PPE and place in the waste bag. Seal the waste bag and place it in a puncture-proof container.

To clean a spill on a carpeted area, don PPE, including respirator mask. Use an absorbent powder to absorb the spill. Use a small vacuum cleaner that is used

only for hazardous drug cleanup to remove the powder. Clean the carpet according to the institutional procedure.

Clean reusable items contaminated by hazardous drugs following the guidelines for cleaning spills on a hard surface. Wear PPE during cleaning and dispose of it appropriately.

Spills Within Biologic Safety Cabinets

Spills within BSCs that are less than 150 ml in volume of solution, which is diluted or undiluted, or less than one entire drug vial should be cleaned according to the procedures for cleaning small and large spills. Spills greater than this volume need to be cleaned followed by decontamination of the BSC. If the spill contaminates the HEPA filter, the BSC should be sealed with plastic and not used until a technician can change the HEPA filter.

Complete an incident or variance report to document that the spill occurred and identify the individual(s) exposed. Include events leading up to the spill, the drug involved, the estimated volume of the spill, the cleanup procedures used, any individuals exposed, and those involved in the cleanup. Exposed individuals should be referred for medical evaluation, as described in the section on accidental exposure.

Accidental Exposure

Even with the diligent use of PPE and meticulous attention to safe handling techniques, accidental exposures to hazardous drugs can occur. Accidental exposure may involve contamination of clothing, protective equipment, and/or skin and mucous membranes. One-quarter of healthcare workers involved in hazardous drug handling have reported skin contact with the drugs. Additionally, healthcare workers may be unknowingly exposed (see Figure 3 in the guideline document). In clinical practice, many accidental exposures may go unnoticed and unreported. It is imperative that nurses be attentive to the possibility of exposure.

Following known exposure, the individual should remove PPE and/or clothing that has been contaminated, taking care not to spread the contamination. The affected area should be washed immediately with soap and water. The exposed individual should follow up with the employee health nurse for triage or go directly to the emergency room, as institutional policy directs. Published literature does not contain a recommendation for the specified amount of time necessary for washing the skin.

In the event of eye exposure to hazardous drugs, the eye should be immediately flushed for at least 15 minutes with either water or isotonic eye wash. Because of the risk of eye exposure, areas where hazardous drugs are handled should have a sink with an eye wash station. Two functionally equivalent and cost-effective alternatives to an eye wash station are an IV bag of 0.9% sodium chloride solution (normal saline) connected to IV tubing or an irrigation bag of water or normal saline with attached tubing. In either situation, staff must have enough solution for a 15-minute eye wash.

The Occupational Safety and Health Administration (OSHA) specified a 15-minute time frame for eye wash in the event of eye exposure. Both the previous edition of this module and the ONS *Chemotherapy and Biotherapy Guidelines and Recommendations for Practice* recommended at least a 5-minute eye wash. However, a conservative approach is to follow the guidelines for lengthier eye wash time rather than risk scleral and corneal damage as a result of hazardous drug exposure.

The American Society of Health-system Pharmacists (ASHP) and OSHA do not provide specific guidelines on the management of accidental inhalation of hazardous drugs in powdered form or procedures for accidental ingestion. The best resources on these types of accidental exposure are material safety data sheets (MSDSs) provided by the drug company or available through other sources. MSDSs for each hazardous drug contain information on steps to take in the event of accidental exposure. MSDSs identify

- Whether skin, inhalation, or ingestion are routes of entry
- Signs and symptoms of exposure
- Acute and chronic health hazards
- Emergency and first-aid procedures

Thus, in the event of accidental exposure, the exposed individual or those treating the individual should review applicable MSDSs. In some instances, the MSDS provides limited information and refers to the drug´s package insert. Consequently, package inserts should be readily available for reference. The MSDS and package inserts should be stored wherever the drugs are prepared or administered or in a central place (e.g., pharmacy, emergency department, occupational health), where they can be accessed quickly. Additional advice from a specific manufacturer can be obtained from the medical affairs department of many companies.

After the initial care for the accidental exposure, the individual should receive follow-up medical care. This may be in an employee health department, occupational health clinic, emergency department, or elsewhere, as designated in the institution's policy manual. The medical care should be based on the exposure and may be different for various routes of exposure and types of hazardous drugs. Again, these policies should be set up in advance.

Accidental exposure can occur in any setting. Thus, nurses working in inpatient areas, home care, outpatient clinics, and all other settings must possess the appropriate protocols for dealing with accidental exposure and other emergencies. Additionally, nurses handling hazardous drugs in the homecare setting should carry the necessary first-aid equipment, written procedures, and emergency phone numbers to call for assistance. In all settings, nurses must be trained to respond to accidental exposures.

Medical Surveillance of Healthcare Workers Handling Hazardous Drugs

The classical occupational health approach to controlling exposure to workplace hazards also applies in the healthcare venue. In addition to using engineering, work practices, and PPE to control and prevent exposure to hazardous drugs,

workers who handle these agents should be routinely monitored in a medical surveillance program.

Medical Surveillance

Refer to the original guideline document for a discussion of the purpose of medical surveillance.

Elements of Medical Surveillance

History

A thorough history is probably the best and most cost-effective source of useful information. Medical and occupational information may be collected via questionnaire. Questionnaires are an efficient means of collecting a standardized set of information and can provide documentation of changes in symptoms or the onset of health problems over time. The questionnaire should be reviewed with the worker to clarify answers and obtain more detail for responses that suggest a potential health effect.

Medical history. The medical history may help clinicians to interpret laboratory data obtained in the surveillance program, or it may identify a worker at potentially high risk in a particular exposure setting. For example, a person with documented asthma would be at increased risk in a job where exposure to respiratory irritants or sensitizers is possible. Symptoms discovered in the medical history may serve as an early warning of a potential problem (i.e., sentinel health event) to the occupational healthcare professional. Symptom questions should focus on organ systems that are targets for the hazardous agent in question. The preplacement medical history should be very detailed. Periodic evaluations can be less exhaustive, focusing on signs and symptoms related to exposure to hazardous drugs and changes in health status since the previous evaluation.

Recording symptoms thought to be caused by drug exposure may give insight into drug-handling practices and alert healthcare professionals to a potential problem. For example, complaints of lightheadedness and dizziness were reported in antineoplastic drug handlers who did not use recommended handling procedures. In addition, a group of nurses exposed to drugs had significantly more hair loss and headaches than did unexposed controls. These symptoms and others known to occur in patients receiving these drugs for treatment should be investigated. Further symptom questions should focus on the known target organs of the agent of exposure. In the case of antineoplastic drugs, special emphasis should be given to the skin and the hematopoietic, hepatic, reproductive, and urinary systems (see Figure 4 in the original guideline document). Constitutional symptoms, including significant, unintentional weight loss, fever, malaise, and unexplained fatigue, may be associated with anemia and hematologic malignancies. These constitutional symptoms should be included in a checklist and pursued in greater detail if they are present. Changes in the presence or frequency of symptoms over time can be an important clue.

Special consideration should be given to the reproductive history of employees handling hazardous drugs. General questions regarding problems in conceiving and poor reproductive outcomes (spontaneous abortions and fetal malformations)

should be included. Male employees should provide information about the reproductive histories of their partners. For female employees, it is useful to request a complete reproductive history of each pregnancy, including dates, outcome, and work history during pregnancy. A sample reproductive history questionnaire from the literature is shown in Figure 5 in the original guideline document.

Work history. Estimating drug handling history may serve as a surrogate measure of the potential exposure dose. Knowing whether drug handlers wear PPE, such as gowns, gloves, masks, and eye protection, will assist healthcare professionals in determining the opportunity for exposure. Use of a BSC during preparation of the drugs also should be noted. Documentation of past untoward events, such as accidents and spills, assists healthcare professionals in estimating opportunity for exposure. A review of the frequency and duration that a worker handles hazardous drugs can be included in the periodic medical exam.

Physical Examination

The physical examination is probably the least helpful source of surveillance data, given the disease outcomes of concern in these workers. However, a baseline exam is useful for documentation of any preexisting findings. Periodic exams should focus on the skin and mucous membranes. The clinician should look for signs of rash, irritation, or other evidence of acute exposure. Evaluation of other target organ systems is also desirable. For example, hepatomegaly, splenomegaly, and lymph node enlargement may be associated with hematologic malignancies. In general, the hematopoietic, hepatic, renal, and urinary systems are more easily evaluated in laboratory studies, and significant illness would likely be picked up from medical history and symptom queries.

Laboratory Studies

Specific laboratory studies should include a complete blood count with differential to monitor hematopoietic function. A reticulocyte count also would be helpful as an indication of bone marrow reserve. Altered liver function test results and evidence of liver damage have been reported in nurses handling antineoplastic drugs. To follow hepatic function, liver transaminase concentrations (e.g., AST, ALT) and alkaline phosphatase may be measured. Several antineoplastic agents, especially cisplatin, have toxic effects on the kidney in patients receiving therapeutic doses. Little renal toxicity has been documented to date in hazardous drug handlers. The usefulness of serum creatinine to assess renal toxicity is uncertain for these workers. A urine dipstick test or a microscopic examination of the urine for blood may be helpful because many hazardous drugs cause bladder damage and hematuria in treated patients. A list of the suggested laboratory studies is given (see Figure 6 in the original guideline document). These tests are relatively inexpensive, and any that are not already part of an employee health evaluation program can be added to a routine panel that already may be in place.

Biologic Monitoring

Refer to the original guideline document for a discussion on biologic monitoring.

Record Keeping

In addition to the periodic review of individual and grouped data to detect trends over time, OSHA recommended that an ongoing registry be maintained of all employees who routinely handle hazardous drugs. In the same way that a record is kept of the lifetime dose of certain chemotherapy drugs received by a patient, a drug-handling history should be maintained in the worker's employee health record. It is not necessary to record every instance of drug preparation and administration, although that would be ideal. This record should at least track the healthcare worker by duration of assignment to a drug handling job and the historical use of BSCs, work practices, and use of PPE.

The drug-handling history then could be used as a surrogate for exposure dose, although "drug dose handled" and "exposure dose to the worker" are obviously not equivalent. The record can, however, be used to estimate the exposure dose and duration and may help in the interpretation of medical surveillance results.

The resources of an individual hospital or health system best determine the mechanics of a record-keeping program. The increasing use of computerized data systems to organize medical information provides the opportunity to incorporate records of occupational drug handling into the current databases.

Pharmacies typically keep a log to record each drug prepared and the name of the preparer. Pharmacies that issue computerized labels for each drug prepared may be able to modify their systems to internally record an identifier for the drug preparer. They also may generate several drug labels, which could be used in tracking the nurses who administer the drug. One label could be placed in the patient's chart and initialed by the nurse who gives the drug, and another label could be placed in a hazardous drug logbook and initialed by the nurse. The pharmacy preparation log and administration log could be reviewed periodically to compile a drug-handling history for each employee. Electronic pharmacy systems that employ bar coding to track drug preparation and administration may use electronic IDs to track personnel, which is another potentially useful means of estimating exposure to hazardous drugs for healthcare workers.

The employee health service and the safety committee could assist in implementing a record-keeping program to track employees who handle hazardous drugs. Data extraction from computerized information systems could result in automatic updates of exposure duration and intensity once the procedures are in place. These records would provide guidance in the interpretation of results from periodic medical surveillance of exposed employees.

Essential Components for Medical Surveillance of Hazardous Drug Handlers

Limited resources may preclude the implementation of a comprehensive medical surveillance program for healthcare workers who are exposed to hazardous drugs. For institutions that do not have the means to develop a comprehensive surveillance program, a few key elements may serve to track employees´ exposures. In healthcare institutions where some form of periodic employee health evaluation is already in place, new elements of surveillance may be added to screen hazardous drug handlers for their specific health risks.

- Maintain a list of all workers who are exposed to hazardous drugs as a part of their job.
- Have all hazardous drug handlers complete an annual questionnaire to track the frequency and duration of contact with these agents, their use of PPE, and any health events that are potentially related to hazardous drug handling.
- Conduct periodic observations of drug preparation and administration practices to determine the need for refresher training in work practices that reduce exposure.
- Carefully document spills, spill cleanup activities, and accidental exposure.
- Share the results of medical surveillance with the employees who handle hazardous drugs.

Conclusions

Effective medical surveillance requires thoughtful planning and organization. The endpoints of the surveillance program should be defined and their significance validated. Data collection as a part of medical surveillance should be meticulous, allowing for sound epidemiologic analysis of grouped data. When adverse outcomes are detected through medical surveillance, appropriate preventive actions should be taken to reduce future risks for workers. Finally, the employees who are monitored by the medical surveillance program should be promptly informed of both their individual results and group findings, and the significance of these findings should be conveyed.

A number of OSHA standards affecting the healthcare industry have medical surveillance provisions, including ethylene oxide, formaldehyde, and blood-borne pathogens. Therefore, including medical surveillance in a comprehensive approach to controlling adverse health outcomes from hazardous drug exposures is not novel in the healthcare setting. Targeted tailoring of existing preplacement or periodic health evaluations performed at many institutions can assist in the seamless integration of hazardous drug surveillance into a generic employee health program. Healthcare workers who handle hazardous drugs and administrative personnel responsible for providing a safe workplace for these employees, working in concert with employee healthcare professionals, can successfully develop and implement a surveillance program that enhances health protection. Surveillance complements other hazard control strategies and can help to ensure the safest workplace possible, where these useful therapeutic agents are handled in a way that protects employee health and minimizes risk.

Staff Education Training

Introduction

Despite the fact that healthcare professionals have been aware of the potential hazards surrounding the administration of antineoplastic drugs since the 1980s, recent studies have shown that practice differs dramatically from policy. Nurses were surveyed in 10 hospitals in the Netherlands regarding safe handling practices. They found that although 94% of the respondents thought that PPE was effective, only 91% reported wearing gloves, 21% wore gowns, and only 3% used goggles or safety glasses. They also found that 34% of the nurses were attaching IV tubing while the bag was hanging on the pole, thus increasing the risk of spray formation and leakage. The authors found that guidelines of the hospitals

surveyed were not up to date, and even at sites with up-to-date policies, the nurses did not always follow the guidelines. A study reported on safe handling practices among Israeli nurses and correlated this with their knowledge and health beliefs. They found that 58% of those mixing drugs used latex gloves, 23% wore gowns, and 6% wore masks. During administration, they reported that 32% wore latex gloves, 3% wore gowns, and 3% wore masks. The authors did not assess the use of goggles or safety glasses. It was identified that use of PPE increased with knowledge and beliefs of susceptibility and benefit. This led to the conclusion that there was a need for education and training.

Agencies must have a system for validating staff performance, and this must be documented. Staff must be evaluated according to their conformity to standard procedures. It is recommended that quality-improvement programs evaluate compliance with safe handling procedures. In addition, current MSDSs must be readily available in the areas of hazardous drug preparation and administration, as well as in a central location within the facility, in compliance with employees´ right to know and other regulatory standards.

Initial Education and Training

Programs for the training of employees who handle hazardous agents must be developed. The initial program should include safety procedures for personnel, based on their specific roles related to hazardous drug handling, such as

- Use of engineering controls
- Use of PPE
- Drug preparation
- Drug transport
- Drug administration
- Disposal of hazardous materials
- Management of hazardous drug spills
- Management of acute exposure.

An educational program based on the material in this module would meet the requirements for establishing the initial knowledge base related to safe handling. All individuals who have potential contact with these hazardous drugs should complete such a program during orientation. Hazardous drug courses should include a review of safe handling practices. Training programs also should review the institutional policies regarding safe handling. A knowledge assessment can be used to document learning.

Once employees are in their work area, they should be observed using safe handling techniques based on practice guidelines of the institution and/or professional organizations. A checklist is one way of documenting adherence to safe handling precautions (see Appendix A in the original guideline document).

Periodic Education and Training

Annual reviews of policies, procedures, guidelines, and updates regarding safe handling must be mandatory for all personnel involved in handling hazardous drugs. Attendance at this program must be documented. Programs should include a review of the same content as initial training plus a review of spill, acute

exposure, and emergency response procedures involving employees, patients, and others. Updated lists of hazardous drugs and MSDSs should be reviewed. All staff members who are involved in the handling of hazardous drugs should attend these programs. Oncology nurses may have this information included in their annual chemotherapy competency and be observed for adherence to practice at that time.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is not specifically stated for each recommendation.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Safe handling of hazardous drugs by nurses and other health care personnel: Increased compliance with work practice guidelines, use of safe handling practices, and use of personal protective equipment should decrease the number of hazardous drug exposures with a concurrent decrease in the number of reported acute symptoms.

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

The guideline document is published by the Oncology Nursing Society (ONS). ONS neither represents nor guarantees that the practices described therein will, if followed, ensure safe and effective patient care. The recommendations contained in the guideline document reflect ONS's judgment regarding the state of general knowledge and practice in the field as of the date of publication. The recommendations may not be appropriate for use in all circumstances. Those who use the guideline document should make their own determinations regarding specific safe and appropriate patient-care practices, taking into account the personnel, equipment, and practices available at the hospital or other facility at which they are located. The editors and publisher cannot be held responsible for any liability incurred as a consequence from the use or application of any of the contents of these guidelines. Figures and tables are used as examples only. They are not meant to be all-inclusive, nor do they represent endorsement of any particular institution by the Oncology Nursing Society (ONS). Mention of specific

products and opinions related to those products do not indicate or imply endorsement by ONS.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Staying Healthy

IOM DOMAIN

Effectiveness
Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

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GUIDELINE AVAILABILITY

Electronic copies: Not available at this time.

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AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

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