

## Hazardous Spills: The Safe Handling of Hazardous Drugs

### ABSTRACT

Healthcare practitioners may underestimate the exposure risk associated with hazardous drugs. The risk of exposure extends along the drugs' entire life cycle, including the manufacturing, transporting, dispensing, and administering processes. The safe handling of hazardous drug spills is uniquely different from other healthcare spills, and exposure extends beyond patients and healthcare practitioners because nonclinical staff are often involved with the containment and disposal of spills. PA-PSRS has received more than 40 reports of patients and staff exposure to hazardous drugs. Many events involved intravenous (IV) tubing disconnections resulting in hazardous drugs leaking to the floor, the patient, hospital gowns, and linens. Many exposure incidents were attributed to IV port or site leaks and involved IV spiking issues, resulting in large hazardous spills. Risk reduction strategies include developing a hazardous drugs program; encouraging personnel compliance in the storing, dispensing, transporting, and administering of these medications; managing spills; and disposing of hazardous drugs in such a way that the most appropriate guidelines are used to minimize exposure. (*Pa Patient Saf Advis* 2008 Sep;5[3]:96-9.)

Accidental patient and staff exposures during hazardous drug administration have been reported through PA-PSRS. These exposures increase the potential for harm to patients and staff. The most often referred to U.S. guidelines for the safe preparation, dispensing, and administration of hazardous medications are from the National Institute for Occupational Safety and Health (NIOSH), American Society of Health-System Pharmacists (ASHP), Oncology Nursing Society (ONS), and Occupational Safety and Health Administration (OSHA).<sup>14</sup> There have been 42 reports of accidental hazardous drug events submitted through PA-PSRS since the program's inception in 2004. Two-thirds of the reported events were attributed to intravenous (IV) tubing disconnections, resulting in hazardous drugs leaking to the floor, the patient, hospital gowns, and linens. The remaining reported events were attributed to IV port or site leaks, IV spiking, and other issues (see Table). One-third of reported events involved volume amounts ranging from 7 mL to the entire contents of the medication IV bag, resulting in large hazardous spills.

While there are many helpful strategies for inpatient, outpatient, and office-based healthcare facilities to apply to the safe handling of hazardous drugs, the first strategy is to recognize the problem. Facilities may consider developing programs for the interdisciplinary safe handling of hazardous drugs that

incorporate national guidelines and outline policies and personnel compliance.

In 2004, the NIOSH Working Group on Hazardous Drugs revised the 1990 ASHP hazardous drug definition to include one or more of the following criteria:<sup>1,2,5</sup>

- Carcinogenicity
- Teratogenicity
- Reproductive toxicity
- Organ toxicity at low doses
- Genotoxicity
- Structure or toxicity similar to drugs classified as hazardous using the above criteria

While the ASHP, OSHA, NIOSH, and ONS guidelines for the safe handling of hazardous drugs are readily available, the application of these guidelines is inconsistent, resulting in increased incidence of hazardous drug exposure. Research has revealed measurable levels of hazardous drugs in the urine of healthcare providers who are involved throughout different stages in the drugs' life cycles.<sup>2,5,6</sup> The life cycle of a hazardous drug begins at manufacture and ends at waste disposal in patient care units, outpatient facilities, office-based practices, and home care.<sup>6,7</sup>

Guidelines now include cradle-to-grave considerations for hazardous drugs because some chemotherapy agents can be administered for noncancerous conditions, thus increasing exposure for healthcare practitioners and patients and their families.<sup>6</sup> Exposure extends to surfaces such as countertops and floors and to the arms and hands of nurses.<sup>8</sup> Drug residue inadvertently left on the outside of drug vials during the manufacturing process can also contribute to hazardous drug exposures.<sup>8</sup> Healthcare providers' hazardous drug exposures can occur by means of inhalation, dermal contact, oral intake, and injection, as well as exposure to drug vaporization.<sup>5,6,8,9</sup> Bodily fluids of patients receiving hazardous medications are also potential sources of exposure. Some research indicates that dermal and inhalation exposure can

**Table. Hazardous Spills Reported to PA-PSRS**

TYPE OF HAZARDOUS SPILL	NUMBER OF SPILLS REPORTED	PERCENTAGE (%)
Tubing disconnect	27	64%
Intravenous port/site leak	5	12%
Spiking issues	4	10%
Other	6	14%
<b>Total</b>	<b>42</b>	<b>100%</b>

be attributed to the act of removing bed linens, decanting urine, or cleaning toilets contaminated with hazardous drugs, any of which could potentially expose environmental services and housekeeping staff as well as other nonclinical employees.<sup>10</sup>

Consider these examples submitted through PA-PSRS:

*The patient removed his IV [containing] docetaxel, an antineoplastic agent, while in the bathroom, spilling approximately 20 cc to 30 cc on the floor. Physician was notified, and the IV was restarted.*

*Patient dislodged IV while sleeping. Approximately 30 cc of Taxol® leaked onto patient's arm and clothing. Nurse stopped infusion, used "chemo spill kit" to clean patient, and disposed of clothing. Treatment resumed after new IV started.*

Still other accidental exposures occur when contaminated surfaces are touched during the preparation, administration, or disposal of hazardous drugs.<sup>6,10,11</sup>

Oral exposure may occur from hand-to-mouth contact.<sup>6</sup> Crauste-Manciet et al.<sup>12</sup> suggest that hands have been identified as the major route of contamination. Other research reveals that hands, forearms, and foreheads account for 87% of cyclophosphamide (i.e., an antineoplastic alkylating agent) total body exposures.<sup>10,12</sup> Drug reconstitution, transfer between containers, spiking and unspiking IV containers, priming IV tubing, and connecting or disconnecting tubing or syringes from injection ports have also resulted in leaking and surface contamination.<sup>5</sup>

Other examples from reports submitted through PA-PSRS include the following:

*Patient was to receive chemo. When the nurse spiked the bag, it began to leak. This resulted in the bag of chemo being wasted, and a new one was prepared. The dose of chemo was administered 90 minutes later. Staff followed all procedures related to chemo spillage, which was contained to the medication room. No harm came to the patient due to the slight delay in administration of the dose.*

*When the patient arrived, the IV started beeping. The chemotherapy bottle was found dripping onto the IV pole and the floor. The spike had come out of the bottle. The nurse was notified and assessed the situation and reconnected the chemotherapy fluid. A chemo spill kit was used to clean the area, and security was alerted according to the spill kit directions. There was no apparent patient or staff injury.*

*When the nurse entered patient's room during chemo infusion, she noted that the bed linens were wet. Upon further investigation, it was noted that the patient's Cytosar-U tubing had become disconnected and was infusing on the bed. The physician was notified, and the sterile tubing was reconnected. Patient was showered, and area was cleaned according to chemo spill protocol. Physicians recalculated rate so that patient would still receive desired dose of Cytosar-U. Parent notified as well. No further interventions required.*

*IV line connection became disconnected, chemotherapy meds spilled onto patient's bed.*

*Patient called nurse stating her sleeve was wet. Taxol was disconnected. Physician was notified. Approximately 50 cc of fluid spilled.*

*5 cc of busulfan chemo spilled on floor when tubing [was disconnected]. Chemo spill kit used to clean up spill. [Environmental services] cleaned floor following cleanup.*

*Patient was receiving IV chemotherapy. While patient was sleeping, line became disconnected and chemo infusion spilled on floor. Chemo spill kit was used to clean up.*

*Tubing disconnected, and Taxol® spilled on bed. Patient was removed from bed and his clothes and linens were removed. Bed was cleaned by housekeeping.*

While most IV equipment has been designed with patient safety in mind, hazardous spills continue to occur. Leaking and spills from needleless IV connectors are discussed in the following reports submitted through PA-PSRS:

*Nursing staff found chemotherapy infusion tubing wet and approximately 15 cc to 20 cc of fluid on the floor. No cracks or defects were noted in the tubing or the medication bag. Chemo spill kit was used to clean area. Environmental health services cleaned entire floor. The patient remained in bed during the entire cleanup. Physician was notified. No patient injury.*

*Patient presented to [emergency room]; [patient] had a history of cancer and was receiving 5-FU [flourouracil] through port when leakage was noticed. Nurse supervisor notified security and maintenance. Oncologist was notified. Spill was cleaned according to policy and protocol. Patient had port removed and skin cleansed. Linens and nightgown were placed in red bags per policy.*

*Patient with peripheral IV infusing 5-FU in forearm. Leakage noted from IV. Infusion stopped, and IV discontinued and removed. Small contact of drug with skin and linen only. Skin cleansed, and linens removed per policy. Doctor notified. No injury to skin noted. No patient injury noted.*

### Risk Reduction Strategies

Although the 2004 NIOSH guidelines outline the safe handling of hazardous drugs, inconsistent use of these strategies continues. Inpatient, outpatient, and office-based healthcare facilities may consider developing facility-specific protocols and policies to facilitate consistent approaches to the safe handling of hazardous drugs. Consider incorporating the following elements into protocols and practice.

### Safe Handling of Hazardous Drugs Program Development

Develop a program for the interdisciplinary safe handling of hazardous drugs that includes initial and

ongoing education and competencies for all health-care staff. Include ongoing education for nonclinical personnel who are involved with hazardous spill cleanup and disposal. Encourage wide availability of policies and procedures, particularly at community-based practices; one study reported that hazardous drug policies and procedures were available in hospitals significantly more than in community-based practices.<sup>7</sup> Consider employing the pharmacy and therapeutics committee to develop and annually update a list of organization-specific hazardous drugs, as well as policies, procedures, and revisions, for dissemination to the pharmacy and appropriate patient care areas. Make material safety data sheets or drug inserts readily available, and update on an annual basis to provide drug-specific resources for healthcare staff if accidental hazardous exposures occur.

### Personnel Compliance

**Storing hazardous drugs.** Evaluate and monitor the current hazardous drug storage practices and equipment in the pharmacy and patient care areas. Hazardous medications require hazardous drug label warnings and safe storage in segregated areas in pharmacy and patient care units. Use personal protective equipment (PPE), including wearing chemical protective gowns and two pairs of gloves that are changed after 30 minutes or whenever a tear, a puncture, or contamination occurs.<sup>1,3,9</sup> Spill kits must be readily available wherever hazardous medications are stored.

**Preparing hazardous drugs.** Evaluate and monitor the current work practices, equipment used, and physical layout in which hazardous drugs are prepared. Don PPE, such as gowns and two pairs of gloves that are changed every 30 minutes or whenever a tear, a puncture, or contamination occurs.<sup>1,3,9</sup> The likelihood of permeation through two pairs of gloves is low, and the second pair of gloves adds protection from contamination of the healthcare providers' hands when removing gloves. Keep hazardous drug waste containers and spill kits readily available in areas where hazardous drugs are prepared.<sup>9</sup> Maintain environmental/ventilation controls by using a pharmacy-dedicated biological safety cabinet (BSC) with a downward flow and a high-efficiency particulate-air filter. A closed system transfer device adds additional protection. If IV tubing is attached in the BSC, care must be taken to avoid contamination of the tubing with the hazardous drug from the surface of the gloves or the BSC.<sup>1,2,9</sup> Strategies for preparing hazardous drugs by pharmacy staff would include priming of IV tubing with nondrug solution to prevent the risk of hazardous drug exposure in a patient's room.

**Transporting hazardous drugs.** Transport hazardous medications safely from the pharmacy to patient care areas in properly labeled containers. The precautions for staff who handle and transport hazardous medications from the pharmacy to patient care areas include donning two pairs of gloves.<sup>1,3,9</sup> Place medications in clear sealable bags to facilitate verification of the bag's contents without drug removal to minimize

exposure risk. The use of pneumatic tube systems with these drugs is not advised due to the potential for hazardous spills. (See the March 2008 *Pennsylvania Patient Safety Advisory* article, "Pneumatic Tubes: A Possible Patient Safety Vacuum?" available online at [http://www.psa.state.pa.us/psa/lib/psa/advisories/v5n1march\\_2008/mar\\_2008\\_v5\\_n1\\_article\\_pneumatic\\_tubes.pdf](http://www.psa.state.pa.us/psa/lib/psa/advisories/v5n1march_2008/mar_2008_v5_n1_article_pneumatic_tubes.pdf).)

**Administering hazardous drugs.** Keep hazardous drug waste containers and spill kits readily available in patient care areas where hazardous drugs are administered. Perform all work below eye level to reduce eye and facial splash potential.<sup>1,2</sup> Use only needleless devices with closed fittings, syringes, infusion tubing, pumps, and closed systems with locking connections when administering these drugs intravenously.<sup>1,3,6,9</sup> Pharmacy staff can complete priming of IV tubing with nondrug solution before drug preparation to prevent the nursing staff from attempting to prime tubing in the uncontrolled environment of a patient's room.<sup>1,3,6,9</sup> To prevent unintended exposure from leaking of residual fluid once an IV is attached, avoid disconnecting, removing, or unspiking the tubing.<sup>1,2,9</sup> PPE is essential and includes two pairs of gloves, a gown, and appropriate eyewear and face shield as needed to avoid hand, eye, mouth, or nasal exposure.<sup>1,3,9</sup> Place a plastic-backed absorbent pad under the administration area to absorb leaking and prevent patient dermal contact.<sup>1,2</sup> Wash hands with soap and water after glove removal.<sup>1,2</sup> Dispose of all PPE in labeled *yellow* hazardous waste containers.

**Managing spills and disposing of hazardous drugs.** Review the availability of spill kits in your facility near all potential exposure sources. Hazardous spills are considered small when their volume is less than 5 mL or 5 gm outside the BSC; spills are considered large when volumes are greater than 5 mL.<sup>2,4,7,9</sup> When managing small and large spills and disposing of hazardous drugs, wear essential PPE, including two pairs of gloves, a gown, appropriate eyewear, and, if necessary, a NIOSH-approved respirator appropriate for exposure to hazardous drugs. Also, use plastic backed spill-control pillows or absorbent towels for larger spills for employee protection when managing hazardous drug spills.<sup>1,4,9</sup> Decontaminate all interior BSC surfaces after spill cleanup of greater than 150 mL or the contents of one vial.<sup>1,4</sup> Protect employees handling hazardous drug waste from potential exposure. When handling linens or decanting urine or feces from patients who received hazardous drugs within the past 48 hours, staff are best protected by wearing two pair of gloves, a disposable gown, and appropriate eyewear and face shield if splashing is possible because surgical masks do not provide adequate protection from splashes to the mouth, nose, and mucous membranes.<sup>1,2,4,8</sup> Dispose of hazardous drug waste in labeled *yellow* hazardous waste containers; it is managed differently than other medical infectious (i.e., *red* bag) and noninfectious waste.<sup>1,2,4,9</sup> Wash equipment surfaces that come in contact with hazardous drugs

with detergent, sodium hypochlorite solution (bleach solution), and a neutralizer.<sup>1</sup>

## Conclusion

Practice guidelines for the safe use of hazardous drugs exist, but inconsistent implementation of these guidelines can lead to inadvertent patient and staff exposure. Inpatient, outpatient, and office-based healthcare facilities may consider developing facility-specific protocols and policies to facilitate consistent approaches to the safe handling of hazardous drugs. Risk reduction strategies include the development of the safe handling of hazardous drugs program, which incorporates guidelines for personnel compliance. The guidelines encompass the entire drug life cycle, including manufacturing, transporting, dispensing and administering these medications. Consistent managing of spills and disposing of hazardous spill cleanup materials will minimize risks to patient and staff in areas where these medications are used.

## Notes

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