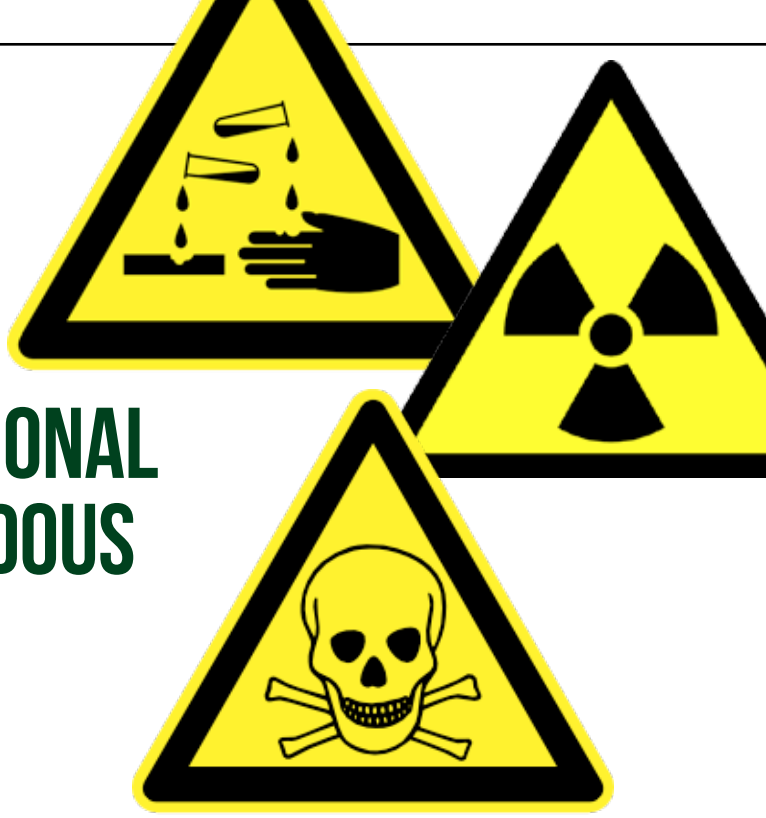

MINIMISING OCCUPATIONAL EXPOSURE TO HAZARDOUS DRUGS IN CLINICS

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This is part of a series on workplace safety and health for healthcare institutions.

Introduction

A number of drugs that are used in the clinics are potentially hazardous to individuals who are inadvertently exposed to them. These at-risk individuals are primarily the clinic healthcare workers who handle these drugs, although patients and their caregivers may also be exposed to these drugs through environmental contamination.

One definition of "hazardous drugs" is: drugs which are potentially genotoxic, carcinogenic, teratogenic, or toxic to body organs, when individuals are exposed to them at relatively low concentrations. By this definition, many of the chemotherapeutic agents that are used in the clinics to treat cancers are hazardous drugs. This article shall focus primarily on these cancer therapies, although the principles discussed in this article would have general applicability to non-chemotherapeutic hazardous chemicals as well. "Hazardous drugs" and "hazardous chemicals" shall be used interchangeably in this article.

Toxicity from occupational exposure to hazardous drugs may arise through acute, large-dose exposures, or through chronic, low-dose, repeated exposures.

This article explains some pertinent facts about occupational hazardous drug exposures, and outlines some relevant preventive measures to minimise such risks.[1]

Modes of exposure to hazardous drugs in the clinic

The three principal modes of toxic exposure are:

1. Inhalation of drug aerosols.
2. Direct skin or mucosal contact with hazardous chemicals.
3. Accidental inoculation of hazardous chemicals through the skin.

By far, the greatest risks of occupational exposure to hazardous drugs are probably the chronic inhalation of drug aerosols and repeated dermal contact with hazardous drugs. Concentrations of 5-fluorouracil ranging from 0.12 to 82.26 ng/m^3 have been found during monitoring of drug preparation without a biological safety cabinet (BSC). Administration of drugs, such as pentamidine, via aerosolisation can lead to measureable air concentrations in the breathing zone of healthcare workers providing treatment.[2] Wipe samples of workstation surfaces in oncology pharmacies have also demonstrated the presence of traces of cyclophosphamide, indicating the opportunity for dermal exposure.[3] It is, however, difficult to quantify the amount of systemic absorption that results from repeated low-dose airway and dermal exposure to such hazardous chemicals.

Deleterious effects of inadvertent exposures

Animal studies have amply documented the carcinogenic, mutagenic and teratogenic effects of hazardous drug exposure in animals. The clearest evidence relates to alkylating agents such as cyclophosphamide and nitrogen mustard. The American Society of Hospital Pharmacists recommends that all pharmaceutical agents that are animal carcinogens be regarded as human carcinogens.

In humans, many hazardous drugs are known to be carcinogenic even when used at therapeutic levels. Chemotherapy use has been associated with the development of future secondary malignancies, such as leukaemia, lymphoma, and bladder cancer. Chemotherapy drugs have been shown to induce chromosomal damage, and the risks increase with the dose and duration of therapy. Chemotherapy, especially alkylating agents, is also well known to cause gonadal dysfunction.

Does occupational exposure to low-level chemotherapeutic agents lead to

significant harm to healthcare workers? This question is not easy to answer. It is inconceivable that a randomised trial will ever be carried out to provide a definitive answer to this question. Indirect evidence provides some clues though. Occupational exposure to chemotherapeutic agents has been demonstrated to correlate with urine mutagenicity in healthcare workers.[4] With improved handling practices, a decrease in mutagenic activity could be demonstrated. Another study showed that urinary mutagenic activity was increased in pharmacy personnel when they were handling chemotherapeutic drugs, but the activity fell to level of unexposed controls within two days of stopping drug handling.

Taken together, the animal and human data suggest that cellular damage and tissue harm may result from "sufficient" exposure to hazardous drugs, either therapeutically or inadvertently through occupational exposures. However, it is unclear if "safe minimal levels" of such exposure exist. The risks are likely a continuum.

At-risk nursing and pharmaceutical procedures[1]

Inadvertent occupational exposure may occur during drug preparation, drug administration, and drug and waste disposal.

Drug preparation

During drug preparation, certain manipulations may cause splattering, spraying and aerosolisation. Examples of such manipulations include:

1. Withdrawing needles from drug vials.
2. Transferring drugs using syringes and needles.
3. Breaking open ampoules.
4. Expelling air from drug-filled syringes.
5. Preparing aerosolised drug therapy.

Employee activities such as smoking, eating, drinking and applying cosmetics where these drugs are prepared, are associated with increased risks of inadvertent drug exposure.

Drug administration

Clearing air from syringes or infusion lines, and leakage at tubing, syringe, or stopcock connections present opportunities for dermal contact with hazardous drugs and aerosolisation.

Drug and waste disposal

Materials used during drug preparation, such as syringes, needles and gloves, contain varying amount of hazardous drugs. Their disposal may present chances for healthcare workers to come into contact with these drugs. The urine of patients receiving cyclophosphamide and cisplatin contain large amounts of these drugs. Inappropriate handling of urine or urine-soaked clothing and bedding may pose risks of occupational exposure.

Measures to minimise inadvertent occupational exposure [1, 5, 6, 7]

Staff education and training

The risks of inadvertent occupational exposure should be made known to all healthcare workers who come into contact with such drugs. Regular reminders would be helpful. Where appropriate, formal training should be given before the employee is declared competent to carry out at-risk activities such as chemotherapy preparation and administration.

Safe work area

The use of dedicated BSCs, where only hazardous drugs are prepared, is highly recommended. These cabinets should be regularly serviced and certified fit for use by trained technicians. High-efficiency particulate air (HEPA) filters of these cabinets should be changed regularly. Appropriate decontamination procedures should be carried out after each drug preparation.

Safe work equipment

Syringes and intravenous sets with Luer-Lok fittings should be used for hazardous drugs. The syringe size should be larger than the amount of drug volume that will be administered, to prevent the plunger from accidentally dislodging. Properly labelled plastic bags and sharps containers should be used for disposing hazardous drugs.

Personal protection equipment (PPE)

Latex gloves must be worn at all times when handling hazardous drugs. Research has shown that thickness of gloves is important when used in handling hazardous drugs. Double-gloving is preferred if it does not interfere with the tasks. Gloves should be changed frequently (at least hourly). Gloves must be changed at once in the event of glove tear or drug spillage. Staff should be familiar with the proper technique of removing contaminated gloves.

Gowns are recommended for healthcare workers when they are handling hazardous drugs. In the event of spillage, the use of respirator masks is recommended. Surgical masks are inadequate against drug aerosol inhalation.

Sound work practices

Many existing nursing practices already reduce the risk of healthcare worker injuries in the course of their work. Some practices that particularly relate to the handling of hazardous drugs are listed here:

1. Aseptic techniques must be observed in all drug preparations.
2. The drug preparation area should not be cluttered.
3. All items necessary for drug preparation should be placed within the BSC before work is begun.
4. All PPE should be donned before work is started in the BSC.
5. The handling of drugs inside BSC should be deliberate, careful and not rushed.
6. All syringes and intravenous bags containing hazardous drugs should be marked with distinctive warning labels.

7. Sharps containers must be placed within the BSC and within easy reach in the general chemotherapy administration area.
8. Needles should not be recapped.
9. As far as possible, priming of the administration set should be done within the BSC. If priming must occur at the site of drug administration, the intravenous line should be primed with non-drug-containing fluid.
10. The use of extremes of positive and negative pressures when accessing medication vials should be minimised. Vial preparations that allow easier access are preferred.
11. Ampoules with dry materials should be gently tapped down before opening to minimise aerosolisation. Wrap a sterile gauze pad around an ampoule's neck before breaking it. Diluents should be introduced into the open ampoule slowly down its inside wall.
12. Hazardous drug bags should be wiped with moist gauze on the outside. These bags should be transported with care to avoid damaging them inadvertently. If the drug bags are being transported between the clinic and another health facility, an appropriately sized and properly labelled plastic container should be used. Staff handling these bags and boxes should don gloves.
13. During intravenous drug administration, fittings should be carefully observed for leakage.
14. Personnel dealing with the urine of patients who have received chemotherapy in the past 48 hours, should don gloves and disposable gowns. Frequent glove changing and hand washing is strongly encouraged.
15. Thick plastic bags with distinctive colours and appropriate labels should be used as trash bags to collect materials that may be contaminated with hazardous chemicals. Needles, syringes and breakable items should be collected in sharps containers. Commercial waste disposal should be carried out by licensed companies.

Management of spills of hazardous chemicals

1. Emergency procedures for managing spills of hazardous chemicals should be developed and staff educated on them.
2. Spills should be cleaned up immediately by trained and properly attired personnel. The spill should be documented and personnel exposed noted.
3. Personnel who have spills on their gowns or gloves should immediately remove these PPE, and cleanse the affected skin with soap and water. Eye exposure should be managed by water or eyewash irrigation for at least 15 minutes. Expert eye consult is advisable.
4. "Small spills", less than five mililitres, should be cleaned up immediately by personnel wearing gowns, double latex gloves and splash goggles. Liquids should be wiped with absorbent gauze pads. Solids should be wiped by wet absorbent gauze. The spill areas should then be thoroughly cleaned with detergent solutions followed by clean water.
5. "Large spill" areas should be isolated and aerosol generation limited. Larger absorbent materials will be needed to wipe up the spillage.
6. After a large spill in a BSC, consider changing the HEPA filters by trained personnel.
7. A spill kit, clearly labelled, should be kept near the drug preparation and administration areas. Its content should include: goggles, gloves, gown, absorbent materials, scoop to collect glass fragments, and hazardous material disposal bags.

Conclusion

Hazardous chemicals are frequently present in clinics. Many of them, such as chemotherapeutic drugs, are used daily in some clinics to treat patients. Awareness of the hazardous properties of these chemicals, establishment of sound work processes, and familiarity with their proper handling, are the cornerstones in their safe usage in clinics. The true safe limit to exposure to these hazardous drugs is unclear. It is prudent to err on the safe side by limiting inadvertent occupational exposure to these agents as much as is practical. ■

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