NIOSH List of Antineoplastic and Other Hazardous Drugs in Healthcare Settings 2012

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
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Preamble: The National Institute for Occupational Safety and Health (NIOSH) *Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings* was published in September 2004 (http://www.cdc.gov/niosh/docs/2004-165/). In Appendix A of the Alert, NIOSH identified a sample list of major hazardous drugs. The list was compiled from information provided by four institutions that have generated lists of hazardous drugs for their respective facilities and by the Pharmaceutical Research and Manufacturers of America (PhRMA) from the American Hospital Formulary Service Drug Information (AHFS DI) monographs [ASHP/AHFS DI 2003]. The 2004 list was updated in 2010; this update adds 26 drugs to the 2010 list. These additions are new drugs or existing drugs that had new warnings from 2007 to 2009. The review process for the addition of the new listings is described in the Federal Register: http://www.cdc.gov/niosh/docket/archive/pdfs/NIOSH-190/0190-080211-frn.pdf

Appendix A · Drugs Considered Hazardous

General Approach to Handling Hazardous Drugs

In the Alert, NIOSH presents a standard precautions or universal precautions approach to handling hazardous drugs safely: that is, NIOSH recommends that all hazardous drugs be handled as outlined in the Alert. Therefore, no attempt has been made to perform drug risk assessments or propose exposure limits. The area of new drug development is rapidly evolving as unique approaches are being taken to treat cancer and other serious diseases.

Defining Hazardous Drugs

Hazardous drugs include those used for cancer chemotherapy, antiviral drugs, hormones, some bioengineered drugs, and other miscellaneous drugs. The definition of hazardous drugs used in the Alert is based on an ASHP definition that was originally developed in 1990 [ASHP 1990]. Thus the definition may not accurately reflect the toxicity criteria associated with the newer generation of pharmaceuticals entering the health care setting. For example, bioengineered drugs target specific sites in the body; and although they may or may not be toxic to the patient, some may not pose a risk to health care workers.

NIOSH and other organizations are still gathering data on the potential toxicity and health effects related to highly potent drugs and bioengineered drugs. Therefore, when working with any hazardous drug, health care workers should follow a standard precautions approach along with any recommendations included in the manufacturer's MSDSs.

ASHP Definition of Hazardous Drugs

ASHP defines hazardous drugs in their 1990 revision of *Technical Assistance Bulletin on Handling Hazardous Drugs* [ASHP 1990]. The bulletin gives criteria for identifying potentially hazardous drugs that should be handled in accordance with an established safety program [McDiarmid et al. 1991; Arrington and McDiarmid 1993]. The criteria are prioritized to reflect the hierarchy of potential toxicity described below. Since the hazardous drugs covered by the Alert were designed as therapeutic agents for humans, human toxicity profiles should be considered superior to any data from animal models or in vitro systems. Additional

guidance for defining hazardous drugs is available in the following citations: carcinogenicity [61 Fed. Reg. 17960–18011 (1996b); IARC 2010], teratogenicity [56 Fed. Reg. 63798–63826 (1991)], developmental toxicity [56 Fed. Reg. 63798–63826 (1991)], and reproductive toxicity [61 Fed. Reg. 56274–56322 (1996a)]. Physical characteristics of the agents (such as liquid versus solid, or water versus lipid solubility) also need to be considered in determining the potential for occupational exposure.

NIOSH Revision of ASHP Definition

The 1990 ASHP definition of hazardous drugs* was revised by the NIOSH Working Group on Hazardous Drugs for the Alert. Drugs considered hazardous include those that exhibit one or more of the following six characteristics in humans or animals:

- Carcinogenicity
- Teratogenicity or other developmental toxicity†
- Reproductive toxicity†
- Organ toxicity at low doses†
- Genotoxicity‡
- Structure and toxicity profiles of new drugs that mimic existing drugs determined hazardous by the above criteria

Determining Whether a Drug is Hazardous

Many hazardous drugs used to treat cancer bind to or damage DNA (for example, alkylating agents). Other antineoplastic drugs, some antivirals, antibiotics, and bioengineered drugs interfere with cell growth or proliferation, or with DNA synthesis. In some cases, the nonselective actions of these drugs disrupt the growth and function of both healthy and diseased cells, resulting in toxic side effects for treated patients. These nonselective actions can also cause adverse effects in health care workers who are inadvertently exposed to hazardous drugs.

Early concerns about occupational exposure to antineoplastic drugs first appeared in the 1970s. Although the antineoplastic drugs remain the principal focus of the Alert, other drugs may also be considered hazardous because they are potent (small quantities produce a physiological effect) or cause irreversible effects. As the use and number of these potent drugs increase, so do opportunities for hazardous exposures among health care workers. For example, an-

*ASHP [1990] definition of hazardous drugs

1. Genotoxicity (i.e., mutagenicity and clastogenicity in short-term test systems)
2. Carcinogenicity in animal models, in the patient population, or both, as reported by the International Agency for Research on Cancer (IARC)
3. Teratogenicity or fertility impairment in animal studies or in treated patients
4. Evidence of serious organ or other toxicity at low doses in animal models or treated patients.

†All drugs have toxic side effects, but some exhibit toxicity at low doses. The level of toxicity reflects a continuum from relatively nontoxic to production of toxic effects in patients at low doses (for example, a few milligrams or less). For example, a daily therapeutic dose of 10 mg/day or a dose of 1 mg/kg per day in laboratory animals that produces serious organ toxicity, developmental toxicity, or reproductive toxicity has been used by the pharmaceutical industry to develop occupational exposure limits (OELs) of less than 10 μg/m^3 after applying appropriate uncertainty factors [Sargent and Kirk 1988; Naumann and Sargent 1997; Sargent et al. 2002]. OELs in this range are typically established for potent or toxic drugs in the pharmaceutical industry. Under all circumstances, an evaluation of all available data should be conducted to protect health care workers.

‡In evaluating mutagenicity for potentially hazardous drugs, responses from multiple test systems are needed before precautions can be required for handling such agents. The EPA evaluations include the type of cells affected and in vitro versus in vivo testing [51 Fed. Reg. 34006–34012 (1986)].

tineoplastic drugs such as cyclophosphamide have immunosuppressant effects that proved beneficial for treating nonmalignant diseases such as rheumatoid arthritis and multiple sclerosis [Baker et al. 1987; Moody et al. 1987; Chabner et al. 1996; Abel 2000].

This document presents criteria and sources of information for determining whether a drug is hazardous. When a drug has been judged to be hazardous, the various precautions outlined in the Alert should be applied when handling that drug. Also included is a list of drugs that should be handled as hazardous. This list is based on a compilation of lists from four health care facilities, one drug manufacturers' organization, and NIOSH.

In addition to using the list of hazardous drugs presented here, each organization should create its own list of drugs considered to be hazardous. This document presents guidance for making such a facility-specific list (see section entitled *How to Generate your own List of Hazardous Drugs*). Once this list is made, newly purchased drugs should be evaluated against the organization's hazardous drug criteria and added to the list if they are deemed hazardous.

Some organizations may have inadequate resources for determining their own list of hazardous drugs. If so, the sample list of hazardous drugs in this document will help employers and workers to determine when precautions are needed. However, reliance on such a published list is a concern because it quickly becomes outdated as new drugs continually enter the market or listed drugs are removed when additional information becomes available. NIOSH will update a list periodically, adding new drugs considered to be hazardous and removing those that require reclassification. This hazardous drug list will be posted on the NIOSH Web site at www.cdc.gov/niosh/topics/hazdrug/.

How to Generate You Own List of Hazardous Drugs

The OSHA hazard communication standard [29 CFR 1910.1200] requires employers to develop a hazard communication program appropriate for their unique workplace. An essential part of the program is the identification of all hazardous drugs a worker may encounter in the facility. Compliance with the OSHA hazard communication standard entails (1) evaluating whether these drugs meet one or more of the criteria for defining hazardous drugs and (2) posting a list of the hazardous drugs to ensure worker safety. Institutions may wish to compare their lists to the sample listing in this document or on the NIOSH Web site.

It is not likely that every health care provider or facility will use all drugs that have received U.S. Food and Drug Administration (FDA) approval, and the OSHA hazard communication standard does not mandate evaluation of every marketed drug. Instead, compliance requires practice-specific assessments for drugs used at any one time by a facility. However, hazardous drug evaluation is a continual process. Local hazard communication programs should provide for assessment of new drugs as they enter the marketplace, and when appropriate, reassessment of their presence on hazardous drug lists as toxicological data become available to support recategorization. Toxicological data are often incomplete or unavailable for investigational drugs. However, if the mechanism of action suggests that there may be a concern, it is prudent to handle them as hazardous drugs until adequate information becomes available to exclude them.

With the increased availability of oral antineoplastic and other hazardous drugs, additional precautions are required in order to prevent worker exposure to these formulations. Some

drugs defined as hazardous may not pose a significant risk of direct occupational exposure because of their dosage formulation (for example, coated tablets or capsules—solid, intact medications that are administered to patients without modifying the formulation). Uncoated tablets may present a risk of exposure from dust by skin contact and/or inhalation when the tablets are counted [Shahsavarani et al. 1993]. However, they may pose a risk if solid drug formulations are altered, such as by crushing tablets or making solutions from them outside a ventilated cabinet.

All hazardous drugs, regardless of the formulation, should be labeled as such to prevent improper handling. Tablet and capsule forms of hazardous drugs should not be placed in automated counting machines, which subject them to stress and may introduce powdered contaminants into the work area. Counting and pouring of hazardous drugs should be done carefully, and clean equipment should be dedicated for use with these drugs. Crushing tablets or opening capsules should be avoided and liquid formulations should be used whenever possible. During the compounding of hazardous drugs (e.g., crushing, dissolving, or preparing a solution or an ointment), workers should wear non-permeable gowns and double gloves. Compounding should take place in a ventilated cabinet whenever possible [ASHP 2006].

Where to Find Information Related to Drug Toxicity

Practice-specific lists of hazardous drugs (usually developed by pharmacy or nursing departments) should be comprehensive, including all hazardous medications routinely used or very likely to be used by a local practice. Some of the resources that employers can use to evaluate the hazard potential of a drug include, but are not limited to, the following:

- MSDSs
- Product labeling approved by the U.S. FDA (package inserts)
- Special health warnings from drug manufacturers, FDA, and other professional groups and organizations
- Reports and case studies published in medical and other health care profession journals
- Evidence-based recommendations from other facilities that meet the criteria defining hazardous drugs

Examples of Hazardous Drugs

The following list contains a sampling of major hazardous drugs. The list (Table 1) was compiled from information provided from (1) the NIOSH Alert [NIOSH 2004] that was based on lists from four institutions that have generated lists of hazardous drugs for their respective facilities and the American Hospital Formulary Service Drug Information (AHFS DI) monographs [ASHP/AHFS 2003], (2) the 2010 NIOSH update to the 2004 list covering the period from 2004 to 2007 [NIOSH 2010], and (3) new drug approvals and new drug warnings from 2007 to 2009. The most recent review resulted in the addition of 26 new entries to the list.

In addition, 15 drugs were removed from the 2010 list. Nine of these are no longer available in the U.S., two are radio-pharmaceuticals that are regulated by the Nuclear Regulatory Agency and require special handling, and four are determined to not meet the criteria for a hazardous drug as defined by NIOSH [NIOSH 2004, 2010] (Table 2). The OSHA hazard communication standard requires hazardous drugs to be handled using special precautions. The mandate applies not only to health care professionals who provide direct patient care but

also to others who support patient care by participating in product acquisition, storage, transportation, housekeeping, and waste disposal. Institutions may want to adopt this list or compare theirs with the list on the NIOSH Web site.

CAUTION: Drugs purchased and used by a facility may have entered the marketplace after the list below was assembled. Therefore, this list may not be all-inclusive.

If you use a drug that is not included in the list of examples, check the available literature to see whether the unlisted drug should be treated as hazardous. Check the MSDS or the proper handling section of the package insert; or check with other institutions that might be using the same drug. If any of the documents mention carcinogenicity, genotoxicity, teratogenicity, or reproductive or developmental toxicity, use the precautions stipulated in this Alert. If a drug meets one or more of the criteria for hazardous drugs listed in this Alert, handle it as hazardous.

The listing below will be updated periodically on this Web site [www.cdc.gov/niosh/topics/hazdrug/].

The attached list of hazardous drugs supersedes the 2004 list [http://www.cdc.gov/niosh/docs/2004-165/ and the 2010 list: http://www.cdc.gov/niosh/docs/2010-167/].

Table 1. Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Acitretin	7	88:04 Vitamin A
Aldesleukin	4,5	10:00 Antineoplastic agents
Ambrisentan	7	24:12.92 Vasodilating agents, miscellaneous
Alefacept	6	84:92 Skin and mucous membrane agents, miscellaneous
Alitretinoin	3,4,5	84:92 Skin and mucous membrane agents, miscellaneous
Altretamine	1,2,3,4,5	10:00 Antineoplastic agents
Amsacrine	3,5	Not in AHFS (antineoplastic agent)
Anastrozole	1,5	10:00 Antineoplastic agents
Arsenic trioxide	1,2,3,4,5	10:00 Antineoplastic agents
Asparaginase	1,2,3,4,5	10:00 Antineoplastic agents
Azacitidine	3,5	10:00 Antineoplastic agents
Azathioprine	2,3,5	92:44 Immunosuppressant agents
Bacillus Calmette-Guerin (BCG)†	1,2,4	80:12 Vaccines
Bendamustine HCl	7	10:00 Antineoplastic agents
Bexarotene	2,3,4,5	10:00 Antineoplastic agents
Bicalutamide	1,5	10:00 Antineoplastic agents
Bleomycin	1,2,3,4,5	10:00 Antineoplastic agents
Bortezomib	6	10:00 Antineoplastic agents
Bosentan	6	24:12.92 Vasodilating agents, miscellaneous
Busulfan	1,2,3,4,5	10:00 Antineoplastic agents
Cabergoline	7	28:36.20.04 Ergot-derivative dopamine receptor agonists
Capecitabine	1,2,3,4,5	10:00 Antineoplastic agents
Carbamazepine	7	28:12.92 Anticonvulsants, miscellaneous
Carboplatin	1,2,3,4,5	10:00 Antineoplastic agents
Carmustine	1,2,3,4,5	10:00 Antineoplastic agents
Cetrorelix acetate	5	92:40 Gonadotropin-releasing hormone antagonists
Chlorambucil	1,2,3,4,5	10:00 Antineoplastic agents
Chloramphenicol	1,5	8:12.08 Chloramphenicols
Choriogonadotropin alfa	5	68:18 Gonadotropins

See footnotes at end of table

(Continued)

Table 1 (Continued). Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Cidofovir	3,5	8:18.32 Nucleosides and nucleotides
Cisplatin	1,2,3,4,5	10:00 Antineoplastic agents
Cladribine	1,2,3,4,5	10:00 Antineoplastic agents
Clofarabine	6	10:00 Antineoplastic agents
Clonazepam	7	28:12.08 Benzodiazepines
Colchicine	5	92:16 Antigout agents
Cyclophosphamide	1,2,3,4,5	10:00 Antineoplastic agents
Cyclosporin	1	92:44 Immunosuppressive agents
Cytarabine	1,2,3,4,5	10:00 Antineoplastic agents
Dacarbazine	1,2,3,4,5	10:00 Antineoplastic agents
Dactinomycin	1,2,3,4,5	10:00 Antineoplastic agents
Dasatinib	6	10:00 Antineoplastic agents
Daunorubicin HCl	1,2,3,4,5	10:00 Antineoplastic agents
Decitibine	6	10:00 Antineoplastic agents
Degarelix	7	10:00 Antineoplastic agents
Denileukin	3,4,5	10:00 Antineoplastic agents
Diethylstilbestrol	5	Not in AHFS (nonsteroidal synthetic estrogen)
Dinoprostone	5	76:00 Oxytocics
Docetaxel	1,2,3,4,5	10:00 Antineoplastic agents
Doxorubicin	1,2,3,4,5	10:00 Antineoplastic agents
Dronedarone HCl	7	24:04.04 Antiarrythmics
Dutasteride	5	92:08 5-alpha reductase inhibitors
Entecavir	6	8:18.32 Nucleosides and nucleotides
Epirubicin	1,2,3,4,5	10:00 Antineoplastic agents
Ergonovine/ methylergonovine	5	76:00 Oxytocics
Estradiol	1,5	68:16.04 Estrogens
Estramustine phosphate	1,2,3,4,5	10:00 Antineoplastic agents
Estrogen-progestin combinations	5	68:12 Contraceptives
Estrogens, conjugated	5	68:16.04 Estrogens
Estrogens, esterified	5	68:16.04 Estrogens

See footnotes at end of table

(Continued)

Table 1 (Continued). Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Estrone	5	68:16.04 Estrogens
Estropipate	5	68:16.04 Estrogens
Etoposide	1,2,3,4,5	10:00 Antineoplastic agents
Everolimus	7	10:00 Antineoplastic agents
Exemestane	1,5	10:00 Antineoplastic agents
Finasteride	1,3,5	92:08 5-alpha reductase inhibitors
Floxuridine	1,2,3,4,5	10:00 Antineoplastic agents
Fludarabine	1,2,3,4,5	10:00 Antineoplastic agents
Fluorouracil	1,2,3,4,5	10:00 Antineoplastic agents
Fluoxymesterone	5	68:08 Androgens
Flutamide	1,2,5	10:00 Antineoplastic agents
Fulvestrant	5	10:00 Antineoplastic agents
Ganciclovir	1,2,3,4,5	8:18.32 Nucleosides and nucleotides
Ganirelix acetate	5	92:40 Gonadotropin-releasing hormone antagonists
Gemcitabine	1,2,3,4,5	10:00 Antineoplastic agents
Gemtuzumab ozogamicin	1,3,4,5	10:00 Antineoplastic agents
Gonadotropin, chorionic	5	68:18 Gonadotropins
Goserelin	1,2,5	10:00 Antineoplastic agents
Hydroxyurea	1,2,3,4,5	10:00 Antineoplastic agents
Idarubicin	1,2,3,4,5	10:00 Antineoplastic agents
Ifosfamide	1,2,3,4,5	10:00 Antineoplastic agents
Imatinib mesylate	1,3,4,5	10:00 Antineoplastic agents
Irinotecan HCl	1,2,3,4,5	10:00 Antineoplastic agents
Ixabepilone	7	10:00 Antineoplastic agents
Leflunomide	3,5	92:36 Disease-modifying antirheumatic agents
Lenalidomide	6	92:20 Biologic response modifiers
Letrozole	1,5	10:00 Antineoplastic agents
Leuprolide acetate	1,2,5	10:00 Antineoplastic agents
Lomustine	1,2,3,4,5	10:00 Antineoplastic agents
Mechlorethamine	1,2,3,4,5	10:00 Antineoplastic agents
Medroxyprogesterone acetate	6	68:32 Progestins
Megestrol	1,5	10:00 Antineoplastic agents

See footnotes at end of table

(Continued)

Table 1 (Continued). Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Melphalan	1,2,3,4,5	10:00 Antineoplastic agents
Menotropins	5	68:18 Gonadotropins
Mercaptopurine	1,2,3,4,5	10:00 Antineoplastic agents
Methotrexate	1,2,3,4,5	10:00 Antineoplastic agents
Methyltestosterone	5	68:08 Androgens
Mifepristone	5	76:00 Oxytocics
Mitomycin	1,2,3,4,5	10:00 Antineoplastic agents
Mitotane	1,4,5	10:00 Antineoplastic agents
Mitoxantrone HCl	1,2,3,4,5	10:00 Antineoplastic agents
Mycophenolate mofetil	1,3,5	92:44 Immunosuppressive agents
Mycophenolic acid	7	92:44 Immunosuppressive agents
Nafarelin	5	68:18 Gonadotropins
Nelarabine	6	10:00 Antineoplastic agents
Nilotinib	7	10:00 Antineoplastic agents
Nilutamide	1,5	10:00 Antineoplastic agents
Oxaliplatin	1,3,4,5	10:00 Antineoplastic agents
Oxcarbazepine	7	28:12.92 Anticonvulsants, miscellaneous
Oxytocin	5	76:00 Oxytocics
Paclitaxel	1,2,3,4,5	10:00 Antineoplastic agents
Palifermin	6	84:16 Cell stimulants and proliferants
Paroxetine**	6, 7	28:16.04.20 Selective serotonin uptake inhibitors
Pazopanib HCl	7	10:00 Antineoplastic agents
Pegaspargase	1,2,3,4,5	10:00 Antineoplastic agents
Pemetrexed	6	10:00 Antineoplastic agents
Pentamidine isethionate	1,2,3,5	8:30.92 Antiprotozoals, miscellaneous
Pentetate calcium trisodium††	6	Not in AHFS
Pentostatin	1,2,3,4,5	10:00 Antineoplastic agents
Phenoxybenzamine HCl	7	12:16.04.04 Non-selective alpha-adrenergic blocking agents
Pipobroman	3,5	Not in AHFS (antineoplastic agent)
Plerixafor	7	20:16 Hematopoietic agents
Podofilox	5	84:92 Miscellaneous skin and mucous membrane agents (mitotic inhibitor)

See footnotes at end of table

(Continued)

Table 1 (Continued). Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Podophyllum resin	5	84:92 Skin and mucous membrane agents, miscellaneous
Pralatrexate	7	10:00 Antineoplastic agents
Procarbazine	1,2,3,4,5	10:00 Antineoplastic agents
Progesterone	5	68:32 Progestins
Progestins	5	68:12 Contraceptives
Raloxifene	5	68:16.12 Estrogen agonists-antagonists
Rasagiline mesylate	6	28:36 Antiparkinsonian agents
Ribavirin	1,2,5	8:18.32 Nucleosides and nucleotides
Risperidone	6	28:16.08.04 Atypical antipsychotics
Romidepsin	7	10:00 Antineoplastic agents
Sirolimus	6	92:44 Immunosuppressive agents
Sorafenib	6	10:00 Antineoplastic agents
Streptozocin	1,2,3,4,5	10:00 Antineoplastic agents
Sunitinib malate	6	10:00 Antineoplastic agents
Tacrolimus	1,5	92:44 Immunosuppressive agents
Tamoxifen	1,2,5	10:00 Antineoplastic agents
Televancin	7	8:12.28.16 Glycopeptides
Temozolomide	3,4,5	10:00 Antineoplastic agents
Temsirolimus	7	10:00 Antineoplastic agents
Teniposide	1,2,3,4,5	10:00 Antineoplastic agents
Testolactone	5	10:00 Antineoplastic agents
Testosterone	5	68:08 Androgens
Tetracycline HCl	7	8:12.24 Tetracyclines
Thalidomide	1,3,5	92:20 Biologic response modifiers
Thioguanine	1,2,3,4,5	10:00 Antineoplastic agents
Thiotepa	1,2,3,4,5	10:00 Antineoplastic agents
Topotecan	1,2,3,4,5	10:00 Antineoplastic agents
Toremifene citrate	1,5	10:00 Antineoplastic agents
Tretinoin	1,2,3,5	84:16 Cell stimulants and proliferants
Trifluridine	1,2,5	52:04.20 Antivirals
Triptorelin	5	10:00 Antineoplastic agents
Uracil mustard	3,5	Not in AHFS (antineoplastic agent)

See footnotes at end of table

(Continued)

Table 1 (Continued). Sample List of Drugs that Should be Handled as Hazardous*

Drug	Source	AHFS Pharmacologic-therapeutic classification
Valganciclovir	1,3,5	8:18.32 Nucleosides and nucleotides
Valproic acid/ divalproex Na	7	28:12.92 Anticonvulsants, miscellaneous
Valrubicin	1,2,3,5	10:00 Antineoplastic agents
Vidarabine	1,2,5	Not in AHFS
Vigabatrin	7	28:12.92 Anticonvulsants, miscellaneous
Vinblastine sulfate	1,2,3,4,5	10:00 Antineoplastic agents
Vincristine sulfate	1,2,3,4,5	10:00 Antineoplastic agents
Vinorelbine tartrate	1,2,3,4,5	10:00 Antineoplastic agents
Vorinostat	6	10:00 Antineoplastic agents
Zidovudine	1,2,5	8:18:08 Antiretroviral agents
Ziprasidone HCl	7	28:16.08.04 Atypical antipsychotics
Zoledronic acid	7	92:24 Bone resorption inhibitors
Zonisamide	6	28:12.92 Anticonvulsants, miscellaneous

*These lists of hazardous drugs were used with the permission of the institutions that provided them and were adapted for use by NIOSH. The sample lists are intended to guide health care providers in diverse practice settings and should not be construed as complete representations of all of the hazardous drugs used at the referenced institutions. Some drugs defined as hazardous may not pose a significant risk of direct occupational exposure because of their dosage formulation (for example, intact medications such as coated tablets or capsules that are administered to patients without modifying the formulation). However, they may pose a risk if solid drug formulations are altered outside a ventilated cabinet (for example, if tablets are crushed or dissolved, or if capsules are pierced or opened).

†BCG preparation should be done using aseptic techniques. To avoid cross-contamination, parenteral drugs should not be prepared in areas where BCG has been prepared. A separate area for the preparation of BCG suspension is recommended. All equipment, supplies, and receptacles in contact with BCG should be handled and disposed of as biohazardous. If preparation cannot be performed in a containment device, then respiratory protection, gloves and a gown should be worn to avoid inhalation or contact with BCG organisms.

1. The NIH Clinical Center, Bethesda, MD (Revised 8/2002). The NIH Health Clinical Center Hazardous Drug (HD) List is part of the NIH Clinical Center's hazard communication program. It was developed in compliance with the OSHA hazard communication standard [29 CFR 1910.1200] as it applies to hazardous drugs used in the workplace. The list is continually revised and represents the diversity of medical practice at the NIH Clinical Center; however, its content does not reflect an exhaustive review of all FDA-approved medications that may be considered hazardous, and it is not intended for use outside the NIH.
2. The Johns Hopkins Hospital, Baltimore, MD (Revised 9/2002).
3. The Northside Hospital, Atlanta, GA (Revised 8/2002).
4. The University of Michigan Hospitals and Health Centers, Ann Arbor, MI (Revised 2/2003)
5. This sample listing of hazardous drugs was compiled by the Pharmaceutical Research and Manufacturers of America (PhRMA) using information from the AHFS DI monographs published by ASHP in selected AHFS Pharmacologic-Therapeutic Classification categories [ASHP/AHFS DI 2003] and applying the definition for hazardous drugs. The list also includes drugs from other sources that satisfy the definition for hazardous drugs [PDR 2004; Sweetman 2002; Shepard 2001; Schardein 2000; REPROTOX 2003]. Newly approved drugs that have structures or toxicological profiles that mimic the drugs on this list should also be included. This list was revised in June 2004.
6. NIOSH addition 2010 updated using ASHP/AHFS DI 2010.
7. NIOSH addition 2012 updated using ASHP/AHFS DI 2011.

**2010, Paroxetine HCl; 2012, Paroxetine mesylate

††Refers to non-radio-labeled formulation only.

Table 2. Drugs Deleted from 2010 Appendix A

Drugs reclassified as not meeting criteria for a hazardous drug*

Drug	AHFS Pharmacologic-therapeutic classification
alemtuzumab	10:00 Antineoplastic agents
interferon alfa 2a	10:00 Antineoplastic agents
interferon alfa 2b	10:00 Antineoplastic agents
interferon alfa n3	10:00 Antineoplastic agents

Radio-pharmaceuticals that are regulated by Nuclear Regulatory Commission, which directs how they are handled†

Drug	AHFS Pharmacologic-therapeutic classification
ibritumomab tiuxetan	10:00 Antineoplastic agents
tositumomab	10:00 Antineoplastic agents

Drugs that are currently not available in the United States‡

Drug	AHFS Pharmacologic-therapeutic classification
dienestrol	68:16.04 Estrogens
interferon alfa n1	10:00 Antineoplastic agents
perphosphamide	Not in AHFS (antineoplastic agent)
piritrexim isethionate	Not in AHFS (antineoplastic agent)
plicamycin	Not in AHFS (antineoplastic agent)
prednumustine	Not in AHFS (antineoplastic agent)
raltitrexed	Not in AHFS (antineoplastic agent)
trimetrexate glucuronate	8:30.92 Miscellaneous antiprotozoals
vindesine	Not in AHFS (antineoplastic agent)

*The 2004 NIOSH list of hazardous drugs was a compilation of hazardous drug lists provided by other organizations. These four drugs were reviewed using the NIOSH criteria and found not to meet the criteria for listing as hazardous.

†Regulations for handling radiopharmaceuticals can be found at: U.S. NRC: Medical Uses of Nuclear Materials, [http://www.nrc.gov/materials/miau/med-use.html].

‡The NIOSH hazardous drug list is based on approvals by the U.S. FDA. These drugs are not approved by the U.S. FDA and are no longer available in the U.S. However, some may be available in other countries.

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