2021

Hazardous Drug Exposure in Healthcare

Brandi Gruenewald
Montana Tech of the University of Montana

David P. Gilkey
Montana Technological University

2021

ISSN 1015-5589 Vol. XXX No. 1

World Safety Journal

In This Edition

WSO's Certification Program is accredited in compliance with ISO/IEC 17024:2012

ICAC international certification accreditation council

World Safety Organisation

Statement of Purpose and Objective

WSO's purpose is to internationalize all safety fields, including occupational and environmental safety and health, accident prevention movement, etc., and to disseminate throughout the world the practices skills, arts, and technologies of safety and accident prevention.

WSO's objective is to protect people, property, resources, and the environment on local, regional, national, and international levels. WSO membership is open to all individuals and entities involved in the safety and accident prevention field, regardless of race, color, creed, ideology, religion, social status, sex, or political beliefs.

WSO is in Consultative Category II Status (Non-Governmental Organisation-NGO) to the Economic and Social Council of the United Nations.

The WSO is a Not-for-Profit Corporation (Missouri, USA), non-sectarian, non-political movement dedicated to

"Making Safety a Way of Life…Worldwide."

Cover Photo Retrieved from EHS Today.
https://www.google.com/search?q=Slips%2C+trips%2C+falls%2C+ice+and+snow%2Cat+work&tbm=isch&ved=2ahUKEwiwr-OxtOPuAhU0iuYKHWJtBLAQ2-cCegQIABAA&oq=Slips%2C+trips%2C+falls%2C+ice+and+snow%2Cat+work&gs_lcp=CgNpbWcQA1CqhAVYqJUFYM-YBWgAcAB4AIAB8gGIAdkNkgEDMi04mAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=nPYlYLDxC7SUmgfi2pGACw&bih=959&biw=1354&gl=ar&hl=en#imgrc=eD7ijl0E-EM-9M

Table of Contents

Article Submission

Articles for inclusion in this journal will be accepted at any time; however, there can be no guarantee that the article will appear in the following journal issue.

All articles shall be written in concise English and typed with a minimum font size of 11 point. Articles should have an abstract of not more than 200 words. Articles shall be submitted as Times New Roman print and presented in the form the writer wants published. On a separate page, the author should supply the author's name, contact details, professional qualifications, current employment position, a brief bio, and a photo of the author. This should be submitted with the article.

Writers should include all references and acknowledgments. Authors are responsible for ensuring that their works do not infringe on any copyright. Failure to do so can result in the writer being accountable for breach of copyright. The accuracy of the references is the author's responsibility.

References

Articles should be referenced according to the Publication Manual of the American Psychological Association 7th ed.

Books are referenced as follows:
Author. (Year of publication). *Title of publication.* Publisher.

Articles are referenced as follows:
Author (Year). Title of article. *Name of Journal. Volume* (Issue), Page numbers of article.

Internet information is referenced as follows:
Name of author. (Year of publication). *Title.* DOI or web address if no DOI.

Submissions should be mailed to:
WSO World Management Center
Attn: Editorial Staff / Dr. Janis K. Jansz
PO Box 518, Warrensburg, MO 64093, USA
or emailed to: j.jansz@curtin.edu.au

Articles, wherever possible, must be up-to-date and relevant to the Safety Industry. ***All articles are Blind Peer Reviewed by at least two referees before being accepted for publication.***

Hazardous Drug Exposure in Healthcare

Brandi Gruenewald, BS, MS (C) and David Gilkey, D.C., Ph.D., CSP. Montana Technological University, 1300 West Park, Butte, MT. Corresponding Author: Dgilkey@mtech.edu

Abstract

Hazardous drug exposure in healthcare is a growing concern for the pharma industry and workers. Significant risks may be present including cancers for those handling and compounding various therapeutic agents. Workplace exposure standards do not exist for those employed in the pharma industry. Recommendations of safety have used the, 'As Low as Reasonably Achievable' (ALARA) principle to control exposures for pharmacists and others that handle hazardous substances. Steps should be taken to systematically eliminate and/or minimize exposures to workers through safer handling protocols, approved safety cabinets, negative pressure rooms, local exhaust ventilation, health surveillance, training and appropriate PPE.

Key words: Hazardous drugs. Antineoplastic drugs. Oncology. Pharmacy industry. Drug safety. ISOPP standards.

Introduction

Antineoplastic drugs are used to treat more than 12.1 million individuals diagnosed with cancer worldwide each year (Graeve, Mcgovern, Alexander, Church, Ryan, and Polovich, 2017). According to NIOSH, approximately 8 million U.S. health care workers are potentially exposed to a multitude of hazardous drugs in the workplace (NIOSH, 2016). The drugs have been detected in the urine of workers and on the floors and counters of worksites (Randolph, 2012). Chemotherapy (antineoplastics) drugs, hormones, antivirals, as well as some monoclonal antibodies and other miscellaneous drugs are classified as a hazardous drug. They are used to treat cancers, human immunodeficiency virus (HIV) and some autoimmune diseases (Müller-Ramírez, Squibb and Mcdiarmid, 2017). As new drugs are developed to treat the numerous cancers and other diseases, the health effects and the toxicity of these drugs is not usually known. These drugs must be handled using special precautions not only by health care professionals, but by those who work in these facilities as well. Although the hazards associated with hazardous drugs are recognized, there is not an acceptable exposure limit to these drugs (Alehashem and Baniasadi, 2018).

Antineoplastic drugs

The health risks and toxicity associated with antineoplastic drugs are well understood. The International Agency for Research on Cancer (IARC) has classified antineoplastic drugs into three groups: Group 1 - carcinogenic to humans; Group 2a - probably carcinogenic to humans and: Group 2b - possibly carcinogenic to humans (Graeve, Mcgovern, Alexande, Church, Ryan, and Polovich, 2017). NIOSH (2004) stated that there are approximately 140 agents that fit the definition of a hazardous drug. Two-thirds of the hazardous drugs are determined to be antineoplastic drugs. Terms commonly known to describe the drugs are "antineoplastic" and "cytotoxic". "Hazardous drugs" is a broader classification that can be used to describe the drugs. The NIOSH Alert glossary defines cytotoxic as "a pharmacologic compound that is detrimental or destructive to cells within the body" (NIOSH, 2004). The International Society of Oncology Pharmacy Practitioners (ISOPP) defines cytotoxic drugs as "chemicals that affect cell growth and proliferation, most of which either bind to genetic material in the cell nucleus or affect cellular proteins synthesis" (ISOPP, 2007).

Health care workers are exposed on a repeated basis and experience side effects from these drugs that have no benefit to these individuals (Müller-Ramírez, Squibb and Mcdiarmid, 2017). Previously, safe handling guidelines have only included cytotoxic or antineoplastic drugs regarding health care worker exposure. Now, it has been expanded to include all hazardous drugs. There has been evidence that indicates that health care workers are at risk from the

effects of occupational exposure to hazardous drugs.

Health effects

Prior studies have shown evidence of adverse health effects associated with exposure to antineoplastic drugs. These effects include acute and chronic outcomes. Acute responses can be nausea, skin rashes, hair loss, nasal sores, abdominal pain, allergic reactions, and dizziness (Müller-Ramírez, Squibb and Mcdiarmid, 2017). Chronic effects to hazardous drug exposures can be delayed conception time, spontaneous abortions, genotoxic changes, and cancers (Foxhall, 2009). Hospital personnel involved in preparation and administration of antineoplastic drugs may be at risk if exposed to these hazardous pharmaceuticals (Korczowska, Jankowiak-Gracz, Sessink, and Grzeskowiak, 2013). If there is contamination in the environment that healthcare workers are present, we can assume that the workers are being exposed as well (Foxhall, 2009). Small exposures to such toxic drugs can have adverse outcomes on the health of the healthcare worker. Most exposures occur in hospitals and oncology facilities during administration of the drugs and the compounding process in the pharmacy. The occupational risk for health care workers is unacceptable (Graeve, Mcgovern, Alexande, Church, Ryan, and Polovich, 2017).

Hazardous drugs can have multiple ways of getting into the body of a healthcare worker. They can be absorbed through inhalation, skin contact, ingestion from hand-to-mouth and injection. The main routes for exposure are believed to be inhalation and ingestion. Currently, it is not possible to establish a safe occupational exposure limit to these drugs. Any preventable occupational exposures should be avoided if possible and follow the “As Low as Reasonably Achievable” (ALARA) standard (Müller-Ramírez, Squibb and Mcdiarmid, 2017).

Healthcare workers and risk control

The University of Minnesota researchers conducted a study of 163 oncology health care workers to determine factors that could contribute to workplace exposure. The objective of the study was to identify possible exposures, as well as determining factors that direct the safety behaviour of employees. The study also conducted environmental hazardous drug wipe sampling on surfaces present in the workplace. There was surface contamination in areas that personal protective equipment was not expected to be used, which can lead to potential exposure (Graeve, McGovern, Alexander, Church, Ryan, and Polovich, 2017).

Many health care facilities that handle hazardous drugs have adopted the hierarchy of controls. The NIOSH Hierarchy of Controls has been identified and can be applied to this health care and the handling of hazardous drugs. These areas covered in the hierarchy of controls include elimination; substitution; engineering controls; administrative controls; and personal protective equipment. The basis behind the hierarchy of controls is that it uses a top-down methodology meaning that the most effective and protective are at the top and less effective and protective are at the bottom. Elimination of the hazard (material or process) is the most effective yet most difficult to implement in any process. In the instance of hazardous drugs, elimination is not possible, therefore diligent use of PPE, proper use of engineering controls and implementation of administrative control must be used. Substitution has the same issues as elimination.

In healthcare, substitution with a less hazardous drug is not possible. Patients are placed on treatments that work for their disease. Engineering controls are the first level that can be used in health care settings because of their designation to remove the hazard before it is in contact with health care personnel. Finally, administrative controls and personal protective equipment (PPE) is used when the exposures are not well controlled.

The first step is the engineering controls. When a hazard cannot be eliminated, an engineering control is recommended for use. In the case of compounding hazardous drugs, it should always be used for product and worker protection. Examples of engineering controls that provide worker and product protection are Class II and III biological safety cabinets (BSC) that are properly ducted with either a canopy or direct connection to an exhaust or a compounding aseptic containment isolator (CACI) that is exhausted to the outside. These engineering controls are placed within a controlled cleanroom environment that is negative pressure. The negative pressure cleanroom suite has pressure in the range of -0.01 to -0.03 inches

water column (in. w. c.) and exhausted to the outside, as well. This is considered a secondary engineering control (SEC) (USP Chapter <800>, 2017). These primary engineering controls are often referred to as "hoods" in which the compounding activities are performed. They provide both product protection with an ISO Class 5 environment inside of the biological safety cabinet, as well as worker protection since the engineering control provides containment.

Another level of protection to use both for compounding and administration is the use of a closed system transfer device (CTSD). This system is needleless and attaches together to transfer the hazardous drug between the vial to IV bag without any exposure. It is an extra level of protection if used within a BSC or CACI. With regards to CTSDs, some facilities consider them as a secondary engineering control used within a primary engineering control when compounding and mixing hazardous drugs, to reduce the risk and exposure to the hazardous drug. Others consider a CTSD as PPE (Mathias, 2019). The U.S. Pharmacopeia (USP) recommends CTSD for compounding hazardous drugs and defines them as mandatory for administration of hazardous drugs (USP Chapter 800, 2017).

Next, the implementation of administrative controls should be used to help with guidance on processes within the health care facility. Some of the administrative controls are to use medical surveillance, training for employees who handle these drugs, cleaning, and decontamination of work surface sand disposal of hazardous drugs. PPE used to compound and any waste from compounding/ administration in the right waste containers (black or yellow), disinfect and deactivate the primary engineering controls (BSCs or CACIs), store hazardous drugs alone in a negative pressure room, define processes for unpacking shipping totes that have hazardous drugs, define a list of all hazardous drugs within the facility, etc. The administrative controls define processes that should be implemented within the facility to lower the exposure risk (Couch, West, and Niemeier, 2013).

A list of all the drugs used in the facility should be compared to the list to the drugs on the NIOSH List of Antineoplastic and Other Hazardous Drugs in Healthcare Settings should be created and made accessible to all the personnel for staff that could possibly be in contact with these drugs. It is important to identify which departments and/or personnel could potentially handle or contact the hazard (ISOPP, 2007). Once the hazardous drugs in a facility have been identified, an assessment of risk should be completed by identifying the path that the hazardous drugs follow from when they enter the facility to when they leave as patient waste, contaminated laundry, IV bags, contaminated medical equipment etc. All potential sources of exposure should be identified. It is also important to identify all individuals who have the potential contact or handle hazardous drugs. Contamination of the environmental can be determined by surface sampling for hazardous drug residue. It is likely that any area where hazardous drugs are used could be contaminated by those drugs. The hazardous drug residue wipe sampling is only available for approximately 12 drugs that are used because they can indicate exposure to any of dozens of drugs the facility uses (ISOPP, 2007).

Personal protective equipment (PPE) is the last area within the NIOSH hierarchy of controls. With proper handling, as well as implementation of proper PPE such as double gloving, use of gloves rated by the American Society for Testing and Materials (ASTM) for chemotherapy, chemotherapy gowns made of polypropylene which have taped seams and coated by polyethylene on the outside to prevent liquids from seepage through and onto the healthcare worker, face shields to prevent splashing onto the face and into the eyes and the use of respirator protection, the incidence rate of exposure is reduced (Couch, West, and Niemeier, 2013). The amount of PPE donned is dependent upon the drug and the procedure involved with handling the hazardous drug (Tomkins, 2015). CSTD systems can also be considered PPE and provide protection to the individuals handling these hazardous substances (Mathias, Mackenzie, Toennis, and Connor 2019).

Studies have shown that more workers are wearing gloves when handling hazardous drugs since the initial safe handling guidelines were implemented (Mathias, Mackenzie, Toennis, and Connor 2019). However, a recent large study of health care workers conducted by

NIOSH (2016) found that one in seven of 2,069 reported not always using gloves while handling hazardous agents. These studies determined that a lower rate of use in PPE was reported. A study of 165 nurses also found personal protective equipment (PPE) use varied by activity, with the lowest adherence to recommendations about the handling of patient excreta (Mathias, Mackenzie, Toennis, and Connor 2019).

Currently, healthcare facilities and pharmacies that compound hazardous drugs are have a new guideline to follow for both non-sterile and sterile products. The United States Pharmacopeia released a new guideline, Chapter 800, that was effective in most States, on July 1st, 2019. All chapters in the USP Compounding Compendium under 1000 are enforceable by state boards of pharmacy. This chapter outlines safe handling, storage, compounding, room requirements, engineering controls and PPE requirements. The chapter was designed to be a guide to help facilities minimize and manage the drug exposures healthcare workers are exposed to, as well as give design elements for the rooms used for compounding. Previously, retail pharmacies had to follow USP Chapter 795 regarding non-sterile compounding rules, however, with the implementation of Chapter 800, it has now designated the same similar elements for pharmacies that compound non-sterile hazardous drugs, such as estrogen and testosterone creams, for hormone replacement therapies.

Conclusions

In conclusion, it is necessary to keep healthcare workers protected from hazardous drug exposures. Use of the proper engineering controls to keep the drugs contained when being stored, compounded, and administered is crucial to the health and well-being of these workers who are exposed daily. Policies and procedures designed around cleaning processes, proper PPE needs, waste disposal, medical surveillance, hazardous drug list, hazardous drug wipe sampling and continuing education are designed to help the individuals handling these drugs have specific operating procedures for their facilities needs that meet or exceed what should be done to protect the workers. It is mission critical to keep these workers safe. Without the implementation of the controls, more unnecessary exposures will occur which will lead to more adverse outcomes to the workers that are caring for some of the sickest patients.

References

Alehashem, M., & Baniasadi, S. (2018). Important exposure controls for protection against antineoplastic agents: Highlights for oncology health care workers. Work (Reading, Mass.), 59(1), 165-172.

Couch, J., West, C. & Niemeier, M. (2013). What happens during a NIOSH HHE of an oncology clinic? A National Institute for Occupational Safety and Health team walks nurses through a health hazard evaluation and explains its recommendations.(FEATURE: Chemotherapy drug safety). Oncology Nurse Advisor, 20.

Foxhall, K. (2009). NIOSH on reproductive effects of hazardous drugs. Drug Topics, 153(12), 49.

Graeve, C., McGovern, P., Alexander, B., Church, T., Ryan, A., & Polovich, M. (2017). Occupational Exposure to Antineoplastic Agents: An Analysis of Health Care Workers and Their Environments. Workplace Health & Safety, 65(1), 9-20.

International Society of Oncology Pharmacy Practitioners Standards Committee (ISOPP). ISOPP standards of practice. Safe handling of cytotoxics. (2007). J Oncol Pharm Pract, 13 Suppl:1-81. doi: 10.1177/1078155207082350. PMID: 17933809.

Korczowska, E., Jankowiak-Gracz, H., Sessink, PJM., and Grzeskowiak, E. (2013). GRP-065 Evaluation of Occupational Exposure to Antineoplastic Drugs in Pharmacy and Oncology Department. European Journal of Hospital Pharmacy. Science and Practice, 20(Suppl 1), A24.1-A24.

Mathias, P., Mackenzie, B., Toennis, C., & Connor, T. (2019). Survey of guidelines and current practices for safe handling of antineoplastic and other hazardous drugs used in 24 countries. Journal of Oncology Pharmacy Practice, 25(1), 148-162.

Müller-Ramírez, C., Squibb, K., & Mcdiarmid, M. (2017). Measuring extent of surface contamination produced by the handling of antineoplastic drugs in low- to middle-income country oncology health care settings. Archives of Environmental & Occupational Health, 72(5), 289-298.

NIOSH. (2004). Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings. Retrieved from https://www.cdc.gov/niosh/docs/2004-165/pdfs/2004-165.pdf.

NIOSH. (2016). List of Antineoplastic and Other Hazardous Drugs in Healthcare Settings 2016. Department of Health and Human Services; Centers for Disease Control and Prevention; National Institute for Occupational Safety and Health. www.cdc.gov/niosh/docs/2016-161/pdfs/2016-161.

Randolph, S. (2012). Hazardous Drugs in Health Care Settings--Recognition and Control. Workplace Health & Safety, 60(9), 412.

Section 19 — Risk management. (2007). Journal of Oncology Pharmacy Practice, 13(3_suppl), 74-75.

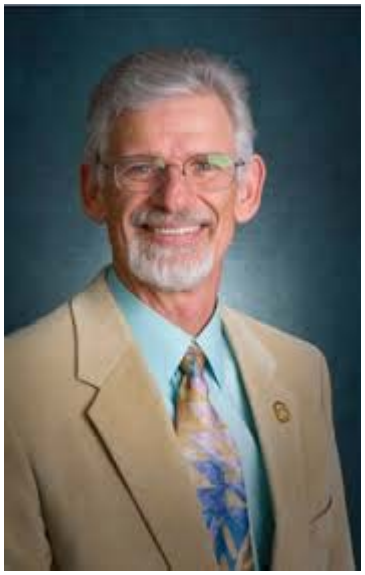
Tompkins, J. (2015). Ensuring Health Care Worker Safety When Handling Hazardous Drugs: The Joint Position Statement From the Oncology Nursing Society, the American Society of Clinical Oncology, and the

Hematology/Oncology Pharmacy Association. Retrieved from https://ascopubs.org/doi/pdfdirect/10.1200/JOP.2015.004978.

USP General Chapter 800 Hazardous Drugs - Handling in Healthcare Settings. (2017) USP Compounding Compendium United State Pharmacopeia.1–20. www.usp.org/sites/default/files/usp/document/our-work/healthcare-quality-safety/general-chapter-800.

Authors

Brandi Gruenewald is Operations Manager of Advanced Infusion Therapeutics, LLC, dba Advanced 797, a pharmacy cleanroom certification, consulting, and education company. She is currently a master's degree graduate student at Montana Technological University in the Industrial Hygiene program. She received her B.S. in Molecular Biology from Northeastern State University, in Broken Arrow, Oklahoma. She is a nationally registered CETA Certification Professional in Sterile Compounding Facilities (RCP-SCF). Her professional focus is working with pharmacy professionals to develop, test and maintain high-quality pharmacy compounding environments and achieve regulatory compliance.



Dr David P. Gilkey, D.C., Ph.D., CPE, CSP, REHS is an Associate Professor at Montana Technological University, 1300 West Park St. Butte, MT 59701. He is an Associate Professor at Montana Technological University in Butte, MT. David has 40 years' experience in occupational and environmental health with expertise in ergonomics, safety, and workplace wellness. Dr. Gilkey earned his Doctor of Chiropractic degree from Southern California Health Sciences University and Ph.D. from Colorado State University with a focus in occupational health, safety, industrial hygiene and ergonomics. He is a Certified Professional Ergonomist (CPE), Certified Safety Professional (CSP) and Registered Environmental Health Specialist (REHS). Dr. Gilkey has authored and/or co-authored 30 articles in peer reviewed scientific journals, 60 articles in trade journals and has provided four book chapter contributions in the areas of ergonomics, occupational safety, and environmental health. He has taught both undergraduate and graduate level courses in environmental and public health, safety and ergonomics. His research has focused in translational (R2P) research looking at methods to enhance safe work practices in agriculture where ATVs are used in farm and ranch operations. He was actively involved in construction safety climate research with an emphasis on evaluating differences between Latino and Non-Latinos workers. His most recent work is focused on safety climate in mining.