

Reproducing safety: handling hazardous drugs in your veterinary practice



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Abstract

Handling drug products in the veterinary setting is not uncommon. Drugs are handled by veterinarians, support staff, and clients. Although some drugs have a higher risk to health than others, there is a lack of knowledge about hazardous drug handling including which drugs pose greater risks. Main purpose of this article is to stimulate engagement in inter- and intraorganizational knowledge sharing related to hazardous drug handling. Hazardous veterinary drugs are not on the federal hazardous drug list, leaving some practitioners unsure where to find hazard information. Therefore references, resources, and recommendations are provided to address the gap in knowledge. Interorganizational collaboration with other practices allows for transfer of knowledge that can be translated and transmitted back into one's own practice for intraorganizational knowledge sharing related to handling hazardous drugs in the workplace. Regulatory considerations and procedure standards are reviewed with resource links provided. Details for applying hazardous drug handling in the veterinary setting include descriptions of learning facilitation needs. Emerging workplace safety concerns related to hazardous drug handling exposes a need for a culture of safety to protect humans, animals, and the work environment. Implementation plans for supporting a safety culture are presented that can be utilized in a veterinary setting.

Keywords: Hazardous drug handling, knowledge sharing, culture of safety, workplace safety

Introduction

Health risks in veterinary settings can come in many forms, from physical interactions with animals and zoonoses to environmental exposures of chemicals and drug products. This article focuses on the risk of hazardous drug exposure in the veterinary setting, why there is a need to minimize the risk, and how to implement a culture of safety utilizing knowledge sharing. Drawing from oncology service examples, exposure risk and workplace safety are made apparent. Workplace safety includes identifying systems that can cause acute, chronic, or delayed harms to humans, animals, or the work environment.¹ Engaging in collaborative inter- and intraorganizational knowledge sharing is an approach to take when reviewing workplace systems that present hazard risks. Knowledge sharing (exchange of ideas, information, and knowledge) is a key component of knowledge management systems.² Two areas of knowledge sharing within the workplace are interpersonal and intraorganizational and expanding beyond the boundaries of the organization is considered interorganizational knowledge sharing.³

Relating to hazardous drug handling as an example, interorganizational knowledge sharing can be appreciated as the collaborative exchange of ideas, information, and knowledge among varied organizations and clinics to build a comprehensive hazardous drug list for the veterinary profession. Once the comprehensive hazardous drug list is completed, dis-

nees collaboratively engage in intraorganizational knowledge sharing to distribute the information throughout the whole organization where they work. Collaborative interpersonal knowledge sharing commences at the department and group level to review the list and determine which hazardous products are utilized in their area and a workplace safety plan is created. Following the plan and modeling the behavior for others facilitates a culture of safety. In sum, collaborative knowledge sharing is a process to engage in dialogue for development of workplace safety products, ideas and actions to inform a culture of safety. Developing a novel and innovative product (e.g., veterinary hazardous drug list) is well suited for interorganizational knowledge sharing, whereas intraorganizational and interpersonal knowledge sharing is positioned to support development of specific workplace safety processes for implementation at the organization and department level.⁴ Workplace safety processes presented can emerge specific equipment needs and learning facilitation opportunities to enhance a culture of safety.

Aim of this article is to stimulate engagement in inter- and intraorganizational knowledge sharing related to hazardous drug handling for application in the veterinary setting. Collaborative efforts of inter- and intraorganizational knowledge sharing can benefit interpersonal knowledge sharing at the department, group, and team levels by supporting a culture of safety. This article begins by providing references and resources in tandem with regulatory and standard considerations to

engage when implementing workplace safety processes. Then, the need for a comprehensive veterinary hazardous drug list is mentioned, followed by an example list of hazardous drugs used in theriogenology. Next, workplace safety implementation processes that inform a culture of safety are detailed. Finally, conclusions of the review and future actions are proffered.

Regulatory and standard considerations

There are 3 agencies within the US Department of Labor that administer and enforce laws, regulations, and standards to protect the health and safety of US workers; however, this paper focuses on the Occupational Safety and Health Administration (OSHA)⁵ for considering hazardous drug handling. Information from OSHA informing workplace safety is available in the Occupational Safety and Health Act of 1970. The US Department of Health and Human Services' (DHHS) Centers for Disease Control and Prevention (CDC) has an occupational safety research branch, the National Institute for Occupational Safety and Health (NIOSH), for informing workplace safety by studying safety and health of workers.⁶ A guidance document published by NIOSH contains a list of US Food & Drug Administration (FDA) approved human drugs deemed hazardous. This list is a useful place to start when building a hazardous drug list for the veterinary practice setting; however, there is a gap in that it does not contain biologics or veterinary hazardous drugs. A more comprehensive approach is required to examine veterinary drugs and biologics. Veterinary biologic information can be identified within the US Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS).

In addition to the NIOSH hazardous drug list, the US Environmental Protection Agency (EPA) considers certain drug waste hazardous to world environment and enforces regulations to protect human and environmental health. For world environment safety EPA and USDA's Safety, Health, and Environmental Management Branch (SHEMB) are resources to utilize; and OSHA, CDC, NIOSH, USDA-APHIS, and USDA-SHEMBA are useful for workplace environment safety. Knowing which agency to glean information from can be confusing. Collaborative interorganizational knowledge sharing is a proposed method to connect the information and address gaps in knowledge to inform a more comprehensive workplace safety plan for hazardous drug handling that can be transmitted via intraorganizational and interpersonal knowledge sharing within the veterinary practice.

Hazardous drugs in clinic

With NIOSH having roots within the DHHS, less attention has been paid to hazardous drugs handled by veterinary workers. Although hazardous veterinary-specific drugs are not listed in the NIOSH hazardous drug list, an emergence of recognition of the knowledge gap between human healthcare settings and veterinary settings is noted in a publication (Safe Handling of Hazardous Drugs for Veterinary Healthcare Workers⁷). More attention has also been brought within an OSHA publication; NIOSH publications and drafts; the US Pharmacopeia General Chapter <800>, and among veterinarians.⁸⁻¹² Although the veterinary setting is mentioned in these references, NIOSH

does not list approved veterinary hazardous drugs or biologics within the hazardous drug list they publish, nor is there a developed mechanism to inform veterinarians about the hazardous drugs they use in their practice setting. This is where inter- and intraorganizational knowledge sharing is useful. An activity to engage would be reviewing product package material to determine hazard risk and transmit data and expected handling procedure to others. To aid the practitioner in deciphering safety needs, a brief overview of US organizations to locate hazardous substance information is summarized (Table 1).

Hazardous drugs used in theriogenology

Human drugs on the NIOSH hazardous drug list exhibit 1 or more criteria for toxicity: (a) reproductive, (b) developmental (e.g., teratogenicity), (c) genotoxicity, (d) carcinogenicity, (e) low dose threshold organ toxicity, or (f) mimics another hazardous drug's structure and toxicity profile (e.g., new drug released on market after NIOSH list posted, research drug).⁹

¹⁰ Hazardous human drugs are commonly used in veterinary settings. Some drugs that were on the NIOSH list in the past were removed from the list when the drug went off the human market. One such veterinary drug is trilostane. Although the Pregnancy and Lactation Labeling Rule (21 CFR Part 201) removed the pregnancy categories A, B, C, D, and X from product labeling,¹³ trilostane had the pregnancy category X designation when it was on the NIOSH hazardous drug list in the past. The package insert of the veterinary trilostane product contains a warning for pregnant women or those trying to conceive not to handle the product.¹⁴ It is important to read the package insert for veterinary specific products used in the clinic to determine the hazard risk since veterinary drugs are not identified in the NIOSH hazardous drug list. Hazardous drugs are commonly used in theriogenology practice. Some of the hazardous drugs are human products, some are veterinary products with similar structure (drug molecule) as the human product, and some are veterinary-specific products. Examples of hazardous drug products that may be used in theriogenology practice settings are provided (Table 2).

Implementing a culture of safety

Promoting a culture of safety where all involved in the handling of hazardous drugs are trained appropriately and are committed to safety is key to minimizing risk of exposure. Based on statistics from the 2017 US Census Bureau of full-time, year-round healthcare workers, women comprise ~ three-fourths of the workforce.¹⁷ Some hazardous substances can be especially harmful to women, and there is concern for their reproductive health. Hazardous drug contamination in the work environment can pose a threat to health and safety of workers. At times contamination is not apparently visible; therefore, employing safety measures and practices routinely is important for keeping the work environment free from contamination. One such hazardous substance posing a threat, used in both humans and animals to treat cancer, is the drug cyclophosphamide. Although the tablet package information for this product stated the tablet coating prevents a direct exposure of the active ingredient to the person handling the cyclophosphamide,¹⁸ it is not advisable as the capsule product information stated to wear gloves when handling the product

Table 1. An overview of organizations in US and their corresponding branch of service are listed. Included are missions for context and links for access to useful material where hazardous substance information is available.

Organization	US Department of Labor https://www.dol.gov/
Branch	Occupational Safety and Health Administration https://www.osha.gov/
Mission	"...to ensure safe and healthful working conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance." https://www.osha.gov/aboutosha
Useful Information	Controlling Occupational Exposure to Hazardous Drugs https://www.osha.gov/hazardous-drugs/controlling-occex
Organization	US Department of Health and Human Services https://www.hhs.gov/
Branch	US Centers for Disease Control and Prevention https://www.cdc.gov/
Branch	National Institute for Occupational Safety and Health https://www.cdc.gov/niosh/index.htm
Mission	"To develop new knowledge in the field of occupational safety and health and to transfer that knowledge into practice." https://www.cdc.gov/niosh/about/default.html
Useful Information	Hazardous Drug Exposures in Healthcare https://www.cdc.gov/niosh/topics/hazdrug/
Organization	US Food & Drug Administration https://www.fda.gov/
Branch	Center for Drug Evaluation and Research https://www.fda.gov/drugs
Mission	"...regulates over-the-counter and prescription drugs, including biological therapeutics and generic drugs." https://www.fda.gov/about-fda/fda-organization/center-drug-evaluation-and-research-cder
Useful Information	Orange Book: Approved Drug Products with Therapeutic Equivalence Evaluations https://www.accessdata.fda.gov/scripts/cder/ob/index.cfm
Organization	US Food & Drug Administration https://www.fda.gov/
Branch	Center for Biologics Evaluation and Research https://www.fda.gov/vaccines-blood-biologics
Mission	"...to protect and promote the public health, in part by ensuring the safety and efficacy of the products we regulate. This includes biological products such as prophylactic and therapeutic vaccines, whole blood and blood products, cellular products and exosomal preparations, gene therapies, tissue products and live biotherapeutic agents." https://www.fda.gov/vaccines-blood-biologics/industry-biologics/coronavirus-covid-19-cber-regulated-biologics
Useful Information	Healthcare Providers (Biologics) https://www.fda.gov/vaccines-blood-biologics/resources-you-biologics/healthcare-providers-biologics
Organization	US Food & Drug Administration https://www.fda.gov/
Branch	Center for Veterinary Medicine https://www.fda.gov/animal-veterinary
Mission	To protect animal and human health. https://www.fda.gov/about-fda/center-veterinary-medicine/cvm-vision-and-mission
Useful Information	Approved Animal Drug Products (Green Book) https://www.fda.gov/animal-veterinary/products/approved-animal-drug-products-green-book
Organization	US Department of Agriculture https://www.usda.gov/
Branch	Animal and Plant Health Inspection Service https://www.aphis.usda.gov/aphis/ourfocus/animal-health/veterinary-biologics
Branch	Center for Veterinary Biologics https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/veterinary-biologics/sa_about_vb/ct_vb_about
Mission	"...to assure that pure, safe, potent and effective veterinary biologics, are available for the diagnosis, prevention, and treatment of animal diseases." https://www.aphis.usda.gov/aphis/ourfocus/animal-health/veterinary-biologics/sa_about_vb/ct_vb_about
Useful Information	Product Summaries https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/veterinary-biologics/product-summaries
Organization	US Environmental Protection Agency https://www.epa.gov/
Mission	"...to protect human health and the environment." https://www.epa.gov/aboutepa
Useful Information	How to Search for Information about Pesticide Ingredients and Labels https://www.epa.gov/ingredients-used-pesticide-products/how-search-information-about-pesticide-ingredients-and-labels Management of Hazardous Waste Pharmaceuticals https://www.epa.gov/hwgenerators/management-hazardous-waste-pharmaceuticals
Organization	The United States Pharmacopeial Convention https://www.usp.org/
Mission	"...to build trust where it matters most: in the world's medicines, dietary supplements and foods. Through our rigorous science and the public quality standards we set, USP helps protect patient safety and improve the health of people around the world." https://www.usp.org/about
Useful Information	<800> Hazardous Drugs — handling in Healthcare Settings https://www.uspnf.com/sites/default/files/usp_pdf/EN/USPNF/revisions/gc-800-rb-note-20200626.pdf

Table 2. Examples of hazardous drugs used in theriogenology practices. Generic name of these drugs, classification, and toxicity criteria are listed.⁹⁻¹⁰

^a Approved human drugs on the NIOSH hazardous drug list used extralabel in animals		
<i>Drug</i>	<i>Classification</i>	<i>Toxicity</i>
Misoprostol	Prostaglandin	Reproductive and/or developmental
Fluconazole	Triazole	Reproductive and/or developmental
^b Approved animal drugs with similar approved human drugs on NIOSH hazardous drug list		
<i>Drug</i>	<i>Classification</i>	<i>Toxicity</i>
Oxytocin	Oxytocic	Reproductive and/or developmental (3 rd trimester)
Gonadotropin, chorionic	Gonadotropin	Reproductive and/or developmental
^c Approved veterinary drugs not on NIOSH hazardous drug list, yet are considered hazardous		
<i>Drug</i>	<i>Classification</i>	<i>Toxicity</i>
Altrenogest	Synthetic progestin	GHS Category 1B (reproductive) ¹⁵
Deslorelin acetate	Gonadotropin	Reproductive and/or developmental ¹⁶

and container.¹⁹ The conflicting information exposes a gap the designated individual can fill with consistent messaging to inform workers of the appropriate safety measures to take when handling this product.

Proper handling of hazardous substances utilizing engineering controls and personal protective equipment decreases exposure of the worker to hazardous substances. Additional workplace safety practices include training before handling hazardous substances, following safety protocols, giving feedback to enhance safety, and embracing the culture of safety to protect all that may come into contact with hazardous substances. Since not all environmental contamination of hazardous substances can be seen on work surfaces, it is important to foster a culture of safety and have protocols in place for deactivation, decontamination, disinfecting, cleaning of equipment and supplies, and the work environment. Addressing the surface contamination concern, swab samples were collected from 20 veterinary specialty hospitals and screened for hazardous substance contamination of 4 commonly used anticancer drugs: vincristine, doxorubicin, carboplatin, and cyclophosphamide.²⁰ Twenty percent of hospitals had surface contamination of cyclophosphamide. In 1 hospital, the suspected contamination was from a cyclophosphamide capsule that had broken open during 'a difficult administration' in the weeks prior to surveillance,²⁰ emphasizing the importance of proper deactivation, decontamination, disinfecting, and cleaning to protect others from exposure. This workplace safety example uncovered a break in the system and highlighted the need for a culture of safety where all parties are working together with a common vision to protect humans, animals, and the work environment from contamination and exposure to hazardous substances that can cause immediate or delayed deleterious effects.

Conclusion

Although hazardous drug handling is prevalent in the veterinary setting, not all practices have a hazardous drug handling protocol in place and hazardous drugs are not identified. Engaging in interorganizational knowledge sharing (e.g., workshops) increases the awareness of the need to create a hazardous drug list for the veterinary practice set-

ting. Once awareness is surfaced, action is taken, knowledge is transferred, and a comprehensive veterinary hazardous drug list is produced; designees can take the knowledge back to their own organization to engage in intraorganizational knowledge sharing by translating and transmitting the data to teams, groups, and departments. Within smaller units, interpersonal collaborative knowledge sharing commences to decipher a process and protocol that is compliant with workplace safety regulations, fits within the workflow, and promotes a culture of safety for the protection of humans, animals, and the environment in which they work. It is recommended that future engagement with this process turns toward developing a comprehensive hazardous drug list for the veterinary profession to inform workplace safety protocols and enhance a culture of safety within veterinary settings. Until a comprehensive list is formed, each veterinary practice should review the products they use, determine safety risk for each drug, and develop a workplace safety process for handling if the product is deemed hazardous. Learning facilitation and documentation of proper equipment use (e.g., gloves, gown, eye protection); decontamination and cleaning; disposal; spill management; and reporting suspected hazardous drug exposure should be available to those who will be handling the hazardous drug(s). Gap analysis tools are available to assess the readiness baseline for handling hazardous drugs in the practice.^{21,22} After assessing the baseline, working towards developing workplace safety plans to protect those working in an environment where hazardous drugs are handled is warranted. Collaborative inter- and intraorganizational knowledge sharing related to hazardous drug handling supports developing plans of action, and modeling workplace safety behavior supports a culture of safety.

Conflict of interest

There are no conflicts of interest to disclose.

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References

1. Beus JM, McCord MA, Zohar D: Workplace safety: a review and research synthesis. *Organ Psychol Rev* 2016;6:352-381.
2. Al-Busaidi KA, Olfman L: Knowledge sharing through inter-organizational knowledge sharing systems. *VINE J Inf Knowl Manag Syst* 2017;47:110-136.
3. Yang TM, Maxwell TA: Information-sharing in public organization: a literature review of interpersonal, intra-organizational and inter-organizational success factors. *Gov Inf Q* 2011;28:164-175.
4. Westerlund M, Rajala R: Learning and innovation in inter-organizational network collaboration. *J Bus Ind Mark* 2010;25:435-442.
5. Workplace Safety and Health. U.S. Department of Labor. Accessed April 4, 2021. <https://www.dol.gov/general/topic/safety-health>
6. About NIOSH. Centers for Disease Control and Prevention. Reviewed March 28, 2018. Accessed April 4, 2021. <https://www.cdc.gov/niosh/about/default.html>
7. Conner TH, Cordes B, Department of Health and Human Services, et al: Safe handling of hazardous drugs for veterinary healthcare workers. Centers for Disease Control and Prevention. June 2010. Reviewed June 6, 2014. Accessed April 4, 2021. <https://www.cdc.gov/niosh/docs/wp-solutions/2010-150/default.html>
8. Occupational Safety and Health Administration: Controlling occupational exposure to hazardous drugs. U.S. Department of Labor. Accessed April 4, 2021. <https://www.osha.gov/hazardous-drugs/controlling-occex>
9. Connor TH, MacKenzie BA, DeBord DG, et al: NIOSH list of antineoplastic and other hazardous drugs in healthcare settings, 2016. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. September 2016. Accessed April 4, 2021. <https://www.cdc.gov/niosh/docs/2016-161/pdfs/2016-161.pdf>
10. Connor T, MacKenzie BA, DeBord D, et al: NIOSH List of Hazardous Drugs in Healthcare Settings, 2020.; 2020. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. 2020-xxx. Accessed April 4, 2021. <https://www.cdc.gov/niosh/docket/review/docket233c/pdfs/DRAFT-NIOSH-Hazardous-Drugs-List-2020.pdf>
11. United States Pharmacopeial Convention: <800> Hazardous Drugs-Handling in Healthcare Settings. United States Pharmacopeia 42–National Formulary 37. Published 2019. Accessed July 1, 2021. <https://www.usp.org/compounding/general-chapter-hazardous-drugs-handling-healthcare>
12. Smith AN, Klahn S, Phillips B, et al: ACVIM small animal consensus statement on safe use of cytotoxic chemotherapeutics in veterinary practice. *J Vet Intern Med* 2018;32:904-913.
13. Pregnancy and lactation labeling (drugs) final rule: U.S. Food & Drug Administration. Updated March 5, 2021. Accessed December 21, 2021. <https://www.fda.gov/drugs/labeling-information-drug-products/pregnancy-and-lactation-labeling-drugs-final-rule>
14. Vetoryl® capsule (trilostane). Dechra Ltd. Updated January 2019. Accessed December 21, 2021. https://www.dechra-us.com/Files/Files/SupportMaterialDownloads/US/Vetoryl_Package_Insert.pdf
15. Merck: Safety data sheet: altrenogest formulation. Updated September 13, 2019. Accessed December 21, 2021.
16. CreoSalus: Safety data sheet: SucroMate equine deslorelin acetate. Updated January 2021. Accessed December 21, 2021.
17. Day JC, Christnacht C: Your health care is in women's hands. United States Census Bureau. Updated August 18, 2020. Accessed April 4, 2021. <https://www.census.gov/library/stories/2019/08/your-health-care-in-womens-hands.html>
18. Baxter: Cyclophosphamide: Highlights of prescribing information. U. S. Food & Drug Administration. Updated May 2013. Accessed April 4, 2021. https://www.accessdata.fda.gov/drugsatfda_docs/label/2013/012141s090,012142s112lbl.pdf
19. DailyMed: Cyclophosphamide Capsule. Updated June 22, 2020. Accessed April 4, 2021. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e73020b2-6abf-4183-bd6d-825a1334bb51>
20. Alexander K, Northrup N, Clarke D, et al: Engineering controls in veterinary oncology: a survey of 148 ACVIM board-certified oncologists and environmental surveillance in 20 specialty hospitals. *Vet Comp Oncol* 2018;16:385-391.
21. Douglass K, Roth A: The 2022 USP, <797> & <800> compliance study: a national study of sterile compounding practices. Updated 2022. Accessed January 7, 2022.
22. HazMedSafety.com: Self-assessment of safe handling practices for hazardous drugs. Joint Commission Resources, Becton, Dickinson and Company. Updated 2022. Accessed January 7, 2022.