



Assessment of safe antineoplastic drug handling practices in community pharmacies, veterinary settings and long-term care homes in Ontario.

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Highlights of this report:

The study authors received a request from the Ontario Ministry of Labour for an evaluation of existing safe work practices in community pharmacies, veterinary clinics and long-term care homes that handle antineoplastic drugs. This request arose from concerns due to the limited amount of information on antineoplastic drug exposure and best work practices for the handling of antineoplastic drugs in these work places. This report summarizes the findings from the evaluation whose goal was to present contemporary work practices and measures in use for minimizing occupational exposure to antineoplastic drugs within community pharmacies, veterinary clinics and long-term care homes in Ontario.

What we did

In December 2016, we administered an online survey that asked about the frequency of use of antineoplastic drugs, existing safe drug handling practices / policies, adherence to safe drug handling policies and barriers to adherence. This survey was distributed to the following groups: select community pharmacists who were listed as members of the Ontario College of Pharmacists, the College of Veterinarians of Ontario and the Ontario Association of Veterinary Technicians who in turn distributed it to registered veterinarians and registered veterinarian technicians respectively, and to the Ontario Association of Non-profit Homes & Services for Seniors.

What we found

- 146 pharmacists, 92 veterinary workers and 5 long-term care homes completed the survey. Of those who responded to the survey (N=243), 79% (N=191) reported that they handled antineoplastic drugs (dispensed, prepared or administered) and about 19% (N=46) did not handle any antineoplastic drugs. They reported that on average they prepared 68 (range: 0 - 500), administered 27 (range: 0 - 300) and dispensed 64 (range: 0 – 1,000) doses per month.
- In general, low utilization and adherence to engineering and administrative controls as well as use of personal protective equipment (PPE) were reported especially for those who dispense antineoplastic drugs.
- Some of the barriers to adhering to safe drug handling guidelines that were identified by the respondents were: a lack of training / awareness in the skills required for handling / compounding of antineoplastic drugs, inadequate staffing levels at the facilities with insufficient time to follow best practices, a lack of access to best practice guidelines and a lack of consensus in respective facilities about the risks of exposure to antineoplastic drugs.

What the employers can do

- Develop policies and procedures for the practice setting based on regulatory and jurisdictional requirements as well as current literature.
- Implement engineering and administrative controls to minimize exposure during the dispensing of oral antineoplastic drugs, and require that employees use these measures.
- Provide employees who handle antineoplastic drugs with routine health and safety training that pertains to safe drug handling particularly handling of oral antineoplastic drugs.
- Train employees who handle antineoplastic drugs on the associated occupational health risks and the potential for surface contamination in all areas.

What employees can do

- Follow recommended work practices and use the required PPE when dispensing and administering antineoplastic drugs including oral antineoplastic drugs.

Background

Antineoplastic drugs play an important role in cancer and other chronic disease treatment though a number of these drugs are known to have carcinogenic, mutagenic and teratogenic properties.¹⁻³ Healthcare workers in hospitals and cancer treatment centres are typically identified as the largest job group known to be at risk. However, recently other job groups have also been identified as likely at risk due to direct or indirect exposure such as: community pharmacists including retail pharmacy workers, veterinarians and veterinarian technicians, nursing and other healthcare workers employed in long-term care homes, as well as workers involved in related shipping and receiving, waste handling, maintenance, housekeeping and laundry etc.^{4, 5}

Studies on exposure levels assessed outside of hospitals and cancer treatment centres revealed that there is a potential hazard present in these settings.^{4,6-11} Surface contamination of various commonly prescribed antineoplastic drugs was observed in these workplaces at measurable levels comparable to those obtained in human oncology settings.^{4, 6-10} In addition, although best practices for safe drug handling have been defined, little is known about the measures and controls in use for the safe handling of antineoplastic drugs outside of acute care settings.

The purpose of this study was to provide information on the extent of use of antineoplastic drugs in veterinary clinics, long-term care homes and community pharmacies in Ontario. The goal was to present a cross section of current practices and measures in use for safe handling of antineoplastic drugs and minimizing exposure following a request from the Ontario Ministry of Labour for an evaluation of safe work practices in community pharmacies, veterinary clinics and long-term care homes. Barriers to adherence of existing safe drug handling practices were also identified. This study aims to fill the gaps in current knowledge about ongoing practices in these work places which may guide future interventions and future research. This is important because of the likely increase in the number of exposed workers due to increased cancer therapy and treatment from increasing numbers of patients with cancer and other chronic illnesses. Assessing workplaces' safety culture and identifying barriers to adherence to safe work practices can contribute to minimizing worker exposure.

Methods

An anonymous online survey (Survey Monkey Canada, Ottawa Canada) was used to assess safe antineoplastic drug handling practices. The survey consisted of 23 multiple choice and open-ended text response questions, and was organized into the following: workplace characteristics, frequency of use of antineoplastic drugs, existing safe drug handling practices / policies, adherence to safe drug handling practices, and barriers to adherence. The survey questions were modified from the National Institute for Occupational Safety and Health (NIOSH) Health and Safety Practices Survey of Healthcare Workers survey.^{12,13} The survey was assessed for appropriateness of the questions that were asked, relevance of the intended information that had been asked, visual layout, ease of use, clarity, format, and participant time requested. Only workers who handled antineoplastic drugs were eligible to complete the survey.

In December 2016, the online survey link was distributed to identified participants through different survey distribution methods. For community pharmacists, the survey link was mailed to all pharmacists in Ontario who were listed in 2016/7 as members of the Ontario College of Pharmacists, self-identified as practicing in community pharmacies and had agreed to receive any email invitations to participate in any research (N=3,050). For long-term care homes, it was not possible to send the online survey to all or any individual institutes or workers nor the association of long-term care homes. The survey link was shared with the Ontario Association of Non-profit Homes and Services for Seniors to reach out to eligible workers from select long-term care homes that handle antineoplastic drugs. For veterinary clinics, the survey link was shared with the Ontario Association of Veterinary Technicians and the College of Veterinarians of Ontario, who also posted the link on their monthly online newsletters that are distributed via email. This link was published every two months on the monthly newsletters. Survey responses from eligible participants were

accepted until May 2017. Survey responses were analyzed (frequency distributions and descriptive statistics) in SAS (SAS v9.4, SAS Institute Inc., Cary NC, USA).

Results

A total of 291 workers filled out the survey. The participant distribution and workplace characteristics of the respondents are summarized in *Table 1* and *Table 2* below. Overall, the majority of the respondents were pharmacists. Excluding long-term care homes, the majority of the respondents were from facilities that could be characterized as small businesses as they employed less than 50 workers (*Table 2*). Within these facilities, less than 40% handled antineoplastic drugs on a weekly basis. For the five long-term care homes (not included in *Table 2*), the characteristics were such that they employed 50 to over 300 workers of which less than 10% handled antineoplastic drugs on a weekly basis.

The predominant reported antineoplastic drug handling activity for all respondents was drug dispensing and the reported mean number of doses prepared, administered and dispensed per month was 68 (range:0 – 500), 27 (range: 0 – 300) and 64 (range: 0 - 1,000), respectively (*Table 2*).

Table 1. Geographic distribution of respondents

Sector	Geographic region in Ontario					Not given	Total N (%)
	Central	Eastern	Greater Toronto Area	Northern	Western		
Community Pharmacy							
Retail (N=129)							
Specialty (N=9)	14	20	65	18	28	1	146 (50)
Long-term care (N=3)							
Unknown (N=5)							
Veterinary Clinics							
Small animal practice (N =78)							
Mixed animal practice (N=5)	9	22	40	5	16	–	92 (32)
Other (N=1)							
Unknown (N=8)							
Long-term care homes	–	3	1	–	1	–	5 (2)
Other (not given)	–	1	2	–	–	45	48 (16)
Total N (%)	23 (8)	46 (16)	108 (37)	23 (8)	45 (15)	46 (16)	291 (100)

Table 2. Antineoplastic drug handling characteristics of the respondent workplaces*

Drug handling workplace characteristics	Community Pharmacy	Veterinary Clinics	Total
Administer antineoplastic drugs only	–	6	6
Dispense antineoplastic drugs only	113	6	119
Prepare antineoplastic drugs only	1	–	1
Dispense and administer drugs	2	22	24
Dispense and prepare drugs	9	–	9
Prepare and administer drugs	–	7	7
Dispense, prepare & administer drugs	2	18	20
Do not handle antineoplastic drugs	18	28	46
Not identified	1	5	6
Number of workers employed (Average± SD)	16± 23	24± 35	19± 28
(range)	(1-175)	(4-200)	(1-200)
Average number of doses prepared /month (Average ± SD)	159±214	37±73	69±132
(range)	(0-500)	(0-240)	(0-500)
Average number of doses administered /month (Average ± SD)	10±0	20±48	19±47
(range)	NA	(0-240)	(0-240)
Average number of doses dispensed /month (Average ± SD)	85±207	16±34	63±175
(range)	(0.1-1000)	(0-170)	(0-1000)

*Results presented in table restricted to community pharmacists (N=146) and Veterinary workers (N=92). Long-term care homes are not presented in the table due to low response rate. The long-term care home respondents (N=3) reported that they administer 90-300 doses per month and dispense and prepare about 50 - 300 doses per month (N=2).

Table 3. Summary of best practices employed in community pharmacies and veterinary clinics

Summary of best practices and safe drug handling guideline recommendations in use*	Pharmacists N (%)	Vet. Workers N (%)
<i>Engineering controls</i>		
A specifically designated room or area within the treatment area is dedicated to the handling of antineoplastic drugs	5(3)	26(28)
Antineoplastic drugs are compounded / crushed in containment area (isolator, biological safety cabinet, fume hood or glove box)	12(8)	14(15)
Oral antineoplastic drugs are dispensed in ready to use formulation	47(32)	27(29)
Antineoplastic drugs are handled using dedicated equipment (counting trays, closed system transfer devices etc.)	26(18)	27(29)
Antineoplastic drugs are stored separately from other drugs and in a location where the special precautions to be taken during their handling are identified	6(4)	27(29)
Access to areas or units where antineoplastic drugs are handled is restricted to workers who have received training on safe handling	7(5)	13(14)
<i>Policies and Procedures</i>		
Workers reported having policies on one of the safe drug handling aspects	42(29)	45(49)
All workers who handle antineoplastic drugs receive training / trained in safe drug handling	35(24)	31(34)
Facilities have assessed occupational exposure through (air, surface wipes, urine, collection of gloves or other)	5(3)	2(2)
<i>Labels</i>		
A list of antineoplastic drugs and other hazardous drugs is posted and made readily accessible for all workers	10(7)	7(8)
Antineoplastic drugs are dispensed with safe drug handling warning labels	25(17)	27(29)
Antineoplastic drugs are received from manufacturers/distributors with safe handling warning labels	32(22)	26(28)
Hazardous waste containers are clearly labeled for hazardous wastes including in receiving, unpacking, storage and other areas	25(17)	31(34)
<i>Spills, accident management and cleaning</i>		
Hand washing facilities are available in areas where antineoplastic drugs are handled	42(29)	32(35)
Spill kits are available in areas where antineoplastic drugs are handled / stored	8(5)	16(17)
Facilities report incidents to a national / provincial incident reporting program or some facility risk management system	30(21)	11(12)
<i>PPE Use</i>		
PPE for antineoplastic drugs handling is provided by the employer	21(14)	31(34)
PPE for antineoplastic drugs handling is readily accessible to all workers	18(12)	30(33)
Workers use one of gloves, gowns, shoe-covers, eye & face protection or approved fit tested respirator for		
• Drug dispensing	26(18)	27(29)
• Drug preparation	5(3)	21(23)
• Drug administration	1(1)	34(37)
• Handling patient excretions	7(5)	36(39)
• Cleaning drug spills	27(18)	34(37)
• Drug disposal	21(14)	36(39)
• Transporting drugs	8(5)	22(24)
• Drug receiving and storage	8(5)	17(18)
• Disposal of contaminated materials (e.g. incontinence products, IV tubing, etc.)	7(5)	32(35)
• Collection and transport of waste receptacles	6(4)	24(26)
• Handling damaged packages containing antineoplastic drugs	13(9)	21(23)
• Cleaning of preparation area (e.g. counter tops, equipment etc.)	22(15)	33(36)

*Results presented in table restricted to community pharmacists (N=146) and Veterinary workers (N=92)

Working practices and use of controls to minimize exposure differed widely among the respondents. The majority of the respondents including long-term care homes reported that they handled oral antineoplastic drugs and these were dispensed in ready-to-use formulation. A little over a third of the respondents (36%, N=87) reported that their workplaces had policies and procedures that addressed at least one aspect of safe drug handling of antineoplastic drugs. For long-term care homes, 100% of respondents reported that they had policies in place and had received training on safe handling of antineoplastic drugs. For all other workplaces, policies on hygiene and sanitation as well as those for employees who are pregnant or breastfeeding were the most identified by the respondents (*Appendix*). In contrast, a considerable proportion of the respondents, nearly 40% (N=92), reported that no training or orientation was available for workers who worked with antineoplastic drugs. An equally large number of respondents (N=104) reported that their workplaces had never assessed for occupational exposure using any method (air, surface wipe or urine samples). A smaller proportion of the respondents (16%, N=39), reported that all antineoplastic drugs were not dispensed or stored separately from other drugs or in dedicated locations, areas or units.

Reported PPE use was highest amongst long-term care home respondents. For all other workplaces, higher reported PPE use was observed for dispensing drugs, cleaning spills, cleaning counters and preparation areas, and drug disposal, and lower for drug receiving, transport and storage, collection and transport of waste receptacles and handling of damaged antineoplastic drug packages (*Table 3*). The most reported PPE worn was gloves (nitrile and vinyl). When stratified by function, workers who administered or prepared antineoplastic drugs reported the highest use of controls and PPE to minimize exposure including use of fit-tested respirators.

According to the respondents, the common barriers to adhering to safe handling guidelines were: a lack of access to best practices guidelines (16%, N=38), a lack of training or awareness required for the safe handling or compounding of antineoplastic drugs (23%, N=56), lack of equipment (9%, N=21), inadequate staffing levels at the facilities with insufficient time to follow best practices (12%, N=29) and a lack of consensus in their respective facilities about the risks of exposure to antineoplastic drugs (12%, N=30).

Discussion

This is one of the few studies that aims to describe the existing safe drug handling work practices in use outside of hospitals and cancer treatment centres. The findings from this study provide evidence that recommended best practices are not well adopted across the different settings and this may put workers at risk of occupational exposure. The findings provide insight on the need for increased awareness and increased accessibility to standardized education grounded on evidence based guidelines and measures for minimizing contamination and exposure to antineoplastic drugs. There is also a need for guidelines that address dispensing of oral antineoplastic drugs relevant to non-acute care settings and are accessible by small businesses. One limitation to this study was the low response rate (small sample size). For example, for long-term care homes, it was challenging to develop meaningful inferences about the workplaces based on the small number of responses. Another limitation was no adjustment was made for missing responses. The findings are reflective of the work experiences of the respondents and may not be appropriately representative of all workers from community pharmacies, veterinary settings or long-term care homes or members of the professional organizations that participated in the study.

Recommendations

Adherence to best practices for safe handling of antineoplastic drugs requires the efforts of both employers and the workers. Jurisdictional and regulatory requirements should be reviewed and implemented where appropriate. Employers and workers are encouraged to assess their own facilities / practice settings to identify where gaps exist for safe drug handling practices. Together they should determine the feasibility of implementing the recommendations and set priorities and timelines for adoption. A summary of recommendations based on the hierarchy of controls grouped by most effective to least effective is shown in *Figure 1*.


 <p>MOST EFFECTIVE</p> <p>LEAST EFFECTIVE</p>	ELIMINATE	
	1	<p>Eliminate / substitute the hazard</p> <ul style="list-style-type: none"> • This is not currently possible. As more improvements in treatment and targeted therapies arise in the future, it may be possible.
	MINIMIZE	
	2	<p>Use engineering controls</p> <ul style="list-style-type: none"> • Provide and ensure workers who compound drugs use isolation devices like glove boxes, Class II type B2 or Class III biological safety cabinets or compounding aseptic containment isolators. • Where possible dispense antineoplastic drugs in ready-to-use formulation. • Ensure that those who dispense drugs use separate equipment for antineoplastic drugs like separate counting trays, disposable counting spatulas, separate waste receptacles, separate storage etc. • Do not use automatic counting machines for oral antineoplastic drugs. • Ensure that crushing or cutting of tablets or opening of capsules is carried out in workplaces that are equipped to safely handle antineoplastic drugs.
3	<p>Use administrative controls</p> <ul style="list-style-type: none"> • Have an up-to date comprehensive plan on how to safely handle, compound, dispense and dispose of antineoplastic drugs including oral antineoplastic drugs. • Maintain an up-to-date antineoplastic and hazardous drug inventory with product safety sheets and a labeling system, and a list of work areas where these drugs are handled, administered, prepared and /or dispensed. • Provide training on health effects, prevention of exposure, good hygiene and safe work practices for workers who handle antineoplastic drugs or have potential exposure to antineoplastic drugs. • Ensure that antineoplastic drugs are prepared and handled in a centralized dedicated location / area or unit and only by personnel with the proper training. • Set policies for good hygiene and safe work practices (e.g. cleaning and decontamination of surfaces and equipment etc.). • Launder contaminated linen or clothing separately. 	
4	<p>Use personal protective equipment (PPE)</p> <ul style="list-style-type: none"> • Provide appropriate respirators when compounding or handling antineoplastic drugs and related wastes (surgical masks do not offer respiratory protection). • Provide gloves (nitrile or double gloves). • Provide face, eye and foot protection (may only be used to protect from splashes). • Provide gowns (disposable gowns made of a lint-free, low permeability fabric with long sleeves, adjustable cuffs and a do-up in the back). • These should be disposed of in separate waste receptacles. 	

Figure 1. Summary of safe drug handling recommendations

Acknowledgement

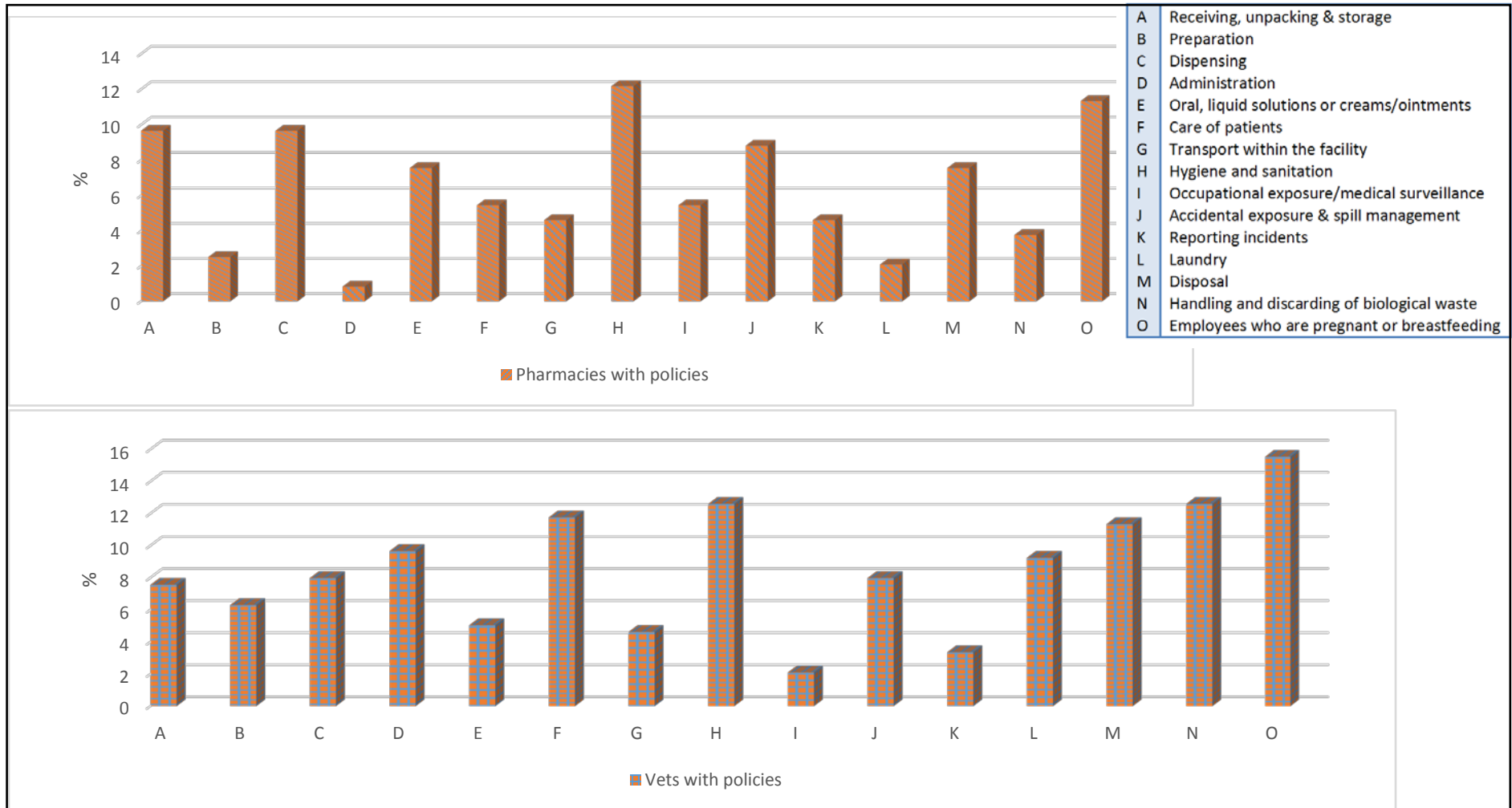
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References

1. International Agency for Research on Cancer IARC. IARC Monographs on the evaluation of carcinogenic risks to humans: Some antiviral and antineoplastic drugs, and other pharmaceutical agents. **Vol 76**, (World Health Organization, 2000).
2. International Agency for Research on Cancer IARC. IARC Monographs on the evaluation of carcinogenic risks to humans: Pharmaceuticals. **100A**, (World Health Organization, 2012).
3. International Agency for Research on Cancer IARC. IARC Monographs on the evaluation of the carcinogenic risk of chemicals to humans: Some pharmaceutical drugs. **Vol 24**, 326 (1980).
4. Meijster, T., Fransman, W., Veldhof, R. & Kromhout, H. Exposure to antineoplastic drugs outside the hospital environment. *Ann. Occup. Hyg.* **50**, 657–664 (2006).
5. National Institute for Occupational Safety and Health NIOSH. NIOSH Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings DHHS (NIOSH) Publication Number 2016-161. Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings. (2016). Available at: <https://www.cdc.gov/niosh/docs/2004-165/pdfs/2004-165.pdf>. (Accessed: 6th March 2017)
6. Couch, J., Gibbins, J. & Connor, T. H. Evaluation of Chemotherapy Drug Exposure at a Veterinary Teaching Hospital in Michigan. *J. Occup. Environ. Hyg.* **10**, D45–D51 (2013).
7. Merger, D., Tanguay, C., Langlois, É., Lefebvre, M. & Bussi eres, J.-F. Environmental contamination with methotrexate in Canadian community pharmacies. *J. Am. Pharm. Assoc. JAPhA* **53**, 423–426 (2013).
8. Kiffmeyer, T. K. et al. Application and assessment of a regular environmental monitoring of the antineoplastic drug contamination level in pharmacies - the MEWIP project. *Ann. Occup. Hyg.* **57**, 444–455 (2013).
9. Schierl, R., B ohlandt, A. & Nowak, D. Guidance values for surface monitoring of antineoplastic drugs in German pharmacies. *Ann. Occup. Hyg.* **53**, 703–711 (2009).
10. Fung, V. & Seneviratne, M. Regulatory verification on safe use of cytotoxic drugs in veterinary clinics and animal hospitals. *Aust. Vet. J.* **94**, 400–404 (2016).
11. Janssens, T. Antineoplastic drugs in veterinary oncology: excretion in dogs, contamination of the environment and exposure assessment of people at risk. (Thesis Utrecht University, 2012).
12. Boiano, J. M., Steege, A. L. & Sweeney, M. H. Adherence to safe handling guidelines by health care workers who administer antineoplastic drugs. *J. Occup. Environ. Hyg.* **11**, 728–740 (2014).
13. Boiano, J. M., Steege, A. L. & Sweeney, M. H. Adherence to Precautionary Guidelines for Compounding Antineoplastic Drugs: A Survey of Nurses and Pharmacy Practitioners. *J. Occup. Environ. Hyg.* **12**, 588–602 (2015).

APPENDIX

Percentage of respondents (pharmacists and veterinarians) having policies on the following drug handling associated tasks and activities where exposure could occur (A-O)



*Vets (includes responses from both RVTs and veterinarians)
Responses are reflective of work experiences of the respondents.