HHS Public Access

Author manuscript

J Occup Environ Hyg. Author manuscript; available in PMC 2015 September 14.

Published in final edited form as:

J Occup Environ Hyg. 2014 ; 11(11): 728–740. doi:10.1080/15459624.2014.916809.

Adherence to Safe Handling Guidelines by Health Care Workers Who Administer Antineoplastic Drugs

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Abstract

The toxicity of antineoplastic drugs is well documented. Many are known or suspected human carcinogens where no safe exposure level exists. Authoritative guidelines developed by professional practice organizations and federal agencies for the safe handling of these hazardous drugs have been available for nearly three decades. As a means of evaluating the extent of use of primary prevention practices such as engineering, administrative and work practice controls, personal protective equipment (PPE), and barriers to using PPE, the National Institute for Safety and Health (NIOSH) conducted a web survey of health care workers in 2011. The study population primarily included members of professional practice organizations representing health care occupations which routinely use or come in contact with selected chemical agents. All respondents who indicated that they administered antineoplastic drugs in the past week were eligible to complete a hazard module addressing self-reported health and safety practices on this topic. Most (98%) of the 2069 respondents of this module were nurses. Working primarily in hospitals, outpatient care centers, and physician offices, respondents reported that they had collectively administered over 90 specific antineoplastic drugs in the past week, with carboplatin, cyclophosphamide, and paclitaxel the most common. Examples of activities which increase exposure risk, expressed as percent of respondents, included: failure to wear nonabsorbent gown with closed front and tight cuffs (42%); intravenous (I.V.) tubing primed with antineoplastic drug by respondent (6%) or by pharmacy (12%); potentially contaminated clothing taken home (12%); spill or leak of antineoplastic drug during administration (12%); failure to wear chemotherapy gloves (12%); and lack of hazard awareness training (4%). The most common reason for not wearing gloves or gowns was “skin exposure was minimal”; 4% of respondents, however, reported skin contact during handling and administration. Despite the longstanding availability of safe handling guidance, recommended practices are not always followed, underscoring the importance of training and education for employers and workers.

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Keywords

antineoplastic drug administration; safe handling practices; health care workers; hazardous drugs; chemotherapy; web-based survey

INTRODUCTION

Antineoplastic drugs, also known as chemotherapy, cytotoxic, and oncology drugs, are used extensively in health care to treat cancer patients and are increasingly being used to treat arthritis, multiple sclerosis, and other noncancer medical conditions. Most antineoplastic drugs are hazardous drugs.[1] In the United States, an estimated 8 million health care workers are potentially exposed to hazardous drugs.[2] This figure is expected to increase in years to come as new cancer cases are on the rise due to an aging population and as these drugs find wider use for treating non-cancer-related medical conditions.[3]

The health risks associated with exposure to antineoplastic drugs are well documented. Patients undergoing chemotherapy treatment have developed secondary malignancies, leukemia being the most frequently observed, although bladder cancer and lymphoma have also been reported.[4–6] Acute health effects associated with occupational exposure include skin rashes, sore throat, chronic cough, dizziness, headache, eye irritation, hair loss, and allergic reactions.[7,8] Reproductive studies of female health care workers exposed to these drugs have shown infertility, miscarriage, birth defects, and other adverse pregnancy outcomes.[9,10] Oncology nurses exposed to chemotherapeutic drugs have increased risk of leukemia and other cancers.[10] An increased frequency of genotoxicity biomarkers including chromosomal aberrations were reported in health care workers who handle chemotherapy drugs.[11,12]

When health risks to exposed workers became a recognized safety concern, professional practice organizations[13,14] and government agencies[15,16] published guidelines for the safe handling of hazardous drugs. The guidelines cover specific methods and equipment for protecting workers who handle hazardous chemotherapy drugs throughout their life cycle in the health care setting—from shipping/receiving, transport and distribution, compounding, administration, and waste disposal. These guidelines are generally consistent with respect to primary prevention measures and application of a hierarchy of control technologies to mitigate workplace hazards.[17] The hierarchy specifies that unless the hazard can be eliminated or substituted by a substance less toxic (which is not feasible with respect to antineoplastic drugs), exposure controls should be systematically implemented in the following decreasing order of efficacy: 1) engineering controls, 2) administrative controls, 3) work practice controls, and 4) personal protective equipment (PPE). Examples of engineering controls include closed-system transfer devices (CSTDs) and luer-lock fittings. Examples of administrative controls include training and education, hazard communication, medical surveillance, and other policies that reduce exposure. Examples of work practice controls include cleaning spilled chemicals immediately and keeping supplies such as absorbent pads readily available.

Regarding PPE, a standard or universal precautions approach should be applied for all hazardous chemotherapy drugs and formulations, as the inherent toxicity of the drug is unaffected by the formulation used. Also, new investigational drugs used to treat cancer and other serious diseases possessing one of the six characteristics which define a hazardous drug should be handled as such.[15] When handling hazardous chemotherapy drugs where there is no known permissible exposure level, prudence dictates that exposure be kept as low as is achievable.

Since the first set of guidelines was published, several survey-based studies of nurses have been conducted to characterize exposure control practices during various chemotherapy handling activities, including administration.[18–26] Each of these studies reported on use of PPE, primarily gloves and gowns, and to a lesser extent on eye protection and respirators. Specialized training, awareness of hazardous drug programs, skin contact, medical monitoring, reasons for PPE disuse, and comparison of selected practices by work setting were sporadically reported. Recent studies[27,28] have reported on PPE full ensemble use, in addition to other practices such as double gloving, gown re-use, and availability of written policies and procedures and spill kits. The latter study[28] is one of the first to evaluate possible correlations between organizational factors and use of precautionary measures, although a prior study[29] examined possible relationships between organizational structures/processes of care and self-reported exposure to chemotherapy.

The primary purpose of this study is to describe chemotherapy drug administration practices and extent of use of exposure controls, and impediments to PPE use by health care workers who administer antineoplastic drugs. This study is distinct from previous studies—it has a national reach and encompasses a large number of respondents and workplaces. Study findings can be used to raise awareness among employers and health care workers regarding hazards, safe handling guidelines, and use of exposure controls.

METHODS

Survey Methodology

The National Institute for Occupational Safety and Health (NIOSH) Health and Safety Practices Survey of Healthcare Workers is an anonymous, multi-module, web-based survey that was conducted January 28 through March 29, 2011. The study population primarily included members of professional practice organizations representing health care occupations which routinely use or come in contact with selected chemical agents. Practices around administration of antineoplastic drugs were addressed by one of seven hazard modules which was targeted to professional organizations representing oncology nurses, hematology/oncology nurses, and infusion nurses. Practices around compounding of chemotherapy drugs were addressed in a separate hazard module and will be reported elsewhere. Information on overall methods used in the development and testing of the survey instrument, web survey design and functionality, survey population, survey implementation, respondent characteristics, and other information including strengths and limitations of the overall survey have been described elsewhere.[30]

Survey Instrument

The hazard module addressing administration of antineoplastic drugs contained 49 questions. The format of the questions varied, including multiple choice, multi-part, yes/no, and numeric. Many of the questions addressing exposure controls included specific engineering controls, administrative controls, and PPE that were recommended in guidelines available at the time of the survey.[15,16,31,32] Topic areas and content of selected questions are presented in Table I.

Respondents were asked to select from a list of 92 antineoplastic drugs and 7 monoclonal antibodies (mAbs) those that they had administered in the past 7 calendar days. Most of the antineoplastic drugs were from the "2010 NIOSH List of Antineoplastic and Other Hazardous Drugs in Health Care Settings"[1] with the remaining identified from literature/ Internet searches. For this question as well as others where the choices were not exhaustive, respondents could mark "other" and type in a response. These were reviewed and determined if they a) fit into one of the existing categories, b) were a valid other response, or c) were unrelated to the question, i.e., general notes about the survey. Responses were recoded, or left as "other" in the case of b), to reflect this determination.

The modular survey was programmed to present, based on screening questions, the most relevant hazard module first, then the core module, and then a second hazard module, if indicated. Respondents were presented with not more than two hazard modules. It was possible for respondents to complete the module on administration of antineoplastic drugs and not the core module. In those cases, demographic information is unavailable.

Data Analysis

Data were analyzed using SAS 9.3 (SAS Institute, Inc., Cary N.C.). Simple frequencies and prevalences are presented. Respondents who only administered mAbs (n = 23) were excluded from the analyses because mAbs are not classified as hazardous drugs and lack authoritative guidelines for their safe use. Results include responses to questions on administration of antineoplastic drugs and selected questions in the core module that describe respondent demographic, employer, and occupation characteristics for those respondents. Age was estimated by subtracting respondents' year of birth from the year the survey took place, 2011. Neither exact birthdate nor age were asked.

Human Subjects Review Board

The NIOSH Human Subjects Review Board determined that the activities in this project were surveillance and did not meet the criteria of research according to 45 CFR 46.1101(b)(2) and CDC *Guidelines for Defining Public Health Research and Public Health Non-Research*.[33]

RESULTS

Respondent Characteristics

There were 2069 respondents who completed the hazard module addressing administration of antineoplastic drugs. Of these, 1954 (94%) completed the core module and thus could be

characterized by demographic and other descriptive information. Demographic characteristics are presented in Table II. These respondents were predominately female, Caucasian, 41 to 55 years of age, and had at least a bachelor's degree.

Nurses represented nearly all respondents and most categorized themselves as oncology nurses, hematology/oncology nurses, and infusion/I.V. therapy nurses. Nearly 7 of every 10 respondents had 6 or more years of experience in their current occupation, and almost half reported working with their current employer for more than 10 years. One in 5 respondents was a member of a labor union.

Most respondents worked in hospitals with nearly all others working in ambulatory health care settings. Nearly 7 in 10 respondents worked for employers with >100 employees. Over half of respondents' employers were non-profit. Respondents worked in all U.S. geographical regions with the South having the highest representation, and nearly two-thirds of their employers were located in large cities.

Administration Characteristics

More than half of the respondents administered antineoplastic drugs for 11 years or more (Table III). Respondents were evenly distributed among the number of days they administered antineoplastics up to 5 days in the past 7 calendar days, with 6 or 7 days being highly uncommon. Nearly half of the respondents administered 4 or fewer treatments in the past 7 calendar days and a small fraction administered more than 40 treatments. Most respondents reported that the number of treatments was no different than usual. Three-quarters of respondents reported that their treatments were in liquid form only; treatments consisting of a combination of liquids and tablets/capsules were less common (Table III).

Respondents reported a number of different work settings where they administered antineoplastic drugs to patients. The areas most frequently reported included outpatient centers/ clinics and patients' or treatment rooms in hospitals (Table II).

Table IV presents the top 20 antineoplastic drugs by decreasing percent of respondents who administered them to patients during the past 7 calendar days. Carboplatin and cyclophosphamide represented the two most commonly administered drugs; slightly over half of the respondents reported that they had administered them. The median number of chemotherapy drugs administered during the past week was 7 (range: 1 to 74). Only 4 of the 92 antineoplastic drugs on the list were not selected including alitretinoin, aminoglutethimide, motexafin gadolinium, and toremifene. Nearly 6% of respondents reported that they had administered "other" antineoplastic drugs and "investigational compounds (not yet named)."

Training and Awareness of Employer Procedures and National Guidelines for Safe Handling of Antineoplastic Drugs

Most respondents reported that they had received training on the safe handling of antineoplastic drugs. Of those who received training, over a third reported that it had been more than 12 months ago (Table V). With respect to continuing education courses

addressing safe handling of chemotherapy drugs, courses offered by the Oncology Nursing Society (ONS) were completed in the highest proportion by respondents.

Some respondents reported that their employer either did not have—or they themselves were not aware if they had—procedures addressing safe chemotherapy administration. Regarding awareness of national safe handling guidelines, respondents were asked to choose their level of familiarity with ONS, American Society of Health-System Pharmacists (ASHP), NIOSH, and Occupational Safety and Health Administration (OSHA) guidelines. Nearly three-quarters of respondents were "very" familiar with ONS guidelines, nearly half with OSHA guidelines, and a lesser extent with NIOSH and ASHP guidelines.

Adherence to Safe Handling Guidelines

Selected work practices were evaluated to determine the extent to which precautionary guidelines were being used to minimize exposures. Frequency distributions of responses primarily focus on the percent of respondents who are not fully adhering to recommended practices.

I.V. Tubing Priming Practices—When asked how liquid chemotherapy drugs were delivered from the pharmacy, more than one of every 10 respondents reported that the I.V. tubing was primed with chemotherapy drug (Table VI). Four of every 10 respondents reported that they always or sometimes primed I.V. tubing before administering chemotherapy to patients. Priming with the chemotherapy drug was reported by 6% of all survey respondents, although priming with a non-drug containing fluid such as saline was a more common practice.

Crushing Tablets and Opening Capsules of Chemotherapy Drugs—The practice of crushing tablets and/or opening capsules of chemotherapy drugs was reported by more than one of every 10 respondents. When asked to select all of the locations where these activities were performed, a third of therespondents each reported bedside, clinical areas, and pharmacy (Table VI).

Use of Engineering Controls—Respondents handling liquid antineoplastic drugs were asked how often they used a CSTD, luer-lock fittings, and needleless systems during administration (Table VII). Over half of respondents reported they sometimes or never used a CSTD; however, needleless systems and luer-lock fittings were more widely used.

Precautionary Work Practices—Respondents were asked how often they utilized specific precautionary work practices relative to minimizing exposure to chemotherapy drugs (Table VII). Four of every 10 respondents sometimes or never used a plastic-backed absorbent pad under the injection site during administration. Over a quarter of respondents reported that they sometimes or never stored prepared chemotherapy drugs in an area restricted to authorized personnel when they had the opportunity to do so. Nearly one of every 10 respondents did not always wash their hands after removing gloves, and a smaller proportion did not always replace their gloves immediately when damaged or contaminated.

Use of Personal Protective Equipment—Respondents were asked how often they wore specific types of PPE while administering chemotherapy drugs to patients (Table VII). Chemotherapy gloves were not always worn by nearly 1 of every 7 respondents. Some did not know whether the gloves they wore were chemotherapy gloves. Of those who reported wearing chemotherapy gloves, nearly 8 of every 10 respondents reported that they did not always wear two pairs (i.e., double glove). Nonabsorbent gowns with closed front and tight cuffs were not always worn by more than 4 of every 10 respondents. Much higher levels of disuse (sometimes/never use) were reported for eye/face protection, respirators, head covers, and shoe covers. Standard surgical masks were reportedly worn by 1 of every 5 respondents while administrating antineoplastic drugs, presumably for infection control.

Respondents who reported that they sometimes or never wore PPE were asked to select from a list all applicable reasons for not always wearing PPE while administering chemotherapy drugs. This information was obtained for chemotherapy gloves, nonabsorbent gowns (with closed front and tight cuffs), eye/ face protection, and respirators. The percents of respondents selecting each of nine reasons (excluding “other”) by type of PPE are presented in Table VIII. The most commonly reported reason for not wearing chemotherapy gloves was “skin exposure was minimal,” followed by “not provided by employer” and “not part of our protocol.” The most commonly reported reason for not wearing nonabsorbent gowns was “skin exposure was minimal” followed by “not part of our protocol” and “no one else who does this work uses them.” The three most commonly reported reasons for not always wearing eye/face protection and respirators were in the same rank order: “not part of our protocol,” “exposure was minimal,” and “an engineering control was being used.”

Took Home Potentially Contaminated Clothing—When respondents were asked if they took home any clothing that came into contact with chemotherapy drugs, 12% responded affirmatively and another 11% did not know (Table VI).

Glove Use: Activities Where Cross-Contamination May Occur (Done While Wearing Gloves That Were Used While Administering Antineoplastic Drugs)—Respondents were asked if they performed specific activities while wearing gloves that had been used to administer antineoplastic drugs. The most common activity reported by 6 of every 10 respondents was “touch I.V. pump or bed controls.” Other reported activities included: “touch waste basket,” “use pens/pencils,” “touch door knobs, cabinets, or drawers,” “use computer or calculator,” “handle files or charts,” among others (Table VI).

Re-Use of Gloves—The practice of re-using gloves (i.e., removing and later putting back on gloves that had been worn while administering chemotherapy drugs) was infrequent, but still reported by 1% of respondents (n = 1961) (Table VI).

Skin Contact and Sharps Injury—Eighty-four (4.2%) respondents who handled (liquid and solid) chemotherapy drugs in the past 7 days reported that their skin came in direct contact with these drugs. Twenty-seven (1.4%) respondents who handled liquid chemotherapy drugs reported that their skin was punctured by a sharp in the past 12 months while administering a liquid antineoplastic drug (data not shown).

Number of Spills by Quantity, Cause of Spill, and Availability of Spill Response Kits—Twelve percent (12%) of respondents who handled liquid chemotherapy drugs reported experiencing a spill/leak during administration in the past week (Table IX). The most common cause, reported by over 70% of respondents reporting a spill, was "attaching, injecting, or detaching from I.V. line." Other causes in decreasing order of prevalence included: bad connection/leak, equipment malfunction, drawing up or expelling air from syringe, and excessive pressure in vial. Respondents who reported a spill were also asked whether or not they had experienced spills/leaks of "less than 5 ml" or "5 ml or more" and, if so, define for each amount the number as "1–2 spills," "3–5 spills," or "more than 5 spills." More respondents reported spills/leaks of less than 5 ml than those of 5 ml or more. Of those reporting a spill, nearly 8 of every 10 reported spills of less than 5 ml and 1 of every 10 reported spills of 5 ml or more. Multiple spill episodes during the past week were also reported. Nearly one of every 10 respondents reporting spills/leaks indicated that they were not always cleaned up. Some respondents reported that hazardous drug spill kits were either not available at work or they did not know if they were or not.

Medical Surveillance and Exposure Monitoring—A medical surveillance program, as defined in the survey, may include work history, physical exam, blood, and/or urine tests. Most (77%) respondents (n = 1987) reported that their employer does not provide a medical surveillance program or that they did not know whether their employer offered such a program or not. Some (19%) respondents reported participating in a medical surveillance program, and few (4%) reported that their employer offered such a program but they do not participate.

Nine of 10 respondents reported that exposure monitoring (e.g., air sampling, wipe sampling) either had not been conducted or they did not know whether it had been conducted in the last 12 months. Not even 1 of every 10 respondents reported that exposure monitoring had been conducted during this period.

DISCUSSION

This study represents one of the largest surveys of health care workers who administer antineoplastic drugs, with nearly 2100 respondents, mostly nurses, completing the hazard module addressing administration practices. The primary purpose of this hazard module was to describe the self-reported use of safe handling precautions during administration of chemotherapy drugs and to better understand impediments to PPE use which was minimally assessed in previous studies.

The survey results indicate that authoritative guidelines for the safe handling of chemotherapy drugs are not being universally followed. Questions addressing impediments to using exposure controls focused solely on PPE. Commonly reported reasons for not wearing requisite PPE (e.g., gloves and gowns) during administration suggest that there is a perception among respondents that chemotherapy drugs pose a minimal exposure risk. They also suggest that employers may be unaware of the adverse health risks of these highly toxic drugs, based on the following responses: "not part of our protocol" and "not provided by employer." Although respondents were not asked why recommended engineering and

administrative controls were not used, the perceived minimal exposure risk may have played a role in their decision not to use them.

OSHA recommends that workers who handle hazardous drugs receive information and training at the time of initial assignment and annually thereafter on the hazards and means to control exposures.[16] The survey results show deficiencies related to the lack/infrequency of training, awareness of employer procedures, and awareness of national safe handling guidelines.

Other examples of breaches in safe work practices concerned the incomplete adoption of engineering controls including CSTDs, luer-lock fittings, and needleless systems. Nearly half of the respondents reported that they never used a CSTD possibly because they are relatively costly and require user training. Not always using luer-lock fittings, which are less prone to accidental separation than friction fittings, increases the likelihood of leaks at connections and potential exposure to chemotherapy drugs. Likewise, not always using needleless I.V. systems increases the likelihood of sharps injuries and potential exposure to chemotherapy drugs. In fact, 27 respondents reported that their skin was punctured by a sharp while administering chemotherapy drugs to patients.

Other work practices that placed study participants at risk of exposure included priming of I.V. tubing with chemotherapy drugs. OSHA specifies that drug administration sets (i.e., I.V. line) should be assembled and primed with a non-drug containing fluid, or a back-flow closed system (i.e., CSTD) should be used.[16] Priming with chemotherapy drug may cause the drug to drip at the end of the tube resulting in the greatest risk of releasing the chemotherapy drug into the work area. However, despite these safe handling guidelines, respondents reported both receiving I.V. lines primed with chemotherapy drugs from the pharmacy and that they themselves used the chemotherapy drug to prime the I.V. lines. Other examples of work practices that may increase the likelihood of exposure to chemotherapy drugs and/or contamination of work areas include not washing hands immediately after removing gloves post-administration, crushing tablets and/or opening capsules in unrestricted areas such as at the patient's bedside and clinical areas, touching various objects in the work area while wearing gloves that had been used to administer chemotherapy drugs, and taking home clothing that came into contact with chemotherapy drugs.

In their safe handling guidelines, ONS, ASHP, NIOSH, and OSHA stipulate that double gloves and nonabsorbent gowns with closed front and tight cuffs should always be worn during administration of chemotherapy drugs. However, only 85% of respondents reported that they always wore (single) chemotherapy gloves, and double gloves were reportedly always worn by only 18% of respondents. These findings are consistent with recent studies reporting 76% to 99% use of single gloves and 15% to 49% use of double gloves.[26–28] Gowns were worn less frequently than gloves. Fewer than 6 of every 10 respondents reported that they always wear gowns, which is within the range (51% to 75%) reported in recent studies.[26,27] The most commonly reported reason for not always wearing chemotherapy gloves and gowns was "exposure was minimal." However, skin contact with antineoplastic drugs was not inconsequential, and was reported by 84 respondents during the

past week. The other top reasons “not provided by employer” and “not part of our protocol” suggest that employers may not be aware of the risks of exposure to chemotherapy drugs.

Spills/leaks of liquid antineoplastic drugs during administration were not uncommon, reported by more than 1 of every 10 respondents. Small spills (<5 ml) were more frequently reported than large spills. The most common causes of leaks were: attaching, detaching, making injections into I.V. line; bad connection; and equipment malfunction. Some respondents reported that spills or leaks were not always cleaned up. ASHP recommends that hazardous drug spill kits be available in all areas where hazardous chemotherapy drugs are handled and administered. A small percentage of respondents reported that spill kits were unavailable or they did not know whether they were, a finding similar to another survey.[27]

OSHA and NIOSH recommend medical surveillance of workers potentially exposed to chemotherapy drugs to prevent occupational injury or disease. Most respondents did not participate in a medical surveillance program; the majority reported that their employer did not have a program, were unaware whether their employer had a program, or decided not to participate. The percent of respondents participating in a medical surveillance program (19%) was markedly lower than reported (46%, 47%) in previous surveys.[24,27]

A recent survey has shown that organizational factors including improved positive workplace safety climate, reduced patient work load (i.e., fewer number of patients per day), and fewer barriers to using PPE play an important role relative to the use of precautionary measures.[28] Similar findings were reported in another survey where the likelihood of chemotherapy drug exposure decreased when nurses reported adequate staffing, resources, and favorable working conditions.[29]

Several limitations apply to this survey. Since the survey sample was targeted at members of professional practice organizations, findings reflect the experiences and practices of the respondents and are not generalizable to all health care workers or to all members of each of the participating professional organizations. Another limitation is that the survey was only available to members with email addresses and Internet access. Survey participants who have the resources that allow them to belong to a professional organization may be more likely to be farther along in their career, better paid, more educated, and more aware of health and safety issues. A response rate cannot be calculated because the invitation email specified the chemical agents under study, including antineoplastics, and that eligibility was based on whether invitees had used antineoplastic drugs on the job; it is unknown who decided not to participate because they did not use antineoplastic drugs versus those who used them but decided not to participate for other reasons.

Demographic information was not available for respondents who elected not to participate in the core module. Information on barriers to using engineering controls and proper work practices, as well as exposure controls used during handling of chemotherapy waste, was not collected in this study and should be evaluated in future studies. Although survey data are self-reported and not validated by observation or other means, the relatively large numbers of respondents reporting lapses in safe working practices cannot be ignored.

CONCLUSION

Antineoplastic drugs represent one of the most toxic classes of chemical agents used in health care. Yet, despite this distinction, and the fact that sufficient evidence exists concerning their harmful effects on exposed health care workers, the data from this survey show that nurses and other health care workers are not universally adhering to longstanding safe handling guidelines, placing themselves and even family members at risk of exposure. The most commonly reported barriers associated with lapses in the use of protective gloves and gowns suggest that there is a perception that exposures are inconsequential or so rare that they do not justify their use. Better risk communication is needed to ensure that employers and health care workers are fully aware of the hazards and precautionary measures to minimize exposures to these highly toxic drugs.

ACKNOWLEDGMENTS

The authors thank Westat, Inc., for their collaboration in developing, testing, and conducting the survey. The authors are grateful to the professional practice organizations and members who participated in the survey. We also thank Seth Eisenberg, Gayle DeBord, and Tom Connor for their valuable comments on and suggestions for an early draft of the manuscript. This project was supported by the National Institute for Occupational Safety and Health.

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TABLE I

Survey Instrument Topic Areas and Content of Selected Questions

Topic Area
Training
Frequency (more or less than 12 months ago)
Source (ONS, APHON courses, other)
Awareness of employer safe administration procedures and national safe handling guidelines
Antineoplastic drugs administered (list of 92 specific drugs)
Administration practices
Number of days administering chemotherapy in the past 7 calendar days
Number of treatments[A] in the past 7 calendar days
How number of treatments[A] compared to usual
Locations where chemotherapy was administered
Frequency of use of selected exposure controls
Physical form (liquid, tablet/capsule) of chemotherapy
I.V. tubing priming practices
Whether or not tubing was primed by pharmacy and, if so, type of priming solution[B]
Whether or not tubing was primed by respondent and, if so, type of priming solution[B]
Frequency of priming by respondent
Spills
Number, quantity, and cause of spills
Availability of spill response kits
Spill cleanup practices
Skin contact/puncture during administration
Use of PPE
Chemotherapy gloves (single and double gloves)
Nonabsorbent gowns with closed front and tight cuffs
Eye/face protection (e.g., goggles/face shields)
Respirators[C]
Shoe and head covers
Use of surgical masks
Barriers to using PPE (except for shoe and head covers)
Activities performed while wearing chemo gloves that had been used to administer chemotherapy drugs
Took home clothing that came in contact with chemotherapy drugs
Medical monitoring practices
Exposure monitoring practices

[A] One treatment equals one or more chemotherapy drugs administered to one patient during one therapy session.

[B] Chemotherapy drug or non-drug containing fluid.

[C] Includes N95 filtering facepiece respirator, surgical N95 respirator, half-facepiece air-purifying (APR) respirator with chemical cartridge(s), and powered air-purifying respirator (PAPR) with chemical cartridge(s), and other.

TABLE II

Respondent Characteristics

Characteristic (n[A])	Percent
Gender (1915)	
Male	4
Female	96
Race (1896)[B]	
Caucasian	92
African American	4
Asian	4
Other	2
Ethnicity (1911)	
Hispanic	3
Age (1883)	
18–25 years	1
26–40 years	18
41–55 years	47
56–70 years	33
>70 years	1
Education (1903)[C]	
Grade 12 or less	1
Vocational certificate	2
Associate's degree	26
Bachelor's degree	51
Master's degree	19
Doctoral degree/Professional degree+	2
Occupation (1943)	
Nurse	99
Nursing specialty (1911)	
Oncology Nurse	39
Hematology/Oncology Nurse	32
Infusion/I.V. Therapy Nurse	9
Clinical Nurse Specialist	4
Other specific nurse specializations (26 with <3% each)	16
Other	1
Time in Current Occupation (1935)	
<1 year	2
1–5 years	20
6–10 years	20
11–20 years	31
>20 years	27
Percent of Time Spent in Direct Patient Care (1938)	

Characteristic (n[A])	Percent
76–100%	69
51–75%	14
26–50%	9
1–25%	8
No direct patient care	0
Time with Current Employer (1940)[B]	
<1 year	5
1–5 years	27
6–10 years	20
11–20 years	25
>20 years	22
Member of a Labor Union (1917)	
Yes	19
No	81
Employer Industry Category (1939)	
Ambulatory health care services	37
Hospital	61
Nursing and residential care	1
Social assistance/services	1
Size of Employer (1934)[B]	
1 (i.e., only myself)	<1
2–9	8
10–99	23
100–249	8
250–1,000	23
> 1,000	39
Employer Ownership Type (1913)	
For profit	31
Non-profit	54
City, county, district, state gov't	11
Federal gov't (VHA, military, IHS)	4
Employer Regional Location (1882)[B]	
Northeast (CT, ME, MA, NJ, NH, NY, PA, RI, VT)	22
Midwest (IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI)	24
South (AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV)	30
West (AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY)	23
Employer Location by Population Density (1931)	
Large city (50,000 people or more)	64
Small city (fewer than 50,000 people)	18
Suburbs (developed areas adjacent to cities)	12
Rural (areas outside cities generally characterized by farms, ranches, small towns, and unpopulated regions)	6

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Percents may add to more than 100 percent because respondents could select more than one answer.

[C] Percents may not add up to exactly 100 percent due to rounding.

TABLE III

Antineoplastic Drugs Administration Characteristics of Respondents

Administration Characteristics (n[A])	Percent
Number of years (in career) administering antineoplastic drugs to patients (2068)	
Less than one year	3
1–5 years	18
6–10 years	20
11–20 years	30
More than 20 years	29
Number of days administering antineoplastic drugs in past 7 calendar days (2043)[B]	
1 day	19
2 days	19
3 days	20
4 days	17
5 days	23
6–7 days	2
Total treatments[C] administered in the past 7 calendar days (2037)	
1–2 treatments	26
3–4 treatments	20
5–9 treatments	17
10–20 treatments	19
21–40 treatments	13
More than 40 treatments	5
Total treatments[C] compared to usual (2035)	
More treatments than usual	10
Fewer treatments than usual	19
About the same number of treatments as usual	71
Antineoplastic drugs administered as a liquid (2023)	
100% of treatments	75
90–99% of treatments	14
1–89% of treatments	7
None of the treatments	4
Antineoplastic drugs administered as tablets/capsules (2023)[B]	
100% of treatments	3
10–99% of treatments	13
1–9% of treatments	8
None of the treatments	75
Location(s) where antineoplastic drugs administered (2028)[D]	
Outpatient center/clinic	47
Patient’s hospital room	36
Oncologist’s office	15

Administration Characteristics (n[A])	Percent
Hospital treatment room	9
Operating room	2
Patient's home	2
Other	4

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Percents may not add up to exactly 100 percent due to rounding.

[C] One treatment equals one or more chemotherapy drugs administered to one patient during one therapy session.

[D] Percents may add to more than 100 percent because respondents could select more than one answer.

TABLE IV

Top 20 Antineoplastic Drugs Administered by Respondents

Antineoplastic Drug	Percent of Respondents Who Administered Drug (n = 2069)
Carboplatin	53
Cyclophosphamide	51
Paclitaxel	49
Cisplatin	47
Fluorouracil	47
Etoposide	45
Doxorubicin	44
Oxaliplatin	42
Gemcitabine	42
Vincristine	41
Docetaxel	38
Irinotecan	33
Methotrexate	26
Bortezomib	24
Pemetrexed	22
Cytarabine	21
Bleomycin	20
Vinblastine	17
Ifosfamide	17
Topotecan	17

TABLE V

Training Received and Awareness of Employer Procedures and National Guidelines for Safe Handling of Antineoplastic Drugs

Training/Employer Procedures	n[A]	Percent Yes		
Ever received training in safe handling of antineoplastic drugs	2061	95		
Training > 12 months ago	1950	36		
Specific training courses taken[B]				
Oncology Nursing Society (ONS) Chemotherapy and Biotherapy course	1947	75		
ONS Safe Handling of Hazardous Drugs course	1947	46		
Association of Pediatric Hematology / Oncology Nurses (APHON) Chemotherapy and Biotherapy course	1947	11		
Other	1947	27		
Employer has procedures for safe administration	2060	94		
Familiarity with national safe handling guidelines		Percent[B] familiar with guideline		
		Very familiar	Somewhat familiar	Not at all familiar
Oncology Nursing Society (ONS) Safe Handling of Hazardous Drugs	2065	73	20	7
Occupational Safety and Health Administration (OSHA) Guidelines for the Management of Antineoplastic Drugs	2067	47	43	10
NIOSH Alert on Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings	2059	25	41	34
American Society of Health-System Pharmacists (ASHP) Guidelines for Handling Hazardous Drugs	2057	12	34	54

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Percents may not add up to exactly 100 percent due to rounding.

TABLE VI

Work Practices with Potential for Exposure

Work Practices (n[A])	Percent
How liquid antineoplastic drugs were most commonly received from pharmacy or drug preparation area (1910)	
I.V. tubing primed with antineoplastic drug	12
I.V. tubing primed with non-drug containing fluid (e.g., saline)	62
I.V. tubing not primed	21
Not applicable (did not receive liquid chemotherapy drugs from pharmacy/drug preparation area)	5
Frequency respondent primed I.V. tubing (1910)	
Always	32
Sometimes	7
Never	61
How respondent primed I.V. tubing (1909)	
Respondent primed I.V. tubing with antineoplastic drug	6
Respondent primed I.V. tubing with non-drug containing fluid (e.g., saline)	35
Crushed tablets/opened capsules (494)	13
Location where tablets crushed/capsules opened (57)[B]	
Bedside	33
Clinical areas	33
Pharmacy	33
Other	7
Took home clothing that came in contact with antineoplastic drugs (1971)	
Yes	12
No	77
I don’t know	11
Activities where cross-contamination may occur (i.e., activities done while wearing gloves that had been used to administer antineoplastic drugs)[B]	
Touch I.V. pump or bed controls (1969)	61
Touch waste basket/garbage bags (1970)	27
Use pens/pencils (1970)	26
Touch door knobs, cabinets, or drawers (1969)	20
Use of computer/calculator (1970)	13
Handle files or charts (1970)	11
Used a non-disposable stethoscope (1969)	6
Use of phone/cell phone or pager (1969)	3
Eat, drink, chew gum, or smoke (1968)	2
Use restroom (1970)	<1
Apply cosmetics (1970)	<1
Put gloves back on that had been used while administering antineoplastic drugs (1961)	1

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Percents may add to more than 100 percent because respondents could select more than one answer.

TABLE VII

Frequency of Use of Engineering Controls, Precautionary Work Practices, and PPE While Administering Antineoplastic Drugs

Type of Control (n[A])	Percent[B] of Frequency of Activity			
Engineering Controls	Always	Sometimes	Never	
Use a closed-system transfer device[C] (e.g., PhaSeal) (1895)	45	8	47	
Use needleless system[C](1925)	90	5	4	
Use luer-lock fittings for all needleless systems, syringes, needles, infusion tubing, and pumps[C](1928)	94	3	3	
Work Practices	Always	Sometimes	Never	
Use a plastic backed absorbent pad under injection site[C](1924)	59	17	24	
Store prepared antineoplastic drugs in an area restricted to authorized personnel before administering them to patients (2011)	73	14	13	
Wash hands after removing gloves (2000)	92	7	1	
Replace damaged gloves immediately when contaminated (1876)	98	1	1	
Personal Protective Equipment	Always	Sometimes	Never	I don't know
Wear chemotherapy gloves[D](1972)	85	5	7	4
Wear double chemotherapy gloves (1762)	20	20	59	<1
Wear a nonabsorbent gown with closed front and tight cuffs (1977)	58	16	26	—[E]
Wear eye or face protection (1886)	12	10	78	—
Wear a respirator[F](1953)	2	3	95	—
Wear shoe covers (1997)	3	3	93	—
Wear a head cover (1995)	4	3	94	—

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer and excluded respondents where the activity was not applicable to them).

[B] Percents may not add up to exactly 100 percent due to rounding.

[C] This response option was only offered to respondents whose treatments included liquid chemotherapy drugs.

[D] A medical glove that has been approved by FDA for use when handling antineoplastic drugs

[E] Dash (—) indicates that this response option was not included in question.

[F] N95, half-facepiece air-purifying respirator, or powered air-purifying respirator.

TABLE VIII

Reasons for not Always Wearing PPE When Administering Antineoplastic Drugs

Reason for not wearing PPE[A,B]	Chemotherapy gloves[C] (n = 218) %	Nonabsorbent gown[D] (n = 820) %	Eye/Face protection[E] (n = 1654) %	Respirator[F] (n = 1881) %
An engineering control was being used	_[G]	15	22	18
(Skin[H]) exposure was minimal	36	42	44	33
Not part of our protocol	29	35	47	66
Not provided by employer	31	13	14	15
No one else who does this work uses them	11	21	18	14
Too uncomfortable or difficult to use	9	15	8	6
Not readily available in work area	20	14	14	11
Cross contamination to other areas is not a concern.	2	7	—	—
Concerned about raising the patient's anxiety	<1	15	9	
Other	18	16	13	6

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Column percents add to more than 100 percent because respondents could select more than one answer.

[C] A medical glove that has been approved by FDA for use when handling antineoplastic drugs.

[D] Nonabsorbent gown with closed front and tight cuffs.

[E] Examples included goggles and face shields.

[F] Choices included N95 respirator, surgical N95 respirator, half-facepiece air-purifying respirator with chemical cartridge(s), and powered air-purifying respirator with chemical cartridge(s).

[G] Dash (—) indicates this reason was not included in question response options.

[H] Response for eye/face protection and respirator was "Exposure was minimal."

TABLE IX

Spills of Liquid Antineoplastic Drugs During Administration: Number of Spills by Quantity, Cause of Spill, and Availability of Spill Response Kits

Characteristics of spills/leaks and cleanup (n[A])	**Percent**
Spill/leak of any amount occurred in past 7 calendar days (1916)	12
Spills or leaks of <5 ml (232)[B]	
No spills <5 ml	22
1–2 spills	71
3–5 spills	7
>5 spills	<1
Spills or leaks of ≥5 ml (230)	
No spills ≥5 ml	91
1–2 spills	9
Cause of spill or leak[C]	
attaching, injecting, or detaching from I.V. line (234)	71
due to a bad connection (234)	33
due to equipment malfunction (233)	22
drawing up or expelling air from syringe (234)	19
due to excessive pressure in vial (233)	17
Spill cleanup	
Spills not always cleaned up (190)	9
Hazardous drug spill kits were not available or didn't know if they were (1991)	3

[A] Number of respondents varied for individual items (i.e., number of eligible respondents less number who elected not to answer).

[B] Percents may not add up to exactly 100 percent due to rounding.

[C] Percents may add to more than 100 percent because respondents could select more than one answer.