

Nurses' Use of Hazardous Drug-Handling Precautions and Awareness of National Safety Guidelines

Martha Polovich, PhD, RN, AOCN®, and Susan Martin, RN, DNSc, AOCN®

Hazardous drugs (HDs) are pharmacologic agents exhibiting one or more of the following characteristics: carcinogenicity, teratogenicity, genotoxicity, reproductive toxicity, or organ toxicity at low doses (American Society of Health-System Pharmacists, 2006). Most HDs are chemotherapy drugs used in the treatment of cancer, making occupational HD exposure a significant problem for oncology nurses. Nurses may be exposed to HDs during preparation, administration, or handling of patient excreta following their use. Such exposure has been linked to acute and long-term health effects, including acute symptoms, adverse reproductive outcomes, and an increased risk of cancer.

Occupational exposure to HDs may result in adverse health outcomes. Those effects are based on the inherent toxicities of the agents. Several published studies have demonstrated health risks for healthcare workers who were exposed to chemotherapy. The first was a small, controlled study in which the authors reported mutagenic activity in the urine of patients who received chemotherapy, as well as the nurses who administered it (Falck et al., 1979). The Ames test was used, which measures genetic mutations in bacteria following exposure to chemicals. Ninety percent of known carcinogens test positive on this tool (Polovich, 2003). The study demonstrated that handling HDs during administration resulted in drug absorption by the nurses.

Pharmacists and nurses have reported acute symptoms from HD exposure, such as skin irritation, sore throat, cough, dizziness, headache, hair loss, allergic reaction, diarrhea, nausea, and vomiting (Harrison, 2001; Kyprianou, Kapsou, Raftopoulos, & Soteriades, 2010; Valanis, Vollmer, Labuhn, & Glass, 1993a, 1993b). Adverse reproductive outcomes have been reported more frequently in HD-exposed as compared to unexposed healthcare workers. Those include miscarriage (Kyprianou et al., 2010; Martin, 2003), spontaneous abortions (odds ratio [OR] = 1.5–2.3) (Selevan, Lindbohm, Hornung, & Hemminki, 1985; Stücker et al., 1990; Valanis, Vollmer, & Steele, 1999), infertility (OR = 1.42–1.5) (Martin, 2003;

Purpose/Objectives: To determine patterns of personal protective equipment (PPE) used by oncology nurses while handling hazardous drugs (HDs) and to assess knowledge of the 2004 National Institute for Occupational Safety and Health (NIOSH) Alert and its effect on precaution use.

Design: Descriptive, correlational.

Setting: The Oncology Nursing Society 31st Annual Congress in Boston, MA, in 2006.

Sample: 330 nurses who prepared and/or administered chemotherapy.

Methods: Nurses described HD safe-handling precaution use by self-report survey.

Main Research Variables: The availability and use of biologic safety cabinets and PPE.

Findings: Respondents were well educated (57% had a bachelor's degree or more), experienced ($\bar{X} = 19$, $SD = 10.2$ years in nursing and $\bar{X} = 12$, $SD = 7.9$ years in oncology), and certified (70%; majority OCN®). Forty-seven percent of respondents were aware of the NIOSH Alert. Thirty-five percent of all participants and 93% of nurses in private practice settings reported preparing chemotherapy. Glove use (95%–100%) was higher than that reported in earlier studies, and gown use for drug preparation (65%), drug administration (50%), and handling excretions (23%) have remained unchanged. Double-gloving was rare (11%–18%). Nurses in private practices were less likely to have chemotherapy-designated PPE available, use PPE, and use spill kits for HD spills.

Conclusions: Nurses have adopted glove use for HD handling; however, gown use remains comparatively low. Chemotherapy-designated PPE is not always provided by employers. Nurses lack awareness of current safety guidelines.

Implications for Nursing: Nurses must know about the risks of HD exposure and ways to reduce exposure. Employers must provide appropriate PPE and encourage its use. Alternative methods of disseminating safety recommendations are needed.

Valanis, Vollmer, Labuhn, & Glass, 1997), longer time to conception (OR = 0.8) (Fransman et al., 2007); preterm labor (OR = 2.98), and preterm births (OR = 5.56) (Martin, 2003). Other documented effects of occupational HD exposure in nurses include DNA damage (Fuchs et al., 1995;

Yoshida, Kosaka, Tomioka, & Kumagai, 2006), chromosomal abnormalities (McDiarmid, Oliver, Roth, Rogers, & Escalante, 2010; Testa et al., 2007), learning disabilities in the offspring of nurses who handled chemotherapy during pregnancy (OR = 2.56), and an increased occurrence of cancer (OR = 3.27) (Martin, 2005).

Safe-handling precautions are recommended to limit worker exposure to HDs. The first U.S. recommendations for HD safe handling came from the American Society of Hospital Pharmacists ([ASHP], 1985). The Occupational Safety and Health Administration (OSHA) released guidelines in 1986 (OSHA, 1986). The Oncology Nursing Society ([ONS], 1988) published safe-handling recommendations in 1988. Current guidelines recommend engineering controls, work practices, and personal protective equipment (PPE) to reduce healthcare worker exposure (American Society of Health-System Pharmacists, 2006; National Institute for Occupational Safety and Health [NIOSH], 2004; OSHA, 1996; Polovich, Whitford, & Olsen, 2009).

NIOSH (2004) summarized the most recent recommendations in an Alert. The purpose of the NIOSH document was to (a) increase awareness of healthcare workers and their employers about the exposure risks of antineoplastic agents and other HDs and (b) provide measures for protecting the health of those potentially exposed.

The main recommendations for HD safe-handling precautions include the use of a biologic safety cabinet (BSC) for HD preparation; the use of PPE, including gowns, gloves, eye protection when splashing is possible, and respiratory protection when aerosols are present; and education and training of those responsible for HD handling. In the 25 years since OSHA published guidelines, the recommendations have not changed significantly. Gown and glove materials have been tested and improved in their ability to provide worker protection. Face shields are suggested instead of goggles because they cover the entire face. BSCs are unchanged in their design, although other types of ventilated cabinets are available now. All of these precautions, when used consistently, can reduce occupational exposure to HDs (NIOSH, 2004).

Despite the availability of safe-handling guidelines, nurses' adherence to recommended precautions has been, historically, low (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Stajicj, Barnett, Turner, & Henderson, 1986; Valanis, McNeil, & Driscoll, 1991; Valanis & Shortridge, 1987; Valanis, Vollmer, Labuhn, Glass, & Corelle, 1992). Table 1 lists several studies of safe-handling precautions published from 1986–2010. All studies used surveys to determine the use of safe-handling precautions for HDs.

Several of the studies captured glove use in general, whereas others recorded specific types of gloves used for HD-handling activities. NIOSH recommends that only gloves that have been tested with HDs be used for handling the agents. Gloves that have been designated

as chemotherapy gloves have been available since the early 1990s. Mahon et al. (1994) reported that 90% of nurses in their study used gloves for drug mixing, but only 44% of the nurses used chemotherapy gloves. Surgical gloves or polyvinylchloride gloves were used more often (Mahon et al., 1994). Martin and Larson (2003) revealed that 84% of nurses mixing HDs and 60% of nurses administering HDs used chemotherapy gloves. Although the use of chemotherapy-designated gloves has increased, nurses continue to report using other types of gloves, which provide less protection.

Gowns are recommended for HD handling in all published guidelines. Most studies, however, have reported low gown use. Stajicj et al. (1986) reported the use of protective outer garments in their study as only 3% for HD preparation and administration. Most studies reported that gowns were used more frequently for HD preparation than for HD administration (Kyprianou et al., 2010; Martin & Larson, 2003; Stajicj et al., 1986; Valanis et al., 1991; Valanis & Shortridge, 1987; Valanis et al., 1992).

Several studies captured the type of gown worn for HD-handling activities. All published guidelines specify that appropriate gowns be disposable and made of low-permeability fabric to provide chemical protection. Cloth gowns or laboratory coats are not considered PPE, but reportedly have been used during HD handling (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Valanis & Shortridge, 1987; Valanis et al., 1992). One study reported the practice of reusing laboratory coats and, in that study, nurses changed them weekly or less often (Valanis & Shortridge, 1987). No studies reported reusing disposable chemotherapy gowns.

In summary, several studies have identified a lack of adherence to safe-handling precautions. Surveys of nursing and pharmacy personnel who handle HDs or care for patients who receive them reveal similar non-adherence to precautions. All studies reported less-than-recommended use of PPE. Only one published study has reported adherence since the release of the NIOSH Alert (Kyprianou et al., 2010).

Purpose

The purpose of the current study was to describe the self-reported use of PPE by oncology nurses while handling HDs and to assess nurses' knowledge about the latest national guidelines related to HD safe-handling precautions. The specific objectives were to

- Describe the use of safe-handling precautions by oncology nurses during HD handling.
- Describe the relationship between demographics of oncology nurses and safe-handling practices.
- Correlate reported handling practices with characteristics of worksite and geographic area.
- Measure nurses' knowledge about the NIOSH Alert "Preventing Occupational Exposures to Antineoplastic

and Other Hazardous Drugs in Healthcare Settings.”

Methods

Sample and Setting

The study used a descriptive, correlational design. Participants consisted of a convenience sample of nurses attending the ONS 31st Annual Congress in 2006. Oncology nurses were asked to participate if they prepared chemotherapy, administered chemotherapy, or both. Return of the survey implied consent.

Instrument

The **Hazardous Drug Handling Questionnaire** is a 24-item, written self-report survey based on the current guidelines for the handling of HDs. The instrument collects information about the availability and use of BSCs and PPE. Frequency of PPE use is recorded on a 3-point Likert-type scale from 1 (usually) to 3 (rarely).

The questionnaire includes items regarding the availability of safe-handling policies and medical surveillance in the respondents' practice settings. Demographic data include employment information; nursing education; years of experience in nursing, oncology, and chemotherapy administration; and certification status. Two questions address the NIOSH Alert.

The questionnaire is based on the 20-item Chemotherapy Handling Questionnaire that previously was used in a study of outpatient chemotherapy nurses (Martin & Larson, 2003). Content and construct validity were

Table 1. Survey-Designed Studies of Safe-Handling Precautions

Study	Sample	Results
Stajic et al., 1986	33 RNs employed in oncologists' private practices in Georgia	Reported PPE use for drug reconstitution <ul style="list-style-type: none"> • Gloves = 49% • Gowns = 3% Reported PPE use for drug administration <ul style="list-style-type: none"> • Gloves = 15% • Gowns = 3% No biologic safety cabinets were available.
Valanis & Shortridge, 1987	632 Oncology Nursing Society members who mixed and or administered anti-neoplastic drugs	Use of protection 75% of the time Drug mixing <ul style="list-style-type: none"> • Gloves = 76% • Gowns = 36% Drug administration <ul style="list-style-type: none"> • Gloves = 50% • Gowns = 14% Many nurses reported wearing laboratory coats and changing them weekly or less often. Inverse relationship found between numbers of doses handled and PPE use Reasons for not using PPE: inconvenience, don't believe danger exists, not available, not appropriate, might upset patients, not mandated by policy
Valanis et al., 1991	125 staff members from 14 facilities in southwestern Ohio, including 7 physicians, 93 nurses, 22 pharmacists and pharmacy technicians, and 3 housekeeping staff or nurse aides	Use of protection 75% of the time Pharmacists reported using PPE more often than nurses for mixing HDs. Nurse-reported PPE use during mixing <ul style="list-style-type: none"> • Gloves = 91% • Gowns = 41% Nurse-reported PPE use during HD administration <ul style="list-style-type: none"> • Gloves = 78% • Gowns = 12% Staff used protection when required by policy (not statistically significant except for goggles). Reported reasons for non-use of PPE: not required, too time consuming, lack of risk awareness, not necessary, too awkward, and gowns and gloves interfere with staff's relationship with patients
Valanis et al., 1992	1,932 nurses and 153 nurse aides from more than 200 healthcare facilities currently handling HDs	Pharmacists used more protection than nurses. Nurses in hospitals were more likely to use protective equipment than nurses in outpatient settings. Drug preparation <ul style="list-style-type: none"> • Gloves = 92% • Gowns = 63% Drug administration <ul style="list-style-type: none"> • Gloves = 82% • Gowns = 23% Handling excreta <ul style="list-style-type: none"> • Gloves = 67% • Gowns = 4%
Mahon et al., 1994	103 nurses, 83 of whom handled chemotherapy, from an Oncology Nursing Society chapter in a large city in the midwestern region of the United States	Participants used PPE, but less than OSHA recommendations. Drug preparation <ul style="list-style-type: none"> • Gloves = 90% • Gowns = 44% (cloth gowns not included) Drug administration <ul style="list-style-type: none"> • Gloves = 94% • Gowns = 59% Patient care <ul style="list-style-type: none"> • Gloves = 94% • Gowns = 12% Many nurses used cloth gowns or laboratory coats.

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HD—hazardous drug; OSHA—Occupational Safety and Health Administration; PPE—personal protective equipment

Table 1. Survey-Designed Studies of Safe-Handling Precautions (Continued)

Study	Sample	Results
Nieweg et al., 1994	824 nurses from 11 Dutch hospitals	94% indicated that precautions were effective. Reported PPE use for HD administration <ul style="list-style-type: none"> • Gloves = 91% • Gowns = 21% • Masks = 18% • Goggles = 3% 88% reported having policies for safe handling. No policies were up to date and nurses did not always follow established guidelines.
Martin & Larson, 2003	263 Oncology Nursing Society members who were nurses from outpatient settings	Reported “usually” using PPE use for drug preparation (more than 50% of the time) <ul style="list-style-type: none"> • Gloves = 99% • Gowns = 53% Drug administration <ul style="list-style-type: none"> • Gloves = 94% • Gowns = 31% Handling excretions <ul style="list-style-type: none"> • Gloves = 96% • Gowns = 23%
Kyprianou et al., 2010	88 nurses from 3 hospitals in Nicosia, Cyprus	Drug preparation <ul style="list-style-type: none"> • Gloves = 95% • Gowns = 85% Patient care activities <ul style="list-style-type: none"> • Gloves = 85% • Gowns = 43%

HD—hazardous drug; OSHA—Occupational Safety and Health Administration; PPE—personal protective equipment

Respondents had a mean nursing experience of 19 years (SD = 10.2 years), a mean oncology experience of 12 years (SD = 7.9 years), and a mean of 11.5 years of chemotherapy experience (SD = 7.8) (see Table 2). The majority were certified and had the OCN® credential, and most indicated that they worked in outpatient settings.

Twenty-seven percent of respondents resided in the Midwest region of the United States, with 25% living in the Northeast, 18% in the West, and 17% in the Southeast, 7% in the Southwest, and 4% in the Mid-Atlantic region.

Adherence to Safe-Handling Guidelines

Availability of personal protective equipment: About a third of respondents indicated that they prepared chemotherapy, and almost all administered chemotherapy.

evaluated in the earlier study. Congruence existed between reported and observed PPE use for 10 nurses, except for glove use by two nurses, which they reported as higher than the observers. Test-retest reliability over two to three weeks was 0.8 as assessed in the 10 respondents.

Procedure

The surveys were distributed at the beginning of each of three educational sessions about HD safe handling and collected at the end of the programs. Time to complete the survey was about 5–10 minutes. Demographic data and employment setting characteristics were summarized using descriptive statistics. Differences in selected safe-handling practices by employment setting, geographic area, nursing experience, and other variables were analyzed using the chi-square statistic for categorical data.

Results

Participant Characteristics

The study population consisted of nurses who attended one of three educational programs at the ONS 31st Annual Congress in Boston, MA, in May 2006. Four hundred questionnaires were distributed and 335 were returned for a response rate of 84%. Five incomplete surveys were eliminated, resulting in a final sample of 330.

The vast majority of participants reported having gloves available for HD preparation (98%), HD administration (99%), and for cleaning HD spills (100%). Although chemotherapy-designated gloves were the type provided most frequently, latex and vinyl gloves were used by some nurses. Gowns were available to 91% of nurses for HD preparation and to 84% of nurses for HD administration. Gowns were available significantly less often in private practices ($p = 0.03$). Some nurses reported using personal laboratory coats for HD preparation (15%) and for HD administration (13%). Other types of gowns were used occasionally, including isolation-type gowns and cloth gowns provided by the employer.

Eye and respiratory protection were available less often than other PPE (see Table 3). Eye and respiratory protection were available for cleaning spills more often than for other HD-handling activities. Private practices were significantly less likely to provide respirators for HD preparation ($p = 0.03$), HD administration ($p = 0.001$), handling excretions ($p = 0.015$), and disposal ($p = 0.01$).

Use of personal protective equipment: Table 4 lists the frequency of use of PPE by study participants. All nurses indicated that they usually wore gloves for HD preparation. For chemotherapy administration, 96% of nurses reported usually using gloves. Chemotherapy-designated gloves were significantly less

likely to be worn in private physician offices for HD administration ($p < 0.05$). No significant differences existed regarding glove use for HD preparation or administration based on geographic region, experience, education, or certification status. Reported glove use was lowest for HD disposal.

Only 11% of participants reported double-gloving for HD preparation, and 18% for HD administration. Those nurses who double-gloved for HD preparation were significantly less likely to work in a private practice setting ($p = 0.001$). Double-gloving for HD administration was reported significantly more often in inpatient settings ($p < 0.05$). Double-gloving was reported most often in organizations where safe-handling policies had been updated to reflect the recommendations in the NIOSH Alert.

Gown use was reported by 62% of nurses for HD preparation and 52% for chemotherapy administration. Gown use was lowest for handling excretions. No significant relationships existed between gown use and nurses' certification status or years of experience in nursing, oncology, or chemotherapy.

Fifty-eight percent of participants reported reusing disposable gowns for HD preparation and 38% reused disposable gowns for HD administration. Although most participants discarded gowns at the end of a day, many reported discarding used gowns at the end of the week or less often. The survey did not collect data on the frequency of reusing cloth gowns or personal laboratory coats.

Chemotherapy preparation: In the current study, chemotherapy was prepared by pharmacists in 46% of settings, by nurses in 35% of settings, and by pharmacy technicians in 20% of settings. In private practice settings, nurses were responsible for HD preparation 93% of the time. Responsibility for HD preparation did not vary by geographic region, years of experience, or certification status. Drug preparation took place in a pharmacy 47% of the time, and in a designated preparation area 34% of the time. From what respondents knew about drug preparation, it always was performed within a BSC; however, 9% of respondents were unsure about BSC use.

Management of spills: Ninety-seven percent of study participants reported that spill kits were available in their work setting. However, only 90% reported using the materials in a spill kit for their most recent HD spill. Nurses working in private practices were significantly less likely to use a spill kit during clean up of their most recent spill ($p = 0.01$).

Medical Monitoring

Only 47% of nurses reported that their employers provided any form of medical surveillance for those involved in HD handling. Of those, a pre-employment physical was the most common form of health appraisal reported (52%), with an annual screening questionnaire being used

about 30% of the time, and an annual physical for about 22% of nurses. Assessment of cancer and/or reproductive history was performed infrequently (7%), as was periodic laboratory testing (9%). Respondents working in inpatient settings were more likely to have access to medical surveillance than those in outpatient or private practice settings ($p < 0.05$). Availability of medical monitoring did not vary by geographic region.

National Institute for Occupational Safety and Health Alert

Only 47% of the nurses in the survey reported having received information regarding the 2004 NIOSH Alert.

Table 2. Characteristics of Participants Compared to Oncology Nursing Society (ONS) Membership

Characteristic	Survey Respondents (N = 330)		ONS Members (N = 32,761)	
	n	%	n	%
Nursing experience (years)				
0–3	11	3**	4,766	14
4–10	70	21	6,036	18
11–20	99	30	8,800	27
21 or more	138	42**	9,774	30
No response	12	4**	3,385	10
Oncology experience (years)				
0–3	39	12**	8,525	26
4–10	114	35	9,820	30
11–20	111	34	9,938	30
21 or more	53	16*	4,035	12
No response	13	4	443	1
Education				
Diploma	39	12	3,948	12
Associate degree	77	23	8,286	25
Bachelor's degree	111	34	12,289	38
Master's degree or higher	43	13*	5,763	17
No response	60	18	2,475	8
Work site				
Outpatient	197	60**	15,549	47
Inpatient	118	36	12,199	37
Other or no response	15	5	5,013	16
Certification				
OCN®	202	61	–	–
AOCN®	13	4	–	–
AOCNP®	1	< 1	–	–
Other	11	3	–	–
Not certified	91	28	–	–
No response	12	4	–	–
Region				
Midwest	84	25	–	–
Northeast	74	22	–	–
West	54	16	–	–
Southeast	51	15	–	–
Southwest	19	8	–	–
Mid-Atlantic	11	3	–	–
No response	37	11	–	–

* $p < 0.05$; ** $p < 0.01$

Note. Respondents differ from ONS members.

Note. ONS membership characteristics as of 6/30/2006.

Nurses working in inpatient settings were significantly more likely to have heard of the NIOSH Alert ($p = 0.01$), particularly those working in academic settings. Nurses working in public or government hospitals (29%) and health maintenance organizations (25%) were least likely to have received information about the NIOSH Alert. When nurses reported having information about the latest guidelines, 44% received the information from their employer and 31% from an ONS program.

Safe-Handling Policies and Procedures

Eighty-nine percent of nurses reported having written policies and procedures regarding HD handling. Inpatient settings were more likely to have written policies than other types of settings ($p < 0.05$). Of those work sites that had written policies, they addressed drug administration (95%), spill management (95%), disposal (90%), drug preparation (81%), and handling of excretions (68%). Private practice settings were least likely to have policies on handling excretions ($p = 0.001$). Sixty-five percent of study participants who knew about the NIOSH Alert reported that their organization updated policies to reflect the recommendations.

Discussion

The goal of the survey was to describe the use of safe-handling precautions by oncology nurses during HD handling and to describe the relationship between nurses' demographics and their safe-handling practices. In addition, the intent was to assess the impact of the latest national guidelines from NIOSH on nurses' safe-handling practices. The participants were an experienced and well-educated group of nurses, similar to the general ONS membership. More nurses reported working in outpatient settings than inpatient settings, which is a reflection of the shift of chemotherapy administration from inpatient to outpatient settings. Not all geographic regions were represented equally in the study sample, which may have affected the study results. At least one previous study identified differences in safe-handling practices by geographic regions (Martin & Larson, 2003).

Table 3. Percent of Participants Reporting Availability of Personal Protective Equipment by Handling Activity

Equipment	Preparation (N = 222) (%)	Administration (N = 324) (%)	Handling Excreta (N = 306) (%)	Disposal (N = 310) (%)	Cleaning Spills (N = 315) (%)
Gloves	98	99	100	100	100
Chemotherapy gloves	91	76	–	–	–
Surgical gloves	–	2	–	–	–
Latex examination gloves	8	16	–	–	–
Vinyl gloves	1	5	–	–	–
Gowns	91	84	77	76	94
Chemotherapy gown	80	77	–	–	–
Personal laboratory coat	15	13	–	–	–
Cloth coat	4	5	–	–	–
Isolation gown	1	5	–	–	–
Eye protection	72	61	56	55	82
Respiratory protection	47	43	40	41	71

Note. Equipment type not specified for handling excreta, disposal, and cleaning spills.

The findings of the current survey indicate that PPE is available in most settings where chemotherapy is handled; however, chemotherapy-designated PPE is not always provided by employers. Chemotherapy-designated gloves are tested with several antineoplastic agents and withstand permeation by these chemicals (American Society for Testing and Materials, 2005). Although no standard exists for chemotherapy gowns, several types of gowns have demonstrated chemical protective qualities and are recommended for use while handling HDs (Connor, 1993; Harrison & Kloos, 1999). At least 20% of nurses reported that chemotherapy gowns were not available for their use. Eye protection and respirators were available less often than other PPE. The NIOSH Alert clearly states that employers are responsible for providing appropriate PPE for HD handling. Failure to do so is one explanation for nurses' nonadherence to guidelines.

Glove use has increased as compared to other studies of chemotherapy-handling practices. All nurses in the current study reported usually wearing gloves for HD preparation. A small number of nurses in the study reported double-gloving for HD handling. That is a recent recommendation in the NIOSH Alert and ONS guidelines (NIOSH, 2004; Polovich et al., 2009). Although most nurses have incorporated single-gloving into their practice for HD handling, double-gloving is uncommon.

Protective clothing has been recommended since 1986 for HD handling. Reported gown use was higher in the current survey than in most other studies for HD preparation and administration. Despite improvement, almost half of the nurse participants reported not using gowns for HD administration, and fewer still used gowns for HD disposal, both of which are opportunities for exposure. The study revealed that some nurses were reusing disposable gowns. The process of removing, storing, and reapplying a used gown may result in contamination

of clothing. The NIOSH (2004) recommendations restate the need for chemotherapy gowns as defined by OSHA and specify that gowns are meant for single use.

Spill kits generally were available for the nurses in the current study. Many nurses reported never having a chemotherapy spill, but a small percent of those who experienced a spill did not use a spill kit for clean up. The reasons for not using a spill kit are unclear and should be explored in a future study.

OSHA (1995) has recommended that individuals who handle HDs occupationally should be followed in a medical surveillance program. The NIOSH Alert did not place emphasis on medical monitoring, but did restate the OSHA recommendation. Less than half of study participants had a health appraisal of any kind. Inpatient settings were more likely to have medical monitoring, which is probably because of the existence of an employee health department. Outpatient settings, particularly private physician practices, are less likely to provide the service, although more nurses who handle HDs work in those kinds of settings.

The NIOSH Alert was released online in the spring of 2004. Print copies were available about five months later. Dissemination of the document was accomplished by varying methods, including use of professional organizations' meetings and Web sites. The recommendations clearly have not reached all of those involved in handling of HDs. Fewer than half of study participants were aware of the NIOSH Alert prior to their attendance at the educational programs where the surveys were distributed. Less than a third of respondents employed in government or public hospitals had heard of the recommendations. That certainly has limited the ability of healthcare workers to comply with the recommendations. Alternative methods of dissemination must be considered to provide this important safety information to all those involved in HD handling.

Limitations

The study is limited by the use of a nonrandom sample. The participants may not accurately represent all nurses who handle HDs. Only nurses who attended the national ONS Congress were included in the survey. Not all regions of the country were equally represented. Nurses who were invited to complete the survey attended educational sessions on safe handling and may have had a heightened interest in chemotherapy safety and, therefore, been biased. Another limitation was the use of self-report to measure use of protective measures. Information regarding PPE use and the availability of HD policies, procedures, and medical surveillance services may be inaccurate. However, surveys have been the usual method of measurement

used in previous studies of PPE use. One study used observation of actual practice of 10 nurses to measure the survey's accuracy and reliability of nurses' responses (Martin & Larson, 2003). Observation is a more reliable measure, but not practical for large sample sizes.

Finally, the 24-item survey used in the current study has been modified from the original 20-item Chemotherapy Handling Questionnaire. No evaluation has been conducted of the survey's validity and reliability since new questions were added. In addition, the instrument may be biased because of the absence of "always" or "never" response options.

Conclusions

In general, the use of PPE has improved over time. Since the 1986 OSHA guidelines were published, nurses have used gloves to handle HDs in their practice. Two areas of concern are that chemotherapy-designated gloves are not being used in all settings and that some nurses do not use gloves for all HD-handling activities. Gown use continues to be lower than expected based on the long-standing recommendations, the reasons for which are not fully understood. Employers do not always provide appropriate PPE, which is concerning.

Implications for Nursing

Several areas for nursing research are suggested by the current study. Barriers to implementing safe-handling precautions have not been explored fully. The individual characteristics and experiences of oncology

Table 4. Reported Frequency of Personal Protective Equipment Use by Hazardous Drug-Handling Activity

Equipment	Usually (%)	Occasionally (%)	Rarely (%)
Preparation (N = 113)			
Gloves	100	–	–
Gowns	62	12	26
Eye protection	25	14	61
Respiratory protection	10	5	85
Administration (N = 311)			
Gloves	96	3	1
Gowns	52	16	32
Eye protection	18	12	70
Respiratory protection	8	8	84
Handling excretions (N = 299)			
Gloves	98	2	< 1
Gowns	24	26	51
Eye protection	9	9	82
Respiratory protection	3	6	90
Disposal (N = 312)			
Gloves	96	3	2
Gowns	43	13	44
Eye protection	13	7	80
Respiratory protection	6	6	88

nurses that affect the use of safe-handling precautions are unknown. Information about the perceived barriers to the use of safe-handling precautions by oncology nurses during HD handling is lacking. The interpersonal and situational influences that affect the use of PPE would be valuable, particularly because some nurses fail to use equipment that is readily available. Because safe-handling practices varied significantly based on the type of work setting, the organizations' characteristics may influence nurses' use of precautions, which also should be a focus of future research.

The NIOSH Alert is an important document that provides information about the risks of exposure to HDs and describes measures for reducing exposure. The latest recommendations have not yet reached all of the intended audiences. That information must be disseminated to nurses and their employers so that protective measures can be implemented in all practice settings.

Although PPE use for HD handling has improved over time, additional improvement is needed. The risks of occupational exposure are well documented. Failure to use PPE may result in nurses' exposure to HDs. Improving the use of HD safe-handling precautions will reduce the potential for HD exposure-related adverse health outcomes among oncology nurses.

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Martha Polovich, PhD, RN, AOCN[®], is the associate director of clinical practice at the Duke Oncology Network in Durham, NC, and Susan Martin, RN, DNSC, AOCN[®], is an oncology clinical coordinator at Genentech BioOncology in Long Beach, NY. No financial relationships to disclose. Polovich can be reached at martha.polovich@duke.edu, with copy to editor at ONFEditor@ons.org. (Submitted November 2010. Accepted for publication June 9, 2011.)

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