Nursing Assistants' Use of Personal Protective Equipment Regarding Contact With Excreta Contaminated With Antineoplastic Drugs

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PURPOSE: To examine the feasibility of observing and interviewing nursing assistants about handling of antineoplastic drugs contaminated with excreta, acceptability of a measure of personal protective equipment (PPE) use with nursing assistants, and predictors of PPE use.

PARTICIPANTS & SETTING: 27 nursing assistants in an inpatient hematology-oncology unit at an academic medical center in the southeastern United States.

METHODOLOGIC APPROACH: This was an exploratory, multimethod study using observation, verbally administered questionnaires, and interviews. Research variables included recruitment rates, acceptability of observation, and understandability of a safe-handling instrument.

FINDINGS: Observed use of double gloves, chemotherapy gowns, and face shields was low; use of plastic-backed pads when flushing excreta was high.

IMPLICATIONS FOR NURSING: Nursing assistants are willing to participate in research. Standardized training and education about PPE use are needed.

KEYWORDS occupational exposure; nursing assistants; personal protective equipment

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Exposure to antineoplastic drugs in the workplace can cause skin rashes, infertility, birth defects, miscarriage, and increased risk of cancer (Connor, Lawson, Polovich, & McDiarmid, 2014; Lawson et al., 2012; McDiarmid, Oliver, Roth, Rogers, & Escalante, 2010; Rogers & Emmett, 1987). Evidence of exposure to antineoplastic drugs in the workplace is mounting. Antineoplastic drug residue in the environment can be used as a proxy for exposure risk. Antineoplastic drug residue has been found on work surfaces (Hon, Teschke, Chu, Demers, & Venners, 2013) and on the hands of those who work near but do not administer the drugs (Hon, Teschke, Demers, & Venners, 2014); antineoplastic drug metabolites have also been found in unit staff's urine (Hon, Teschke, Shen, Demers, & Venners, 2015; Rogers & Emmett, 1987). In addition, family members of patients receiving antineoplastic drugs may have antineoplastic drug metabolites in their urine, and antineoplastic drug residue has been found on bathroom surfaces in homes (Yuki, Sekine, Takase, Ishida, & Sessink, 2013; Yuki, Takase, Sekine, & Ishida, 2014; Yuki, Ishida, & Sekine, 2015). These findings suggest high exposure risk to antineoplastic drugs for family members and healthcare providers.

Like family members, nursing assistants perform intimate personal care duties as part of their role in caring for patients receiving antineoplastic drugs, including feeding, bathing, toileting, dressing, grooming, repositioning, and changing linens, which repeatedly expose them to the bodily fluids of patients (U.S. Bureau of Labor Statistics, 2018). Findings from the limited studies on nursing assistants' exposure to antineoplastic drugs suggest that

nursing assistants likely have high exposure risk. A single case study described acute effects experienced by a nursing assistant exposed to antineoplastic drugs from contact with patient excreta (Kusnetz & Condon, 2003). Two studies have included nursing assistants in their sampling frame; one focused on antineoplastic drug contamination on the hands of various groups of workers in a healthcare system and the other on healthcare worker knowledge, perceptions, and behaviors (Hon et al., 2014; Hon, Teschke, & Shen, 2015). However, no study has focused solely on antineoplastic drug exposure or on protective behaviors of nursing assistants despite the fact that they constitute a large portion of the healthcare workforce.

The National Institute for Occupational Safety and Health (NIOSH) recommends that nursing assistants use personal protective equipment (PPE), including two pairs of chemotherapy-rated gloves, disposable gowns, and a face shield (or combination of a face mask and face shield) if splashing is possible when handling excreta contaminated with antineoplastic drugs (U.S. Department of Health and Human Services, 2004); however, actual practice of nursing assistants' handling of excreta has never been examined.

The lack of inclusion of nursing assistants in antineoplastic drug exposure and protective behavior studies, despite their exposure potential, underscores nursing assistants' vulnerability to harm in the workplace. The objectives of this descriptive, exploratory, multimethod study were to determine the feasibility of observing and interviewing nursing assistants about safe handling of antineoplastic drug–contaminated excreta, examine the acceptability of measures originally developed for use with nurses and adapted for use with nursing assistants (Polovich & Clark, 2012), and explore the use of PPE and factors that predict use of PPE by nursing assistants. This study determines the feasibility of including nursing assistants in studies about antineoplastic drug exposure, as well as whether existing instruments will work for them. In addition, it explores factors that predict PPE use among nursing assistants.

Methodologic Approach

Theoretical Framework

The Factors Predicting Use of Hazardous Drug Safe-Handling Precautions model guided the current study (Polovich & Clark, 2012). This model is based on the health promotion model (Pender, Murdaugh, & Parsons, 2002) and takes into account individual, situational, and environmental factors that affect behavior. In the model, knowledge of the hazard is related to perceived risk and self-efficacy. Higher self-efficacy for using PPE and positive organizational influences are expected to decrease perceived barriers. Perceived risk, self-efficacy, perceived barriers, conflict of interest, organizational influences, and interpersonal influences are expected to affect use of safe-handling precautions (Polovich & Clark, 2012).

Participants and Setting

This study took place in a 50-bed hematology-oncology inpatient unit at a large academic medical center in the southeastern United States. The unit employed more than 125 staff members at the time of the study, and 32 staff members were non–float pool nursing assistants. All non–float pool nursing assistants were eligible to participate in this study. Those in the float pool were not eligible because they would not have received training or orientation specific to the unit. All eligible nursing assistants should have received information about the appropriate use of PPE during orientation led by a nursing assistant preceptor. In addition, all eligible nursing assistants should have received an annual refresher training module on safe handling of antineoplastic drugs.

Procedures and Data Collection

Ethical considerations, recruitment, and enrollment: After institutional review board and hospital approvals were obtained, the principal investigator (PI) introduced the study at nursing assistant staff meetings and at other times on the inpatient hematology-oncology until all 32 non–float pool nursing assistants employed on the unit had been invited to participate. Ultimately, 27 nursing assistants agreed to participate. After signing informed consent, the PI gave each participant a study ID and made an appointment with each of them for observation during work hours.

Observations and quantitative data collection: The PI used the charge RN list and unit assignment sheet to determine which patient rooms were occupied by patients receiving antineoplastic drugs. Prior to entering any patient room to observe the nursing assistant, the PI introduced herself to the patient, spoke briefly about the study, and ensured that the patient provided assent to enter the room and observe. After the observation, each participating nursing assistant (N = 27) completed a questionnaire outside of work hours that was verbally administered by the PI and audio recorded.

The purpose of the observation was to document how often nursing assistants use PPE when in contact with antineoplastic drugs, as well as to compare against self-reported PPE use in the verbally administered questionnaire. Nursing assistants were observed using a standardized checklist for two hours of a routine shift. All PPE used when coming into contact with antineoplastic drug–contaminated excreta was noted. Observations took place from 9 am to 11 am or 9 pm to 11 pm, depending on the shift the nursing assistant was working, to ensure that the same tasks were being observed by nursing assistants across shifts. All observations were conducted by the PI.

Qualitative data collection: Semistructured interviews with nursing assistants were conducted by the PI in a private room on the unit immediately after completion of the verbally administered questionnaire; interviews were audio recorded and transcribed verbatim. The interview included 11 open-ended questions. Six focused on contextual factors around PPE use, including probing for what nursing assistants knew about risks, concerns they have, what influences PPE use, and barriers and facilitators of PPE use. The other five focused on how observation felt, how well the observation period represented their typical day, and questions about participation in research more generally. At the completion of the interview, each participating nursing assistant received a $20 gift card.

Instruments

Observational checklists have been used extensively in the healthcare setting to measure a variety of behaviors and with nursing assistants in particular (Resnick, Rogers, Galik, & Gruber-Baldini, 2007; Son et al., 2011). The observational checklist was used to quantify nursing assistant contact with antineoplastic drug–contaminated bodily fluids (e.g., emptying urinals, bedpans, urine collection containers inside toilets, or emesis basins; handling linens or clothes), the use of PPE (e.g., use of single gloves, double gloves, gowns, face shields, and plastic-backed pad when handling excreta, emesis, or linens), and handwashing after glove removal. Observational data were captured by the PI using an observational checklist (an event tally system) (Altmann, 1974). In addition, the observational checklist captured whether a chemotherapy precautions sign was on the patient's door. The behaviors included were discussed with the research team and other content experts to assess face validity of the instrument.

An instrument was adapted from a previously used instrument related to PPE and was verbally administered (Polovich & Clark, 2012). The current authors used all instrument items in their original form except for removing items about activities that were outside of nursing assistants' scope of practice. A total of 72 items were selected prior to the addition of demographic questions. The authors also clarified items that used the term "coworkers" by making explicit that they included doctors, nurses, and unit clerks. In the current article, these collected and adapted instruments are termed the Factors Predicting Use of Hazardous Drug Safe-Handling Precautions instrument, a name based on the model by Polovich and Clark (2012), which was adapted with permission.

Chemotherapy exposure knowledge was measured using 12 items with responses of "true," "false," or "do not know" (Geer et al., 2007). Scores range from 0 to 12, with higher scores indicating greater knowledge (α = 0.7) (Polovich & Clark, 2012).

Self-efficacy was measured with six items using a four-point Likert-type scale with options from strongly agree to strongly disagree (Geer et al., 2007). Scores range from 6 to 24, with higher scores indicating greater self-efficacy (r = 0.7, α = 0.79) (Polovich & Clark, 2012).

Barriers to using PPE were measured with 13 items on a four-point Likert-type scale with options from strongly disagree to strongly agree (Geer et al., 2007). Scores range from 13 to 52, with higher scores indicating more perceived barriers (r = 0.72, α = 0.88) (Polovich & Clark, 2012).

Perceived risk was measured using three items on a four-point Likert-type scale with options from strongly disagree to strongly agree (Geer et al., 2007). Scores range from 0 to 4, with higher scores indicating higher perceived risk (r = 0.78, α = 0.73) (Polovich & Clark, 2012).

Interpersonal influence: importance of PPE to others was measured using three items (range = 0–3), with higher scores indicating a more positive view of coworkers' attitudes toward PPE (McCullagh, Lusk, & Ronis, 2002). Interpersonal influence: use of PPE by others was measured with four items (range = 0–2), with higher scores indicating a more positive view toward use of PPE (r = 0.92, α = 0.8 combined).

Conflict of interest was measured using six items on a four-point Likert-type scale adapted from the Healthcare Worker Questionnaire (Gershon et al., 1995). The response options range from strongly agree to strongly disagree, and scores range from 6 to 24, with higher scores indicating higher conflict of interest (r = 0.7, α = 0.89) (Polovich & Clark, 2012).

Workplace safety climate was adapted from the Healthcare Worker Questionnaire (Gershon et al., 1995, 2005, 2007) and measured using 21 items on a five-point Likert-type scale. Scores range from 21 to 105, with higher scores indicating a better safety climate ($r = 0.86$, $\alpha = 0.93$) (Polovich & Clark, 2012).

Self-reported use of safe-handling precautions was measured using an adapted version of the Revised Hazardous Drug Handling Questionnaire (Martin & Larson, 2003). The original responses ranged from never (0) to always (5), using a mean score for all items. This measure was further adapted for use with nursing assistants after use with nurses. Higher scores indicate greater use of safe-handling precautions ($\alpha = 0.83$) (Polovich & Clark, 2012).

TABLE 1. Sample Characteristics (N = 27)

Characteristic	$\bar{X}$	SD
Age (years)	26.6	6.3
Nursing assistant experience (years)	4.7	5.3
Oncology nursing assistant experience (years)	2.1	3.1
Chemotherapy handling experience (years)	2.3	3.1
Characteristic		**n**
Gender		
Female		23
Male		4
Race/ethnicity		
White		18
Black		7
Latino		2
Education level		
High school		16
Associate degree		2
Bachelor's degree		9
Pursuing a higher degree currently		
Yes		19
No		8
Received orientation for safe handling of chemotherapy		
Yes		15
No		12
Received annual refresher for safe handling of chemotherapy		
Yes		10
No		9
Do not know or not employed long enough to know		8

Finally, a series of open-ended questions after the observation and at the end of the interview enabled respondents to share general comments about PPE use and exposure to antineoplastic drugs (six questions), as well as give feedback on the study, which included questions about understandability of the instrument (five questions). This instrument is available from the authors on request.

Data Analysis

Quantitative data analysis: Psychometrics for the Factors Predicting Use of Hazardous Drug Safe-Handling Precautions instrument were computed. Descriptive statistics were computed for demographics, observed PPE use, and self-reported PPE use. Frequencies and percentages were calculated for categorical variables, and sample means and standard deviations were calculated for count and interval variables. Medians and interquartile ranges were also computed for observed and self-reported PPE use because of the small sample size; the authors wanted to acknowledge the potential contributions of extreme values. Group differences were assessed using Wilcoxon signed-rank tests at the $p \leq 0.05$ significance level. Simple linear regression was performed to examine bivariate associations between self-reported PPE use and each of the predictive factors separately. Although the authors' assessment of predictive factors of PPE use was exploratory, the regression analysis had 80% power to detect a large effect size (Cohen's $f^2 = 0.35$). All analyses were conducted using SAS, version 9.4.

Qualitative data analysis: The audio-recorded interviews were transcribed by a student in an MSN program, and 10% of the sample was validated by the PI with minor edits made. The PI coded the transcripts line by line independently and listened to each audio recording again to provide context. A second investigator then coded independently. Before discussion, the investigators had developed a codebook with a priori codes and coded 77% (n = 334 of 435) of text excerpts identically. Through case-by-case discussion, the investigators resolved all discrepancies, leading to 100% agreement (Patton, 2002). The PI undertook a secondary review of the data after the initial coding of the data to reexamine it all after coding (Saldaña, 2009).

Findings

Sample Characteristics

Participant characteristics are shown in Table 1. Most participants were female (85%) and White (67%). The

TABLE 2. Observed Personal Protective Equipment Use

Behavior	N	No Glove	Single Glove	Double Gloves	Gown[a]	Face Shield	Plastic-Backed Pad	Handwashing After Glove Removal
Handling linen or clothes	32	4	28	–	4	NA	NA	14[b,c]
Emptying bedpan	1	–	1	–	1	–	1/1	–[b]
Emptying emesis basin	1	–	1	–	1	–	1/1	1
Emptying specimen collection pan	6	–	5	1	2	2	6/6	5
Emptying urinal	20	–	14	6	–	1[b]	15/20	8[b]

[a] Of the gowns used, only one was a chemotherapy gown.
[b] One participant's information is missing.
[c] N for this category is 28 instead of 32.
NA—not applicable

average age of participants was 26.6 years (range = 19–43). All participants completed high school, and the majority were currently seeking a college degree (70%). Nursing assistants had an average of 4.7 years of nursing assistant experience with, on average, half of that time spent in oncology (2.1 years).

Quantitative Instrument Results

The Factors Predicting Use of Hazardous Drug Safe-Handling Precautions instrument was used with nursing assistants for the first time in this study with minor adaptation. The internal consistency with this sample was as follows:

- Chemotherapy exposure knowledge (12 items, α = –0.06)
- Self-efficacy (6 items, α = 0.85)
- Barriers to using PPE (13 items, α = 0.92)
- Perceived risk (3 items, α = 0.75)
- Interpersonal influence: importance of PPE to others (3 items, α = 0.81)
- Interpersonal influence: use of PPE by others (4 items, α = 0.5).
- Workplace safety climate (21 items, α = 0.87)
- Conflict of interest (6 items, α = 0.75)
- Self-reported use of safe-handling precautions when handling excreta (5 items, α = 0.56)

Qualitative Results for Acceptability of the Instrument

For the interview data, some question refinement was indicated for use with nursing assistants, particularly clarification about who is meant by "oncology staff in general" and what is meant by "orientation" and "training." Participants also discouraged the use of double negatives in questions. With those few exceptions, nursing assistants did not report that any other questions were hard to understand or suggest specific changes to additional questions.

Personal Protective Equipment Use by Nursing Assistants

Of 131 total observations made, 60 included handling antineoplastic drug–contaminated bodily fluids. The most common activity conducted by nursing assistants was handling linens or clothes (n = 32), followed by emptying urinals (n = 20), emptying specimen collection pans (n = 6), emptying bedpans (n = 1), and emptying emesis basins (n = 1). Observed PPE use is shown in Table 2. Results indicate there is considerable room for improvement in the use of PPE. Nursing assistants did not consistently use two pairs of chemotherapy-rated gloves, did not use nonabsorbent gowns (contact gowns were the predominant gown used, if a gown was used at all), and did not use face shields in situations where splashing was possible from contact with antineoplastic drug–contaminated excreta. Handwashing with soap and water (not alcohol hand sanitizer) after glove removal is recommended by NIOSH (U.S. Department of Health and Human Services, 2004) and was performed in only 28 of 56 observed instances of removing gloves.

Verbally administered questionnaires were used to elicit self-reported PPE use when handling antineoplastic drug–contaminated excreta and are reported in Table 3. Nursing assistants reported use of

chemotherapy-rated gloves, but three nursing assistants reported using other gloves when no other glove type was supplied on the unit, underscoring their lack of understanding of the supply provided. Table 4 demonstrates some discrepancy between selected self-reported and observed PPE use. Self-reported usage of double gloves is significantly higher than observed usage ($p < 0.001$), as is self-reported versus observed plastic-backed pad usage ($p = 0.001$). There were no significant associations between self-reported PPE use and factors that predict PPE use, which were assessed by the verbally administered questionnaire (see Table 5). The only demographic variable significantly associated with self-reported PPE use was participating in an annual refresher on safe handling of chemotherapy. The following themes were identified from the verbally administered questionnaires and open-ended interview questions: reflection on observation, extent of PPE use, factors that predict PPE use, participation in future research, and knowing who is receiving antineoplastic drugs.

Reflection on observation: The majority of participants reported that the time of observation chosen (9 am to 11 am or 9 pm to 11 pm) was slower than other times and that the PI did not have a chance to see how busy they could be. Several reported that their behaviors were typical for them. One participant said, "I felt like I wasn't doing it right. But I wanted to do it how I do it usually" (P19).

Extent of PPE use: Some PPE use was low. One participant said, "I don't ever wear a gown. I think I might have, might have worn one once. But that would be a stretch" (P21). Some participants also reported practices that are not necessarily recommended, such as double flushing and holding one's breath while flushing excreta down the toilet.

Factors that predict PPE use: Knowledge about the risks from exposure to antineoplastic drugs was lacking. One participant said, "I know it's bad for you. . . . I don't know if the side effects are the same as patients receiving the amounts of chemo. I know that . . . it's just bad. It's a horrible answer. It's unsafe" (P15). Several nursing assistants reported knowledge about issues with fertility, increased risk of cancer, and the same side effects as patients—a suppressed immune system and neuropathy. Some nursing assistants also mentioned that it could "hurt your vital organs" and could cause "genetic mutation from radiation." Each of the following emerged as topics which participants had little or no knowledge about:

- How far antineoplastic drug contamination can extend
- What the concentration of antineoplastic drugs is in body fluids
- Long-term consequences of exposure
- If antineoplastic drugs can create contamination in the air
- How to explain risks of exposure to patients
- What to do if a nursing assistant comes into contact with bodily fluids

In addition, participants described a relatively high influence of others on the unit: "[PPE use] is

TABLE 3. Self-Reported PPE Use (N = 27)

Type of PPE	Never	1%–25%	26%–50%	51%–75%	76%–99%	Always
Chemotherapy gloves	1	–	1	–	2	23
Chemotherapy gowns	11	8	4	2	–	2
Double flushing	15	5	2	1	2	2
Double gloves	8	3	6	2	2	6
Eye protection	25	1	–	1	–	–
Face shield	12	6	4	2	1	2
Other gloves	23	–	–	–	1	3
Other gowns	7	5	4	6	3	2
Reuse of gowns	26	–	1	–	–	–
Use of plastic-backed pad	–	–	–	7	9	11

PPE—personal protective equipment

TABLE 4. Comparison of Selected Observed and Self-Reported PPE Use

		Observed		Self-Reported		Observed		Self-Reported		
Type of PPE	Range	$\bar{X}$	SD	$\bar{X}$	SD	M	IQR	M	IQR	p
Use of double gloves	0–5	0.79	1.72	2.19	1.94	0	0	2	4	0.0001
Use of face shields	0–5	1.25	1.65	1.26	1.56	0	2.5	1	2	0.97
Use of gowns	0–5	0.58	1.47	0.07	0.38	0	0	0	0	0.25
Use of plastic-backed pad	0–5	2.58	2.15	4.15	0.82	2.5	5	4	2	0.0011

IQR—interquartile range; M—median; PPE—personal protective equipment
Note. Wilcoxon signed-rank test was used for p value. Higher scores indicate more frequent PPE use.

not reinforced by peers and by people who are nurses who are more educated about it possibly than we are" (P13). A variety of other factors that predict PPE use were mentioned in qualitative responses and included factors that discourage use, such as time, convenience, PPE being too hot, making patients uncomfortable, type of patient, number of patients to care for, work task, urgency of that work task, overconfidence in handling safely, lack of reinforcement, and inadequacy of training. Participants also shared reasons why some protective behavior use, such as double gloving, was low: "I was told that the new purple gloves that we have are all chemo safe, so one pair of gloves will do, so I don't wear two pairs. Very rarely do I" (P3). They also mentioned factors that encourage use, such as safe-handling policies, believing PPE works, and fear of exposure to antineoplastic drugs.

Participation in future research: Nursing assistants were also asked some questions about participation in other research in the future. Participants were asked if they would be likely to participate in the future if giving a urine sample was described as part of the research study. All 27 nursing assistants responded that they would be willing to give urine samples with a range of reasons why—from describing it as not burdensome, to something more altruistic, to seeing it as personally beneficial. One participant said, "I'm all for research that's looking to improve the lives of anybody. And this specifically pertains to me and my job" (P7).

Knowing who is receiving antineoplastic drugs: Observation of nursing assistants led to several additional findings. First, it was hard for the observer to determine which patients were on chemotherapy precautions. In 131 observations with patients believed to be on precautions, there were no signs on the doors of 29% (n = 37) of those patients. Qualitative data reinforced reliance on those signs. One participant said, "We put up the orange chemo signs, and . . . I mean, that's a huge help because otherwise I would have no idea who's getting chemo. . . . If someone didn't have an orange sign up, I would not know" (P20). Nursing assistants not only described the problem in the qualitative interviews, but also suggested solutions, such as more access to patient information in the electronic health record.

Discussion

This study found that observing and interviewing nursing assistants about their handling of antineoplastic drug–contaminated excreta and use of PPE was feasible and that nursing assistants were interested in being in this study and being included in further research. In addition, an instrument developed to measure factors related to PPE among nurses was found to be acceptable for use with nursing assistants with only minor modifications. The authors did note, however, that the reliability or internal consistency of the items related to chemotherapy exposure knowledge was extremely low (–0.06) for nursing assistants compared to when the tool was used with nurses (0.7). The current authors verified the coding and the result and posit that the negative and low alpha level is related to the small sample size or that what nursing assistants know about chemotherapy exposure may be different or more dimensional than nurses, which can affect the alpha level (Tavakol & Dennick, 2011). The dichotomous response options made a factor analysis difficult, but the authors saw that some questions were focused on routes of exposure (which nursing assistants may not have much education and training about), and others were focused on the efficacy

of PPE in minimizing exposure (which nursing assistants may have received training about). More research with nursing assistants on what they know about antineoplastic drugs and how they come to know it is needed. Although self-efficacy came close to statistical significance in predicting self-reported PPE use, none of the other factors that the authors expected to be predictive of PPE use were close to being statistically significant. It also may be possible that self-reported PPE should not have been used as a summary score. Perhaps self-efficacy would have been predictive of individual behaviors

TABLE 5. Factors Predicting Self-Reported PPE Use

Individual Factor	Est	SE	F	p
Barriers	–0.01	0.02	0.19	0.665
Conflict of interest	0.09	0.05	2.79	0.107
Knowledge	–0.1	0.15	0.51	0.482
Perceived risk	–0.21	0.3	0.47	0.5
Self-efficacy	0.09	0.05	3.89	0.06
Organizational Factor	**Est**	**SE**	**F**	**p**
Interpersonal influence: importance of PPE to others	0.8	0.5	2.62	0.118
Interpersonal influence: use of PPE by others	–0.16	0.18	0.79	0.383
Workplace safety climate	0.0	0.02	0.04	0.845
Demographic Factor	**Est**	**SE**	**Stat**	**p**
Age (years)	0.03	0.02	1.32[a]	0.262
Nursing assistant experience (years)	0.05	0.03	3.57[a]	0.07
Oncology nursing assistant experience (years)	0.06	0.05	1.44[a]	0.242
Chemotherapy handling experience (years)	0.06	0.05	1.63[a]	0.214
Number of patients receiving chemotherapy	–0.05	0.07	0.44[a]	0.513
Number of patients receiving chemotherapy on unit per day	0.0	0.02	0.0[a]	0.956
Gender (male versus female)	0.04	0.43	61.5[b]	0.735
Race/ethnicity (non-White versus White)	0.67	0.3	160[b]	0.095
Education level (high school degree versus greater than high school degree)	0.21	0.31	135[b]	0.368
Pursuing higher degree (yes versus no)	–0.52	0.32	141.5[b]	0.134
Received orientation to safe handling of chemotherapy (yes versus no)	0.22	0.31	161[b]	0.753
Received annual refresher on safe handling of chemotherapy (yes versus no)	0.79	0.35	62.5[b]	0.04

[a] F test statistic
[b] Wilcoxon ranked-sum test statistic
est—estimate; PPE—personal protective equipment; SE—standard error; stat—statistic
Note. This table shows factors' association with the mean of the following items obtained by self-report: use of gloves labeled for use with chemotherapy, double gloves, gowns labeled for use with chemotherapy, eye protection, face shield, and plastic-backed pad over the toilet.

within self-reported PPE (e.g., chemotherapy glove use, chemotherapy gown use). The only individual factor predictive of self-reported PPE use was participation in an annual refresher on safe handling of chemotherapy, suggesting that considering these behaviors more frequently may be beneficial. Finally, the authors found that PPE use was suboptimal, and some behaviors were overreported compared to observed. The fact that use of double gloves was significantly overreported compared to what was observed validates prior research that shows workers (in this case, farmworkers) often overreport PPE use (Walton et al., 2016). Although there were no significant predictors of self-reported PPE use, qualitative data helped the authors to understand more about how the nursing assistants felt being observed, extent of PPE use, factors that predict PPE use, participation in future research, and issues about knowing who is receiving antineoplastic drugs.

With regard to the sample of nursing assistants, 70% indicated they were pursuing a college degree. Therefore, one might also then expect them to have greater knowledge of safe-handling practices related to current clinical coursework; however, that is not what was found. Only half of the sample reported training on safe-handling precautions at orientation and in the form of an annual refresher, and several reported confusion about what constituted orientation and training. Nursing assistants are oriented to the unit by a preceptor, who fills out a checklist. Exactly how a preceptor conveys the information on the checklist can vary. The annual refresher may be a skills station in which the nursing assistant performs a relevant skill for the RN tester (like identifying, donning, and doffing PPE), or it may be a poster with content that the nursing assistant acknowledges by signing after reading. Lack of appropriate training (real or perceived) and lack of information about who is receiving these antineoplastic drugs can increase exposure risk.

Limitations and Strengths

A few limitations are noteworthy. First, as is the case with feasibility studies, the sample size is small and took place on a single inpatient oncology unit in a large academic medical center, limiting generalizability. Participants also indicated the personal relevance of the information to their health as a motivation for participation in this research study. Future studies should take measures to ensure a more diverse sample with regard to educational attainment because many of the nursing assistants in this study were currently seeking degrees, which may not be representative of all nursing assistants. Second, although recruitment was excellent, the authors did not ask those who refused why they refused. Third, although the authors acknowledge that participants may have modified their behaviors because they were being observed, their qualitative responses to how being observed felt told researchers that, although they were aware of observation, they also wanted to perform their tasks as usual for the observer. Finally, the patients that nursing assistants were caring for in this study required limited assistance with activities of daily living, such as toileting. Behaviors and perceptions may be different among nursing assistants who are more frequently coming into contact with the excreta of patients receiving antineoplastic drugs.

The strengths of this study are that it included data collected by a variety of methods (i.e., observation, questionnaire, and interview), it had high recruitment rates, it adapted an instrument that has been previously published, and it included the behaviors, data, and voices of a group of workers with high antineoplastic drug exposure risk who have been previously understudied.

KNOWLEDGE TRANSLATION

- There is room for improvement in the personal protective equipment used by nursing assistants when handling antineoplastic drug–contaminated excreta.
- Nursing assistants overreport some protective behaviors.
- Nursing assistants have insights to improve training, education, and use of personal protective equipment in the workplace.

Implications for Nursing

Additional research is needed by oncology nurse scientists about the actual amount of exposure to nursing assistants and how much comes from antineoplastic drug–contaminated excreta. Interventions should be developed for all healthcare workers on a unit to increase knowledge of all members of the team and because the culture of the unit with regard to workplace safety and the behavior of other workers is so influential on the behaviors of nursing assistants. Interventions should also include training and documentation of that training. Nursing assistants asked for more information on a host of topics related to antineoplastic drugs, particularly risks from contact with antineoplastic drugs and routes of exposure that would not necessarily be part of what they learned from their nursing assistant preceptor. Two short

educational sessions for nursing assistants were given at the conclusion of this study that focused on risks of contact and recommended PPE.

Because PPE use was suboptimal and nursing assistants in this study reported that they are greatly influenced by the PPE use of RNs, interventions that focus on improving the use of PPE by RNs and all healthcare workers on the unit are needed. RNs are frequently responsible for designing unit-specific education for nursing assistants. On this unit, as in others, experienced RNs oversee the management, education, and annual competency training of nursing assistants. Therefore, role modeling safe behaviors by RNs and creating norms for the proper use of PPE are important.

Findings showed that nursing assistants overreported PPE use compared to what was observed. This study demonstrated that there was room for improvement in nursing assistants' use of PPE and handwashing with soap and water when gloves are removed. This study also demonstrated that nursing assistants are less likely to use PPE in some work tasks, such as changing linens, and RNs could use that information to focus nursing assistant training.

Nursing assistants were very specific about desiring to know more about risks from exposure to antineoplastic drugs and recommended PPE to use to minimize exposure. They were receptive to feedback on their PPE use. Only half of the nursing assistants said that they had received standardized education and training, despite this particular unit having a module in their annual required competency training, which means that nursing assistants are not recognizing the standardized nature of their orientation or training. Not all units have annual refreshers of that type. The sessions the authors provided after the study each took about 15 minutes. High-quality training has been associated with nursing assistant job satisfaction in other care settings (Ejaz, Noelker, Menne, & Bagaka'S, 2010; Han et al., 2014) and can only prove beneficial in inpatient oncology as well.

Finally, nursing assistants in this study were not sure which patients were receiving antineoplastic drugs and did not know if the signage on the patient door was accurate. The fact that nearly one-third of the rooms included during observation in this study were incorrectly identified supports their distrust of the signage and points to the need to include nurses and unit clerks in interventions because both may assist with posting signs. All unit staff need to work together to ensure appropriate and accurate training, to confirm that there is good communication about which patients are receiving antineoplastic drugs, and to create a culture of safety on the unit.

There are implications for research, education, and practice with families of patients receiving antineoplastic drugs as well. When healthcare providers are not being well educated about the risks of exposure or well trained on PPE use and protective behavior, there is a clear corollary to the exposure risk, education, and training of family caregivers who perform much of the assistance with activities of daily living in the home that nursing assistants do in the inpatient oncology units. The literature shows that exposure risk exists for family caregivers as well (Yuki et al., 2013, 2014, 2015) and that interventions that center on minimizing their exposures must also be considered.

Conclusion

Nursing assistants were willing to participate in research that examines their PPE use when handling antineoplastic drug–contaminated excreta, and adapted scales were easy to understand and complete even though the internal consistency for the chemotherapy exposure knowledge items was much lower in this group. Only self-efficacy came close to being a statistically significant predictor of self-reported PPE use, but the authors believe self-efficacy may best predict individual behaviors and not a summary of those behaviors. There is room for improvement in the PPE used by nursing assistants, particularly double gloving and the use of chemotherapy gowns and face shields. Standardized training, annual refreshers, documentation of receipt and understanding of training and refreshers, and clear delineation of which patients are receiving antineoplastic drugs through appropriate signage on the units are promising targets for improving the PPE use of nursing assistants.

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REFERENCES

Altmann, J. (1974). Observational study of behavior: Sampling methods. *Behaviour, 49*, 227–265.

Connor, T.H., Lawson, C.C., Polovich, M., & McDiarmid, M.A. (2014). Reproductive health risks associated with occupational exposures to antineoplastic drugs in health care settings: A review of the evidence. *Journal of Occupational and Environmental Medicine, 56*, 901–910. https://doi.org/10.1097/jom.0000000000000249

Ejaz, F.K., Noelker, L.S., Menne, H.L., & Bagaka'S, J.G. (2008). The impact of stress and support on direct care workers' job satisfaction. *Gerontologist, 48*(Suppl.), 60–70. https://doi.org/10.1093/geront/48.Supplement_1.60

Geer, L.A., Anna, D.H., Curbow, B.A., Diener-West, M., de Joode, B.W., Mitchell, C.S., & Buckley, T.J. (2007). Survey assessment of worker dermal exposure and underlying behavioral determinants. *Journal of Occupational and Environmental Hygiene, 4*, 809–820. https://doi.org/10.1080/15459620701612722

Gershon, R.R.M., Mitchell, C.S., Sherman, M.F., Vlahov, D., Lears, M.K., Felknor, S.A., & Lubelczyk, R.A. (2005). Hepatitis B vaccination in correctional health care workers. *American Journal of Infection Control, 33*, 510–518. https://doi.org/10.1016/j.ajic.2005.04.245

Gershon, R.R.M., Qureshi, K.A., Pogorzelska, B.A., Rosen, J., Gebbie, K.M., Brandt-Rauf, P., & Sherman, M.F. (2007). Non-hospital based registered nurses and the risk of bloodborne pathogen exposure. *Industrial Health, 45*, 695–704. https://doi.org/10.2486/indhealth.45.695

Gershon, R.R.M., Vlahov, D., Felknor, S.A., Vesley, D., Johnson, P.C., Delclos, G.L., & Murphy, L.R. (1995). Compliance with universal precautions among health care workers at three regional hospitals. *American Journal of Infection Control, 23*, 225–236. https://doi.org/10.1016/0196-6553(95)90067-5

Han, K., Trinkoff, A.M., Storr, C.L., Lerner, N., Johantgen, M., & Gartrell, K. (2014). Associations between state regulations, training length, perceived quality and job satisfaction among certified nursing assistants: Cross-sectional secondary data analysis. *International Journal of Nursing Studies, 51*, 1135–1141. https://doi.org/10.1016/j.ijnurstu.2013.12.008

Hon, C.Y., Teschke, K., Chu, W., Demers, P., & Venners, S. (2013). Antineoplastic drug contamination of surfaces throughout the hospital medication system in Canadian hospitals. *Journal of Occupational and Environmental Hygiene, 10*, 374–383. https://doi.org/10.1080/15459624.2013.789743

Hon, C.Y., Teschke, K., Demers, P.A., & Venners, S. (2014). Antineoplastic drug contamination on the hands of employees working throughout the hospital medication system. *Annals of Occupational Hygiene, 58*, 761–770. https://doi.org/10.1093/annhyg/meu019

Hon, C.Y., Teschke, K., & Shen, H. (2015). Health care workers' knowledge, perceptions, and behaviors regarding antineoplastic drugs: Survey from British Columbia, Canada. *Journal of Occupational and Environmental Hygiene, 12*, 669–677. https://doi.org/10.1080/15459624.2015.1029618

Hon, C.Y., Teschke, K., Shen, H., Demers, P.A., & Venners, S. (2015). Antineoplastic drug contamination in the urine of Canadian healthcare workers. *International Archives of Occupational and Environmental Health, 88*, 933–941. https://doi.org/10.1007/s00420-015-1026-1

Kusnetz, E., & Condon, M. (2003). Acute effects from occupational exposure to antineoplastic drugs in a para-professional health care worker. *American Journal of Industrial Medicine, 44*, 107–109. https://doi.org/10.1002/ajim.10230

Lawson, C.C., Rocheleau, C.M., Whelan, E.A., Lividoti Hibert, E.N., Grajewski, B., Spiegelman, D., & Rich-Edwards, J.W. (2012). Occupational exposures among nurses and risk of spontaneous abortion. *American Journal of Obstetrics and Gynecology, 206*, 327.e1–327.e8. https://doi.org/10.1016/j.ajog.2011.12.030

Martin, S., & Larson, E. (2003). Chemotherapy-handling practices of outpatient and office-based oncology nurses. *Oncology Nursing Forum, 30*, 575–581. https://doi.org/10.1188/03.ONF.575-581

McCullagh, M., Lusk, S.L., & Ronis, D.L. (2002). Factors influencing use of hearing protection among farmers: A test of the Pender Health Promotion Model. *Nursing Research, 51*, 33–39. https://doi.org/10.1097/00006199-200201000-00006

McDiarmid, M.A., Oliver, M.S., Roth, T.S., Rogers, B., & Escalante, C. (2010). Chromosome 5 and 7 abnormalities in oncology personnel handling anticancer drugs. *Journal of Occupational and Environmental Medicine, 52*, 1028–1034. https://doi.org/10.1097/JOM.0b013e3181f73ae6

Patton, M.Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Pender, N.J., Murdaugh, C.L., & Parsons, M.A. (2002). *Health promotion in nursing practice*. Upper Saddle River, NJ: Prentice Hall.

Polovich, M., & Clark, P.C. (2012). Factors influencing oncology nurses' use of hazardous drug safe-handling precautions [Online exclusive]. *Oncology Nursing Forum, 39*, E299–E309. https://doi.org/10.1188/12.ONF.E299-E309

Resnick, B., Rogers, V., Galik, E., & Gruber-Baldini, A.L. (2007). Measuring restorative care provided by nursing assistants: Reliability and validity of the Restorative Care Behavior Checklist. *Nursing Research, 56,* 387–398. https://doi.org/10.1097/01.NNR.0000299854.52429.ac

Rogers, B., & Emmett, E.A. (1987). Handling antineoplastic agents: Urine mutagenicity in nurses. *Image—The Journal of Nursing Scholarship, 19,* 108–113.

Saldaña, J. (2009). *The coding manual for qualitative researchers*. London, UK: Sage.

Son, C., Chuck, T., Childers, T., Usiak, S., Dowling, M., Andiel, C., . . . Sepkowitz, K. (2011). Practically speaking: Rethinking hand hygiene improvement programs in health care settings. *American Journal of Infection Control, 39*, 716–724. https://doi.org/10.1016/j.ajic.2010.12.008

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

U.S. Bureau of Labor Statistics. (2018). Occupational outlook handbook: Nursing assistants and orderlies. Retrieved from http://www.bls.gov/ooh/healthcare/nursing-assistants.htm

U.S. Department of Health and Human Services. (2004). NIOSH alert: Preventing occupational exposures to antineoplastic and other hazardous drugs in health care settings (2004–165). Retrieved from https://www.cdc.gov/niosh/docs/2004-165/pdfs/2004-165.pdf?id=10.26616/NIOSHPUB2004165

Walton, A.L., LePrevost, C., Wong, B., Linnan, L., Sanchez-Birkhead, A., & Mooney, K. (2016). Observed and self-reported pesticide protective behaviors of Latino migrant and seasonal farmworkers. *Environmental Research, 147*, 275–283. https://doi.org/10.1016/j.envres.2016.02.020

Yuki, M., Sekine, S., Takase, K., Ishida, T., & Sessink, P.J. (2013). Exposure of family members to antineoplastic drugs via excreta of treated cancer patients. *Journal of Oncology Pharmacy Practice, 19*, 208–217. https://doi.org/10.1177/1078155212459667

Yuki, M., Takase, K., Sekine, S., & Ishida, T. (2014). Evaluation of surface contamination with cyclophosphamide in the home setting of outpatients on cancer chemotherapy. *Journal of Nursing Education and Practice, 4*(10), 16–23. https://doi.org/10.5430/jnep.v4n10p16

Yuki, M., Ishida, T., & Sekine, S. (2015). Secondary exposure of family members to cyclophosphamide after chemotherapy of outpatients with cancer: A pilot study. *Oncology Nursing Forum, 42*, 665–671. https://doi.org/10.1188/15.ONF.42-06ap