

Nurse Adherence to Safe-Handling Practices: Observation Versus Self-Assessment

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Background: Chemotherapy medications place nurses at risk for occupational exposure, a primary nursing safety concern. No literature was available on adherence to following chemotherapy handling practices and nurses' perceptions of safe-handling practices.

Objectives: The aims of the pilot study were to examine actual and subjective ambulatory oncology nurse adherence to chemotherapy safe-handling guideline recommendations that prevent chemotherapy exposure.

Methods: A prospective, comparative mixed-methods study was used to compare objective and subjective nurse behaviors of expected safe chemotherapy handling—specifically, micro-ethnography and questionnaires. Fisher's exact test was used to assess differences in the rates of observations and questionnaire responses.

Findings: Twenty-two cases of chemotherapy handling were observed, and 12 of 33 nurses completed self-assessments. Of observed practices, nurses completed three behaviors 100% of the time (disposing of gloves in a chemotherapy-approved container after initiating chemotherapy, discarding the chemotherapy bag and tubing after disconnecting chemotherapy infusions, and washing hands after chemotherapy was administered). When objective and subjective behavior adherence were compared, three behaviors were carried out with greater frequency than what nurses perceived on questionnaires (double gloving and gowning when disconnecting chemotherapy and properly discarding chemotherapy). Two behaviors were carried out with less frequency than nurses provided on questionnaires (double gloving and protecting work surfaces during administration).

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Oncology nurses routinely administer medications that are categorized as hazardous, such as chemotherapy, placing them at risk for occupational exposure. Strong evidence exists in the literature concerning potential adverse health effects associated with occupational exposure. Healthcare workers with exposure had increased cancer occurrence; adverse reproductive outcomes, including infertility and miscarriage; fetal defects when exposed during pregnancy; chromosomal damage; and symptoms such as nausea, allergic reactions, and contact dermatitis (Bouraoui et al., 2011; Dranitsaris et al., 2005; Durrieu, Rigal, Bugat, & Lapeyre-Mestre, 2004; El-Ebiary, Abuelfadl, & Sarhan, 2011; Fransman et al., 2007; Hemminki, Kyrrönen, & Lindbohm, 1985; Mader, Kokalj,

Kratochvil, Pilger, & Rüdiger, 2009; McDiarmid, Rogers, & Oliver, 2014). In this article, chemotherapy refers to antineoplastic agents administered via the parenteral route for the treatment of cancerous conditions, excluding biotherapy.

The National Institute for Occupational Safety and Health (NIOSH) and the American Society of Health-System Pharmacists (ASHP) define hazardous drugs as having certain characteristics, including carcinogenicity, teratogenicity, reproductive toxicity, organ toxicity at low doses, and genotoxicity. To date, no processes are available to determine if a certain level of chemotherapy exposure is safe; therefore, limiting exposure in all forms is recommended (NIOSH, 2004, 2014; Polovich, Olsen, & LeFebvre, 2014). As new evidence has emerged, recommendations for personal protective equipment have evolved.

Anecdotal reports and studies investigating the relationship between exposure levels and adverse health effects of workers exposed to chemotherapy drugs date to the 1970s (Falck et al., 1979; Fransman et al., 2007; McDiarmid, Oliver, Roth, Rogers, & Escalante, 2010; Valanis, Vollmer, & Steele, 1999). For decades, a major concern for healthcare workers, their employers, and policy makers was balancing the provision of safe, quality patient care with safe working conditions when exposure to chemotherapy drugs was a risk (ASHP, 1990, 2006; NIOSH, 2004). U.S. Department of Labor Occupational Safety and Health Administration (OSHA) personnel originally addressed concerns by developing guidelines to assist employers and employees in the best methods of safe handling and administration of chemotherapy drugs to reduce exposure risk (Yodaiken & Bennett, 1986).

Despite evidence supporting safe-handling practices recommended by OSHA, lack of standardization in implementation and sporadic adherence to guidelines across disciplines and practice settings were found throughout the United States (Mahon et al., 1994; Martin & Larson, 2003; McDiarmid & Presson, 1996). In 2004, NIOSH updated the OSHA guidelines on safe handling and administration of hazardous drugs to reduce exposure risk and issued an alert to draw attention to adherence in preventing occupational exposures to chemotherapy drugs. The Oncology Nursing Society (ONS) published its first guideline recommendations in 1988, which were later updated (ONS, 1988; Polovich et al., 2014). The American Society of Clinical Oncology (ASCO) and ONS also partnered to release joint chemotherapy administration safety standards (Neuss et al., 2013).

The NIOSH guideline recommendations for administration or disposal of chemotherapy drugs or waste are to wear (at minimum) two pairs of chemotherapy gloves and a disposable gown with low permeability, a closed front and cuffs, and long sleeves (referred to as personal protective equipment [PPE]). The original ONS and NIOSH guidelines were congruent and brought widespread attention to the potential health hazards facing unprotected healthcare workers. Both guidelines emphasized consistent use of PPE, biological safety cabinets, and quality training for personnel involved in any task in which contact with a chemotherapy drug would be a risk (Yodaiken & Bennett, 1986). Although many surveys were published on nurses' perceptions of adherence to chemotherapy safe handling (Bioano, Steege, & Sweeney, 2014; Polovich & Clark, 2012; Polovich & Martin, 2011), little is known about actual adherence to the NIOSH and ASCO/ONS PPE guideline recommendations and hospital policies in real-world clinical practice.

At the Cleveland Clinic Taussig Cancer Center in Cleveland, Ohio, chemotherapy safe-handling, administration, and disposal policies are congruent with the NIOSH and ONS (Polovich et al., 2014) recommendations. All oncology nurses are educated about safe-handling policies and are expected to demonstrate proper chemotherapy administration practices, including correct use of PPE, during orientation and annual assessments.

The objective of this pilot quality improvement study was to learn if current NIOSH PPE and hospital policy chemotherapy exposure controls were adhered to in actual clinical

practice based on observation and nurses' self-assessment. The specific aims of the study were to determine if (a) based on direct observation, nurses adhered to PPE recommendations and hospital policies for safe handling when administering and disposing of IV chemotherapy; (b) based on nurse self-assessment, PPE recommendations and hospital policies for safe handling were followed; and (c) any differences were noted in nurses' observed and self-assessed adherence to PPE recommendations and hospital policies for safe handling.

Methods

This study, approved by the medical center's institutional review board, used a prospective and comparative mixed-methods design.

Sample and Setting

The setting was the Cleveland Clinic, a quaternary care medical center with 1,400 beds, that had 76 ambulatory oncology infusion treatment chairs for chemotherapy. This study involved assessments of ambulatory oncology nurses using two distinct methodologies: a micro-ethnography (observational) sample and a cohort of nurses who completed a questionnaire of adherence to PPE recommendations. The micro-ethnography sample involved experienced oncology nurses, defined as RNs with two or more years of experience in oncology nursing. The goal of this study was to observe at least 15 nurse encounters in the administration and disposal of chemotherapy. To maintain confidentiality during observations, no nurse characteristics were obtained. The quantitative cohort sample consisted of oncology nurses who delivered IV chemotherapy agents to patients in an outpatient setting and were willing to participate. For the micro-ethnography component of the study, nurses were required to have a minimum of two years' experience in oncology nursing. No exclusion criteria existed for participation in the questionnaire component; as such, 33 ambulatory oncology nurses were eligible to participate. The goal for questionnaire data collection was a participation rate of at least 40% of all nurses working in the outpatient oncology center.

Measures

Adherence to PPE recommendations was assessed using two measures. To assess observations of handling, administering, and disposing of chemotherapy, a 15-item "yes or no" nurse skill checklist was developed by investigators; this checklist mimicked NIOSH guideline expectations and institutional policies. To obtain self-assessments of nurses' adherence to PPE recommendations and institutional policies, an investigator developed a nine-item questionnaire that used a five-point Likert-type response set ranging from 0 (never) to 4 (always), plus a "not applicable" option. Content was derived directly from NIOSH and ONS guidelines and institutional policies. Ten oncology RNs provided face and content validity of questionnaire items prior to use. Eight nurse demographic and professional characteristics were collected with self-assessment questionnaires using checkbox and fill-in-the-blank response sets.

Procedures

Data collection involved two phases. The micro-ethnicity observations occurred from January 2012 to March 2013, before the self-assessment questionnaire was administered in March 2013. The micro-ethnography observation involved using three observers with the following characteristics: knowledgeable in oncology nursing care and PPE recommendations (two of three were working on hospital oncology units), unknown to the nurses being assessed in ambulatory oncology, and trained in observing behaviors for this research by the principal investigator. After orientation, the principal investigator carefully assessed the quality of data collection for each day of observation. Nurses received chemotherapy medications from the pharmacy. Medications were double-bagged, spiked, and primed with compatible carrier fluid by the pharmacist. Observers assessed handling, administering, and disposing of chemotherapy agents and equipment using the nurse skill checklist. Data were collected confidentially, and the same nurse could have been observed more than one time on different days. Self-assessment questionnaires were delivered to all outpatient oncology nurses. A pre-addressed, self-sealing envelope was provided for return of anonymous questionnaires.

Data Analysis

Data analysis involved describing the nurse skill checklist frequencies and self-assessment of RN characteristics using medians and quartiles of counts and percentages for all categorical variables. Mean scores for the nine-item self-assessment questionnaire on PPE recommendations were calculated by averaging responses across administration, disconnection, and disposal of chemotherapy. After matching factors from the nurse skill checklist and self-assessment questionnaire, data were compared to learn if differences existed in adherence to PPE recommendations and hospital policies for safe chemotherapy handling. All analyses were two-tailed and were performed at a significance level of 0.05. SAS®, version 9.3, and R were used for all analyses.

Findings

Using the nurse skill checklist, three observers made 22 confidential observations on 13 different days and involving 12 of the 20 nurses who met inclusion criteria. Twelve of 33 nurses, some of whom may

have been involved in the observation component of the study, completed the self-assessment questionnaires and personal characteristics. Of nurse characteristics, median (interquartile range [IQR]) years as an RN were 10 [5.5, 23] and years working in the current hospital oncology area were 3.9 [1.5, 7]. Two nurses were oncology certified and, when asked about comfort in their current role as oncology nurses, responses ranged from very uncomfortable ($n = 5$), to somewhat comfortable ($n = 4$), to very comfortable ($n = 3$).

Observation of Adherence

Of 22 observations of nurses performing usual care in chemotherapy administration, not all components of safe chemotherapy handling were observed and recorded on the nurse skill checklist. The following were observed: behaviors related to handling, administering, and disposing of chemotherapy agents and equipment ($n = 16$); behaviors related to chemotherapy agents and equipment ($n = 16$); chemotherapy disconnection and discarding

TABLE 1. Observations of Chemotherapy Safe-Handling Adherence in 22 Events

Behavior	Adherence (n)	Observations (n)
Handling		
Uses absorbent pad as work surface for chemotherapy agents	1	13
Wears one pair of chemotherapy-approved gloves to remove chemotherapy agents from transport bag	4	19
Wears two pairs of chemotherapy-approved gloves to remove chemotherapy agents from transport bag	8	19
Removes outer gloves prior to programming pump	7	16
Washes hands	9	12
Wears second pair of chemotherapy-approved gloves over ribbed cuff of gown	15	20
Removes gown prior to leaving room	17	19
Wears chemotherapy-approved gown, with first pair of approved gloves under ribbed cuff of gown	18	20
Disposes of gloves in a chemotherapy-approved container after initiating chemotherapy	20	20
Disconnecting and discarding		
Removes gown prior to leaving room	—	2
Wears two pairs of chemotherapy-approved gloves and chemotherapy-approved gown when handling chemotherapy	1	6
Wraps gauze pad around connection site when disconnecting chemotherapy tubing, leaving chemotherapy bag attached	1	6
Disposes of gloves in a chemotherapy-approved container	5	6
Washes hands	5	5
Discards the chemotherapy bag and attached secondary tubing in chemotherapy-approved waste container	6	6

(n = 2); and the entire process from setup to discard (n = 4). Nurses completed three items 100% of the time (disposing of gloves in a chemotherapy-approved container after initiating chemotherapy, appropriately discarding the chemotherapy bag and attached secondary tubing in chemotherapy-approved waste container after chemotherapy was administered, and washing their hands after chemotherapy was administered). Of the 12 items not completed all of the time, seven items had less than 45% adherence. Table 1 lists all observations and adherence to PPE recommendations.

Self-Assessment of Adherence

Of the nine items that were scored for administering, disconnecting, and discarding chemotherapy, nurses' self-assessment of their adherence to PPE and safe-handling policies was 100% in two areas: using a chemotherapy-approved gown during administration and disposing of contaminated equipment in the right container during administration, disconnection, and disposal. Self-assessed adherence to other PPE and safe-handling policies ranged from 17% (double gloving at disconnection) to 92% (washing hands when administering chemotherapy).

Comparison of Observation and Self-Assessment

Observations were compared to nurses' self-assessments to determine awareness of adherence to PPE recommendations and safe-handling policies. Of the two items that achieved 100% by self-assessment, only one rated 100% adherence by observation: disposal of contaminated equipment in the proper container. Adherence to PPE recommendations and safe-handling policies was higher by self-assessment than observation for using absorbent pads to protect work surfaces during chemotherapy administration (83% versus 8%, respectively; $p < 0.001$). In no cases was adherence to specific PPE recommendations lower by self-assessment than observation. For many PPE recommendations, no differences were noted in adherence rates between observation and self-assessment; however, low overall adherence by observation and self-assessment reflected opportunities for improvement (see Table 2).

Discussion

A predetermined hierarchy exists concerning the expected effectiveness of measures used to minimize the risk of exposure to hazards in the workplace. According to OSHA (1998), at the bottom of the hierarchy (least effective) is PPE, preceded by work practice controls, administrative controls, engineering controls, and elimination of the hazard (most effective). In this pilot study, two of five controls used to determine the risk of exposure to hazards were assessed: PPE (NIOSH recommendations of gloves and gowns) and work (actual) practice controls (via hospital policies). Although work practice controls were in place, gaps in PPE and safe-handling practices were identified in observations and by nurses' self-assessment.

During observations of safe-handling work practices and use of PPE equipment, gloves and gowns were most often involved in nonadherence. Although no research literature was found on observations of actual PPE and safe handling of chemotherapy practices, in one quality improvement project developed to improve PPE adherence, the authors reported a 30%–40% adherence rate at baseline that was below expectations (Hennessy & Dynan, 2014). The PPE work practices in this study were similar to those in the quality report and reflect an opportunity to improve PPE behaviors. No research or quality reports were found regarding observations of safe chemotherapy handling; as such, determining if the current authors' findings represent universal nurse behaviors is difficult. Nurses may have failed to follow policies if they focused on delivering treatment to patients rather than on protecting themselves and the environment. Alternatively, they may have been properly trained but initiated shortcuts over time that were missed in annual competency assessments. In a study of cyclophosphamide exposure on surface areas in pediatric treatment rooms and bathroom floors, surface wipe samples were positive for exposure (Ramphal, Bains, Vaillancourt, Osmond, & Barrowman, 2014), reflecting that nurses may have inconsistent work practices related to PPE and safe handling of chemotherapy agents.

Research is needed concerning adherence to PPE and safe-handling policies in clinical settings. For example, using

TABLE 2. Safe-Handling Adherence Between Observation and Self-Assessment

Behavior	Observation Adherence			Self-Assessment Adherence (N = 12)		p
	N	n	%	n	%	
Double gloved during administration	20	15	75	9	75	0.99
Removed outer gloves prior to programming the IV pump	16	7	44	7	58	0.7
Washed hands after glove removal postadministration	12	9	75	11	92	0.59
Double gloved during disconnect	6	1	17	2	17	0.99
Wrapped gauze pad around connection site	6	1	17	7	58	0.15
Removed gown prior to leaving room at disconnect	2	—	—	9	75	0.11

surface wiping may be one method to assess environmental exposure and to determine the extent of the problem and the level of need for enhanced awareness and ongoing quality monitoring. Assessment of the level of exposure is particularly important because nurses' self-assessed adherence to chemotherapy exposure guidelines and policies may not match actual practices, and exposure is invisible, preventing nurses from receiving immediate feedback about adherence failures. In this study, only 12 nurses participated in self-assessment of their chemotherapy safe-handling behaviors. Nurses may have been reluctant to report behaviors when they realized that they did not follow hospital policies. Study results may underestimate adherence to NIOSH and local hospital policies.

Self-assessed adherence of PPE and safe-handling policies is not routinely completed. Polovich and Martin (2011) assessed safe-handling practices by surveying 330 oncology nurses who attended an oncology nursing conference. Nurses self-reported that their use of double gloving during chemotherapy was 11%–18% and their use of single-gloving was 95%–100%. In the current study, the self-assessed rate of always or usually double gloving during administration of chemotherapy was 92%, compared to an observation rate of 75%. Although not ideal, the current study's higher adherence rates to the safe-handling recommendation of double gloving may be attributable to organizational policies and work practice expectations that are based on current NIOSH recommendations. When Polovich and Clark (2012) surveyed 165 oncology nurses and 20 managers, nurses reported awareness of the risk to exposure and were knowledgeable about and experienced in safe handling and chemotherapy; however, double gloving and gown use were low. Polovich and Clark (2012) concluded that safe-handling practices were influenced by organizational support and the presence of equipment, education, and policies supporting current NIOSH recommendations.

Limitations

Limitations existed in this pilot study. The study was conducted in a single center, and, although the response rate for the self-assessment questionnaires was adequate based on the total population size, the sample size was small. To maintain confidentiality of nurses being observed during the ethnographic assessment, project leaders did not collect nurse characteristics. The sample sizes for the nurse observations of chemotherapy safe-handling behaviors were also small. Research that replicates this quality improvement project but using a multicenter approach and larger sample sizes would increase generalizability of findings. In addition, one nurse may have been observed more than one time on different days by different observers. RNs who completed self-assessments may have been different than nurses who were observed. Observations occurred at any point during an RN's interaction with chemotherapy agents, and self-reported skills covered specific points in the handling of chemotherapy agents. Lack of uniformity in assessment item wording could have led to differences in reported frequencies in adherence to PPE recommendations. In this real-world study, some nurses who completed self-assessments may have been new to oncology nursing, although they were experienced clinical

Implications for Practice

- ▶ Note that hazardous drugs may have adverse health effects and reproductive risks.
- ▶ Understand that no safe level of chemotherapy exposure is known, and protective measures must be used.
- ▶ Realize that a chemotherapy safe-handling quality improvement program may improve nurses' adherence to the use of personal protective equipment during administration.

cal nurses. Because nurses who were observed had a minimum of two years' experience in oncology nursing, nurses' behaviors may not have been well matched in the group comparisons. Finally, analyses were completed based on group findings, and no correlations were noted between observed behaviors and self-assessment by individual nurses. A higher quality research design would be to compare perceived (by self-assessment) and actual behaviors by individual nurses.

Implications for Nursing Practice

The results of this pilot study provide new knowledge about observed and self-assessed adherence to PPE and safe-handling policies that should raise a call to action by all chemotherapy treatment center sites and the nurses who are responsible for the safe administration and handling of chemotherapy. Consistent adherence to practice expectations may require more than an annual competency assessment. More research is needed to learn if exposure risks are similar when less intense PPE and safe-handling policies are implemented. Ultimately, chemotherapy exposure is a team concern in that one healthcare clinician can follow all policies, yet still be exposed to chemotherapy if others fail to do so.

Conclusion

In this pilot study, nurses double gloved when administering chemotherapy agents (both observed and self-reports) at higher rates than in other published reports. However, for many PPE recommendations, observation group adherence rates did not match the rates of groups of nurses who completed self-assessments, and overall adherence rates were generally lower than expected. Nursing interventions and quality monitoring may be needed to improve overall PPE adherence; competency evaluation and training education revisions may strengthen clinical practice based on policies. More research is needed to determine if actual PPE adherence practices by nurses provide the same level of chemotherapy protection as NIOSH recommendations. More education of oncology nurses is needed to emphasize the purpose of double gloving and other PPE recommendations, as well as the importance of increased awareness about contamination of the environment.

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