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This dissertation, NURSES' USE OF HAZARDOUS DRUG SAFE HANDLING PRECAUTIONS by Martha Polovich was prepared under the direction of the candidate's dissertation committee. It is accepted by the committee in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing in the Byrdine F. Lewis School of Nursing in the College of Health and Human Sciences, Georgia State University.

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ABSTRACT

NURSES' USE OF HAZARDOUS DRUG SAFE HANDLING PRECAUTIONS

by

MARTHA POLOVICH

Problem: Nurses are potentially exposed to hazardous drugs (HDs) in their practice. HD exposure is associated with adverse outcomes (reproductive problems, learning disabilities in offspring of nurses exposed during pregnancy, and cancer occurrence). Safe handling precautions (safety equipment and personal protective equipment, [PPE]) minimize exposure to HDs and decrease the potential for adverse outcomes. Despite existing OSHA recommendations, adherence to precautions is below recommendations. The purpose of this study was to examine relationships among factors affecting nurses' use of HD safe handling precautions, to identify factors that promote or interfere with HD precaution use, and to determine nurse managers' perspectives on use of safe handling precautions. This study used a conceptual model which proposes that both individual and organizational factors influence precaution use.

Methods: A cross-sectional, correlational design was used. Nurses (N = 165; 46% response rate) from oncology centers across the US who reported handling chemotherapy completed a mailed survey. Instruments measured HD precaution use, knowledge, self efficacy, barriers, perceived risk, conflict of interest, interpersonal influences and workplace safety climate. Hierarchical regression was used. Twenty managers of nurses handling chemotherapy were interviewed.

Results: Nurses were experienced in oncology (M = 15.8 ± 7.6) yrs, well-educated (62.5% ≥BSN), certified in oncology nursing (85%), worked in outpatient settings (69%), and on average treated 6.8 ± 5.2 patients per day. Chemotherapy exposure knowledge was high (M = 10.9, ± 1, 0-12 scale); as was self efficacy for using PPE (M = 20.8 ± 3, 7-24 scale), and perceived risk (M = 3.14 ± .6, 0-4 scale). Total precaution use during HD administration and disposal was low (M = 1.9, SD = 1.1, 0= never to 5 = 100%). Nurse characteristics did not predict HD precaution use. In the final model (R^2 = .29, F (2, 155) = 24.6, $p < .000$), fewer patients per day, fewer barriers and better workplace safety climate were independent predictors of higher precaution use.

Conclusions: Results emphasize the importance of organizational influence on nurses' HD safe handling precaution use and suggest fostering a positive workplace safety climate and reducing barriers as interventions.

NURSES' USE OF HAZARDOUS DRUG SAFE HANDLING PRECAUTIONS

by

MARTHA POLOVICH

A DISSERTATION

Presented in Partial Fulfillment of Requirements for the
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2010

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LIST OF ABBREVIATIONS

ACCC	Association of Community Cancer Centers
AMA	American Medical Association
ANA	American Nurses Association
ASHP	American Society of Health System (Hospital) Pharmacists
BSC	Biological Safety Cabinet
CFR	Code of Federal Regulations
CVI	Content Validity Index
FDA	Food and Drug Administration
HBM	Health Belief Model
HCW	Healthcare Worker
HD	Hazardous Drug
HIV	Human Immunodeficiency Virus
HPD	Hearing Protection Device
HPM	Health Promotion Model
ID	Identification
IRB	Institutional Review Board
MSDS	Material Safety Data Sheet
NAHP	Netherlands Association of Hospital Pharmacists
NIOSH	National Institute for Occupational Safety and Health
ONS	Oncology Nursing Society
OR	Odds Ratio

OSHA	Occupational Safety and Health Administration
PHDP	Factors Prediction Use of Hazardous Drug Safe Handling Precautions
PPE	Personal Protective Equipment
PUHPM	Predictors of Use of Hearing Protection Model
RN	Registered Nurse
RR	Relative Risk
SEER	Surveillance, Epidemiology, and End Results
SPSS	Statistical Package for the Social Sciences
TPB	Theory of Planned Behavior
U.S.	United States
UP	Universal Precautions
WSC	Workplace Safety Climate

CHAPTER I

INTRODUCTION

Over five and one half million healthcare workers (HCWs) are potentially exposed to hazardous drugs (HDs) in the workplace. While most drugs defined as hazardous are cytotoxic agents used in the treatment of cancer, many drugs used for other indications and in other patient populations are equally unsafe. The Occupational Safety and Health Administration [OSHA] acknowledged this occupational risk and issued recommendations for the safe handling of HDs more than twenty years ago (OSHA, 1986). According to the National Institute for Occupational Safety and Health [NIOSH] (2004), there is documented evidence of contamination of the work environment with HDs, which increases the potential for exposure by nurses, pharmacists and other healthcare workers when these agents are handled inappropriately.

Occupational exposure to HDs has been associated with acute symptoms such as hair loss, abdominal pain, nasal sores, contact dermatitis, allergic reactions, skin injury, and eye injury (Harrison, 2001). Adverse reproductive outcomes have been identified in many studies of nurses and pharmacists working with HDs, including fetal loss, miscarriage, or spontaneous abortions (Selevan, Lindbohm, Hornung, & Hemminki, 1985; Stucker et al., 1990; Valanis, Vollmer, & Steele, 1999); fetal abnormalities; (Hemminki, Kyyronen, & Lindbohm, 1985); infertility (Fransman et al., 2007; Martin, 2005; Valanis, Vollmer, Labuhn, & Glass, 1997); preterm births and learning disabilities

in offspring (Martin, 2005). Furthermore, consistent with the inherent carcinogenic potential of many HDs, there is an increase in the risk of cancer among occupationally exposed individuals (Hansen & Olsen, 1994; Martin, 2003; Skov et al., 1992).

The best way to protect workers from a hazardous exposure is by elimination or substitution of the hazard, but this is not feasible with drug therapy. Next on the hierarchy of controls (U.S. Department of Labor, 1998) is the use of engineering controls to isolate or contain the hazard to prevent worker exposure. Education and training of those responsible for HD handling are examples of administrative controls, the next level of protection. The last level of protection is personal protective equipment (PPE) which is barrier protection between the worker and HDs, and is effective only when the worker uses PPE.

Safe handling precautions include the use of safety equipment, work practices and PPE. All precautions, when used consistently, can reduce occupational exposure to HDs (NIOSH, 2004). Given the potentially serious consequences of HD exposure, one would expect that the use of safe handling precautions is high; however, safe handling precautions have neither been universally implemented by all nurses nor in all settings. Several studies on PPE use have been published since 1986, and all reported glove and gown use that was lower than current recommendations (Mahon et al., 1994; Martin & Larson, 2003; Nieweg, deBoer, Dubbleman et al., 1994; Stajicj, Barnett, Turner, & Henderson, 1986; Valanis, McNeil, & Driscoll, 1991; Valanis & Shortridge, 1987; Valanis, Vollmer, Labuhn, Glass, & Corelle, 1992).

While many researchers have measured how often nurses use HD safe handling precautions, few studies have measured the impact of specific factors on nurses' use of

HD safe handling precautions. Understanding factors that promote or interfere with HD safe handling precautions may help to develop targeted interventions to increase their use.

Several factors are thought to influence the adoption of protective behaviors. These are knowledge about the hazard (Gershon et al., 1995; McGovern, Gershon, Rhame, & Anderson, 2000), perceived risk of harm (Levin, 1999; Martin, 2006), beliefs about personal susceptibility to harm (Brewer et al., 2007) perceived benefits of action (Lusk, Ronis, & Hogan, 1997) interpersonal influences (Hong, Lusk, & Ronis, 2005; Lusk et al., 1997) and personal and organizational factors (Gershon et al., 1999; Gershon et al., 1995). While these factors have been explored for other types of occupational health-protective behaviors, such as use of Universal Precautions (UP) (Gershon et al., 2000; Gershon et al., 1999; Gershon et al., 1995), hearing protection devices (HPDs) (Hong et al., 2005; McCullagh, Lusk, & Ronis, 2002; Ronis, Hong, & Lusk, 2006) and eye protection (Lipscomb, 2000) few studies have explored factors that influence nurses' use of precautions for HD handling.

Purpose and Significance

Exposure to hazardous chemicals in the workplace is a significant occupational problem for nurses. Nurses and other HCWs are subject to HD exposure during routine activities related to patient care. Exposure is associated with a risk of adverse health outcomes. Use of safety precautions can reduce nurses' HD occupational exposure (NIOSH, 2004).

Despite the availability of safety guidelines for more than twenty years (OSHA, 1986), use of protective equipment is less than ideal. Recent studies found that 25-40% of

nurses used improper gloves for chemotherapy handling and up to 69% of nurses failed to wear gowns (Martin & Larson, 2003; Polovich & Martin, 2008, February). The reasons that some nurses do not incorporate safety precautions into their practice are not fully understood. Knowledge about nurses' decision to use safety precautions is necessary to provide guidance in designing interventions to increase their use and reduce hazardous exposures.

The purpose of this study was to examine factors that are thought to influence the use of HD safe handling precautions. Identifying factors that predict the use of HD safe handling precautions is essential to the consistent implementation of these measures. This study provides valuable information to promote safety for nurses doing hazardous work. Reducing exposure to HDs will decrease the potential for adverse health outcomes and improve the safety and quality of life for nurses.

The following aims, hypotheses and research questions were proposed:

Specific Aim 1: Determine the influence of individual and organizational factors on nurses' use of safe handling precautions for nurses exposed to HD in their practice.

Hypothesis 1a: Nurses' individual characteristics (higher knowledge, higher perceived risk of harm from HD exposure, higher self-efficacy for using PPE and fewer perceived barriers to using PPE) will be associated with an increased use of HD safe handling precautions.

Hypothesis 1b: Organizational factors (better workplace safety climate and interpersonal influences) will be associated with increased use of safe handling precautions.

Hypothesis 1c: Nurses' individual characteristics (higher knowledge, higher perceived risk of harm from HD exposure, higher self-efficacy for using PPE, fewer barriers to using PPE) and organizational factors (better workplace safety climate and interpersonal influences) will each account for significant variance in use of safe handling precautions.

Research Question 1d: Does nurses' perceived conflict of interest (need to protect self vs. need to provide medical care) moderate the relationship between self-efficacy for using PPE and use of safe handling precautions?

The secondary aim of the study was to determine nurse managers' perspectives on use of safe handling precautions in the workplace. The research questions were:

Research Question 2a: What are nurse managers' perceptions of the organizational safety climate for safe handling precautions?

Research Question 2b: For nurses they supervise, what are nurse managers' perceptions of nurses' use of safe handling precautions?

Theoretical Framework

The use of safe handling precautions, particularly PPE, is conceptualized as self-protective behavior. DeJoy (1996) describes several theoretical models that are applicable to workplace self-protective behavior. Some are expectancy-value models, such as the Health Belief Model (HBM) (Janz & Becker, 1984) and the Theory of Planned Behavior (TPB) (Ajzen, 1991) which are based on threat-related beliefs or perceptions about a behavior. They incorporate concepts related to an individual's attitudes, beliefs, and expectations about health threats, and are often referred to as cognitive models. Contextual or environmental models take into account the interaction between the person

and the situation or environment that influences behavior. Some examples are the PRECEDE model (Dejoy, 1986) and the Health Promotion Model (HPM) (Pender, Murdaugh, & Parsons, 2006). Because these models include individual and environmental factors, they are referred to as integrative models (Peterson & Bredow, 2003). Another category includes behavior models that focus on the process, and describe behavior change in terms of stages, such as the Transtheoretical Model (Prochaska, DiClemente, & Norcross, 1992) and the Precaution Adoption Process (Weinstein, 1988). These models propose that factors relevant to adopting protective behaviors vary depending on the readiness of individuals to alter their behavior. All of the above-mentioned perspectives have been used to explain self-protective behavior; however, the process models are not well-studied in HCWs and there is less support for their usefulness in those settings.

The Factors Predicting Use of HD Safe Handling Precautions (PHDP) model was used for this study (Figure 1). It is a model adapted from the Predictors of Use of Hearing Protection Model (PUHPM) (Lusk et al., 1997) which was derived from the HPM (Pender et al., 2006). The HPM is based on three theories: The Theory of Reasoned Action (Ajzen & Fishbein, 1980) the Theory of Planned Behavior (Ajzen, 1991) and Social Cognitive Theory (Bandura, 1999).

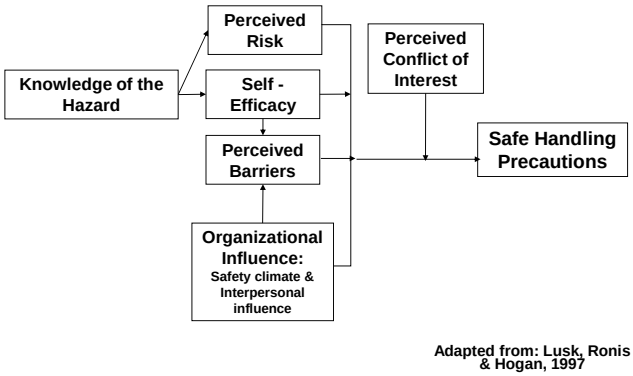

Figure 1. Factors Predicting Use of HD Safe Handling Precautions

The variables in the PHDP are knowledge about HD exposure, perceived risk of harm from HD exposure, self-efficacy for using PPE, barriers to using PPE, organizational safety climate and workplace interpersonal influences, and perceived conflict of interest between protecting self and providing patient care. The theoretical predictor variables and their relationships are discussed below.

Safe Handling Precautions. The use of HD safe handling precautions is the behavior of interest. It is a specific type of self-protective behavior, and includes the use of safety equipment, work practices and PPE.

Knowledge about HD exposure is defined as information about both the risks of HD exposure and the effectiveness of precautions in preventing exposure. Knowledge is necessary for an individual to begin thinking about a health hazard. The PUHPM includes "benefits of use," also called "value of use," which is characterized as an attitude in the model, but is dependent upon knowledge. For example, an item in the *Use of Hearing Protection Questionnaire* (Lusk, 2006) "wearing hearing protection protects me against hearing loss from noise exposure" reflects knowledge related to HPD use.

Perceived risk is a cognitive process where individuals consider the seriousness of a threat, personal susceptibility, personal severity, and short and long-term threat related to a situation. Individuals are not likely to engage in risk-reducing behaviors until they recognize personal susceptibility (Brewer et al., 2007). The Health Belief Model (Janz & Becker, 1984) the Precaution Adoption Process (Weinstein & Sandman, 1992) and an extended Theory of Planned Behavior (Levin, 1999) all include perceived risk as a predictor of behavior. The HPM does not include the concept of risk as a motivator, but was originally designed to explain health-promoting behaviors. Use of PPE is a health-protective behavior, rather than health-promoting. Motivation for protective behavior must necessarily consider the concept of risk. It is proposed that knowledge of HD exposure is related to perceived risk of harm from HD exposure and that perceived risk is positively related to the use of HD safe handling precautions.

Self-efficacy is the judgment of a person's ability to carry out a particular behavior. According to the PUHPM model, self efficacy has a direct effect on HPD use (Lusk et al., 1997). Self-efficacy is related to knowledge. Additionally, higher self efficacy decreases the perception of barriers to performing a health-protective behavior (Pender et al., 2006; Ronis et al., 2006). In the PHDP model, self-efficacy refers specifically to use of PPE for HD protection.

Barriers are impediments to engaging in a behavior that a person decides to adopt. These barriers may include "unavailability, inconvenience, expense, difficulty, or time-consuming nature of a particular action" (Pender et al., 2006, p. 53). Perceived barriers are expected to be negatively related to self-efficacy as well as the use of safe handling precautions. In the PHDP model, barriers are those that interfere with PPE use.

Organizational influence refers to perceptions by an employee about the commitment of the employer to promote a safe work environment. A positive relationship was found between organizational commitment to safety and compliance with UP (Gershon et al., 2000; Gershon et al., 1999; Gershon et al., 1995). Organizational influence is proposed to affect HD safe handling precautions in several ways: a direct effect on use of precautions; an indirect effect by decreasing perceived barriers; and an indirect effect by increasing social modeling of precaution use.

Interpersonal influence in the workplace is part of the organizational climate, and refers to the impact of important others' attitude toward and encouragement of the use of protective equipment. This includes social modeling, which is a significant predictor of HPD use (Hong et al., 2005; Lusk et al., 1997). The findings in HPD studies indicate that workers are more likely to use protective equipment if their co-workers do. This had not been previously studied with HD safe handling precautions and the same relationship was anticipated, although not supported by this study.

Perceived conflict of interest is defined by Gershon and others as a conflict "between workers' need to protect themselves and their need to provide medical care to patients" (1995, p. 225). It is a specific type of "immediate competing demand" in the revised HPM (2006) but the variable is not well studied. In one report, HCWs with low levels of conflict of interest were more than twice as likely to comply with UP as those with high levels (Gershon et al., 1995). Higher perceived conflict of interest is expected to interfere with HD precaution use.

The proposed model of factors influencing the use of HD safe handling precautions is adapted from a model that has consistently predicted HPD use, a type of

protective behavior. Perceived risk is included because it is an important variable in other health behavior models and the fact that it predicts other health-protective behaviors. Perceived conflict of interest is included because it affects UP use, which is similar to HD precaution use. Because of the suggested relationships between organizational influences and the other predictor variables, this variable is proposed to strongly predict the use of HD safe handling precautions.

The HPM emphasizes the role of behavior-specific factors on the outcome of interest (Pender et al., 2006). It is essential to identify factors that are salient to each particular type of self-protective behavior. PPE use by HCWs is a specific self-protective behavior that is undertaken by an individual for the purpose of protection against a future adverse health effect, and it requires ongoing adherence over a long period of time. The PHDP model represents an adaptation of the HPM and the PUHPM to include those factors with high relevance to this self-protective behavior.

The uniqueness of the healthcare environment suggests the need for specific predictors. Nurses work most often as employees rather than as independent practitioners in hospitals, clinics, or physician office practices; therefore, organizational influence is expected to affect PPE use. The PHDP proposes that organizational commitment to safety has a direct effect on use of precautions. This relationship is supported in several studies of UP use (Gershon et al., 2000; Gershon et al., 1995; Stone, Du, & Gershon, 2007; Stone & Gershon, 2006).

Perceived conflict of interest is another factor that is unique to patient care situations. This concept is not a part of the PUHPM because it is not relevant to HPD use. The PHDP incorporates perceived conflict of interest because it is particularly relevant to

HCWs' use of self-protective behavior (Gershon et al., 1995; Lymer, Richt, & Isaksson, 2004).

To summarize the proposed relationships of the PHDP model, depicted in Figure 1, knowledge of the hazard is related to perceived risk and self-efficacy. Self efficacy is expected to decrease perceived barriers. Organizational influences are expected to decrease perceived barriers. Perceived risk, self-efficacy, perceived barriers, organizational influences and interpersonal influences are expected to influence use of safe handling precautions. Finally, perceived conflict of interest is proposed to influence the use of safe handling precautions.

Assumptions

The following are assumptions inherent in the PHDP:

- Individuals value health and therefore seek to protect their health
- Individuals strive to regulate their own behavior
- Individuals are complex beings who interact with their environment
- Organizations differ in their values related to health and safety
- Clinical situations are unique situations that influence HCWs' priorities

The most important assumption related to the PHDP is that self-protective behavior is not a function of individual motivation alone. The workplace environment influences how and when workers engage in self-protective behavior. Healthcare organizations promote patient health and safety, but worker safety may vary in priority from one setting to another. In addition, HCWs may feel as though they must choose between their own safety and the safety of patients in care situations (Gershon et al., 1995; Lymer et al., 2004). The findings from one qualitative study on UP precautions

prompted the authors to comment, “On a conceptual level, this means that non-compliance [with precautions] must be conceived as being a natural tendency in clinical work” (Lymer et al., 2004, p. 548).

CHAPTER II

LITERATURE REVIEW

This chapter provides an overview of the adverse effects of occupational exposure to hazardous drugs; a summary of recommended HD safe handling precautions; and factors that are thought to influence the use of protective behaviors.

Adverse Effects of Occupational Exposure to Hazardous Drugs

Evidence of the adverse effects of HD exposure has been available since the 1970's. Several chemotherapy agents were linked to secondary leukemia and other cancers in patients who received antineoplastic agents for primary, un-related malignancies (Harris, 1976; Penn, 1976; Rosner, 1976). This information was soon followed by concern that the risk might extend to healthcare workers exposed to the drugs in the course of their work (Donner, 1978; Ng & Jaffe, 1970). Lancet published the first convincing evidence of health care worker exposure in a letter to the editor in 1979 (Falck et al.). In a small but controlled study, mutagenic activity was found in the urine of patients who received chemotherapy and nurses who administered the chemotherapy. The investigators had intended the nurses to be the control group, but instead found evidence of their exposure. In several recently published studies, hazardous drugs have been measured in the urine of nurses, pharmacists and pharmacy technicians (Pethran et

al., 2003; Sessink & Bos, 1999; Wick, Slawson, Jorgenson, & Tyler, 2003), indicating that there has been little reduction in exposure in over twenty-five years.

Acute symptoms have been reported in nurses and pharmacists who were occupationally exposed to HDs. These include hair loss, abdominal pain, nasal sores, contact dermatitis, allergic reactions, skin injury, and eye injury (Harrison, 2001; Valanis, Vollmer, Labuhn, & Glass, 1993a, 1993b). Adverse reproductive outcomes have been identified in nurses and pharmacists working with HDs, including miscarriage (OR = 1.01, $p = .03$) (Martin, 2003), spontaneous abortions (OR = 1.5-2.3) (Selevan et al., 1985; Stucker et al., 1990; Valanis et al., 1999); fetal abnormalities (OR = 4.7, $p = .02$) (Hemminki, et al., 1985); infertility (OR = 1.42-1.5) (Martin, 2003; Valanis et al., 1997) longer time to conception (OR = .8) (Fransman et al., 2007); preterm labor (OR = 2.98, $p < .01$), preterm births (OR = 5.56, $p < .01$) and learning disabilities (OR = 2.56, $p < .01$) in offspring of nurses exposed during pregnancy (Martin, 2005). Consistent with the inherent carcinogenic potential of twenty-three chemotherapy agents (International Agency for Research on Cancer, 2007), there is an increased relative risk (RR) of cancer among occupationally exposed pharmacy technicians (RR = 1.1-3.6) (Hansen & Olsen, 1994) and nurses (RR = 10.65) (Skov et al., 1992). More recently, Martin (2003) found that exposed nurses were significantly more likely to report a cancer diagnosis than unexposed nurses (OR = 3.27, $p = .03$). In that study, the nurses' age at initial cancer diagnosis was younger than that reported in the Surveillance, Epidemiology, and End Results [SEER] Data (National Cancer Institute, 1999).

Safe Handling Precautions for HD Handling

Since exposure to HDs is associated with adverse outcomes, safe handling precautions are recommended to reduce or eliminate exposure for health care workers. The first guidelines were published by the American Society of Hospital Pharmacists (ASHP, 1985), and these influenced the Occupational Safety and Health Administration document (OSHA, 1986). Professional organizations such as the American Medical Association [AMA] (1985) and the Oncology Nursing Society [ONS] (Polovich, Whitford, & Olsen, 2009) and NIOSH, a governmental agency (2004) have published similar guidelines. The recommended methods for reducing HD exposure include 1) biological safety cabinets (BSCs) to protect against inhalation exposure during drug preparation; 2) two pairs of disposable gloves that are powder free and have been tested for use with HDs; 3) a disposable gown made of chemical-protective fabric with long sleeves, cuffs and back closure; 4) A NIOSH-approved respirator to protect against aerosols; 5) eye and face shield that provides splash protection; 6) administrative controls and 7) careful work practices to reduce opportunities for exposure. All precautions, when used consistently, can reduce occupational exposure to HDs (NIOSH, 2004; OSHA, 1995).

Given the risks of exposure, use of safe handling precautions should be high; however, safe handling recommendations have not been universally implemented. Several studies on PPE use for HD handling have been published since the 1986 OSHA guidelines (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Stajicj et al., 1986; Valanis et al., 1991; Valanis & Shortridge, 1987; Valanis et al., 1992). These studies reported variation in PPE use by nurses based on the type of HD handling

activity. Glove use ranged from 49-99% for drug preparation and 15-94% for drug administration; while gown use ranged from 3-63% for drug preparation and 3-31% for drug administration. Not all studies reported PPE use for handling patient's HD-contaminated excretions and for disposal of chemotherapy, but when reported it ranged from 58-96% for gloves and 4-23% for gowns (Martin & Larson, 2003; Polovich & Martin, 2008, February; Valanis et al., 1991).

The PPE studies published before 1990 demonstrated the lowest glove use (Stajicj et al., 1986; Valanis & Shortridge, 1987). All of the PPE studies published after 1990 demonstrated higher glove use for HD preparation and administration (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Valanis et al., 1991; Valanis et al., 1992), but it still fell short of recommendations. Recent studies continue to report less frequent PPE use for handling HD-contaminated excretions and drug disposal. In addition, the newer guidelines (ASHP, 2006; NIOSH, 2004; Polovich et al., 2009) recommend double gloves for all HD handling activities. In one recent study, adoption of this precaution was only 11-18% (Polovich & Martin, 2008, February).

Many studies did not report the type of gloves used for HD handling. Two studies, however (Martin & Larson, 2003; Polovich & Martin, 2008, February) found that 25-40% of nurses used gloves not designated for use with chemotherapy. They found that nurses working in private physician office practices where chemotherapy is prepared and administered were less likely to have access to appropriate PPE. Because permeation studies indicate that many medical gloves provide limited protection from HDs (Connor, 1999; Gross & Groce, 1998; Klein, Lambov, Samev, & Carstens, 2003; Singleton & Connor, 1999), not all gloves are appropriate for HD handling. This is particularly

important because hands are the most frequent site of dermal exposure to HDs (Fransman, Vermeulen, & Kromhout, 2004, 2005).

Gowns are recommended for HD handling in all published guidelines. Most studies indicate that gowns are used more frequently for HD preparation than for HD administration, although overall gown use does not meet OSHA guidelines (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Valanis et al., 1991; Valanis & Shortridge, 1987; Valanis et al., 1992). Additionally, some studies have reported that nurses wear gowns made of cloth and other materials that are not designated for HD handling (Mahon et al., 1994; Martin & Larson, 2003; Polovich & Martin, 2007, March; Valanis & Shortridge, 1987). Such gowns provide limited protection against chemical permeation (Connor, 1993; Harrison & Kloos, 1999) and should not be used for HD handling. In addition, Polovich & Martin (2008, February) found 58% of nurses reported reusing disposable gowns for HD preparation and 38% of nurses reused disposable gowns for HD administration. Reuse of disposable gowns may increase the chance of contaminating clothing.

To date, there have been eight published studies on PPE use with chemotherapy (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Polovich & Martin, 2008, February; Stajicj et al., 1986; Valanis et al., 1991; Valanis & Shortridge, 1987; Valanis et al., 1992) (See Table 1)**.** All of the studies that measured use of HD safe handling precautions were descriptive, cross-sectional studies. One study used a comparative design in reporting nurses' and pharmacists' use of safe handling precautions before and after publication of OSHA guidelines (Valanis et al., 1992). Two studies examined relationships between the use of HD safe handling precautions and

nurse characteristics (such as years of experience) and work site characteristics (such as type of setting) (Martin & Larson, 2003; Polovich & Martin, 2008, February).

Table 1

Studies of Safe Handling Precautions

Authors	Sample	Reported PPE Use
Stajicj et al., 1986	33 registered nurses employed in oncologists' private practices in Georgia	Drug preparation: Gloves = 49% Gowns = 3% Drug administration: Gloves = 15% Gowns = 3%
Valanis & Shortridge, 1987	632 ONS members who mix and/or administer antineoplastic drugs.	Drug preparation: Gloves = 76% Gowns = 36% Drug Administration: Gloves = 50% Gowns = 14%
Valanis et al., 1991	125 staff from 14 facilities in Southwestern Ohio, including 7 physicians, 93 nurses, 22 pharmacists & technicians, and 3 nurse aides/ housekeeping staff	Drug preparation: Gloves =91% Gowns = 41 % Drug administration: Gloves = 78% Gowns = 12%
Valanis, et al., 1992	1932 nurses and 153 nurses aides from >200 health care facilities currently handling HD's	Drug preparation: Gloves = 92% Gowns = 63% Drug administration: Gloves = 82% Gowns = 23% Handling excreta Gloves = 67% Gowns = 4%

(Table 1 Continues)

(Table 1 Continued)

Authors	Sample	Reported PPE Use
Mahon et al., 1994	103 nurses, 83 of whom handle chemotherapy, from an ONS chapter in a large Midwestern city.	Drug preparation: Gloves = 90% Gowns = 44% Drug administration: Gloves = 94% Gowns = 59% Patient care: Gloves = 94% Gowns = 12%
Nieweg et al., 1994	824 nurses from 11 Dutch hospitals	Drug administration: Gloves = 91% Gowns = 21% Mask = 18% Goggles = 3%
Martin & Larson, 2003	263 ONS members; nurses from outpatient settings	Drug preparation: Gloves = 99% Gowns = 53% Drug administration: Gloves = 94% Gowns = 31% Handling excretions: Gloves = 96% Gowns = 23%
Polovich & Martin, 2008	330 nurses attending an ONS conference from various settings who handle chemotherapy	Drug preparation: Gloves = 98% Gowns = 91% Drug administration: Gloves = 99% Gowns = 84% Drug disposal: Gloves = 99% Gowns = 75% Handling excreta: Gloves = 99% Gowns = 77%

Each study evaluated PPE use by self-report measures. Instrument content validity was evaluated using experts in all studies except one (Nieweg et al., 1994) in which validity was not reported. Martin & Larson (2003) reported observing PPE use in

ten study participants, which matched their self-report for all but two items. Reliability was most often evaluated using test-retest procedures with kappa reported in the range of .64-1.0 (Martin & Larson, 2003; Valanis & Shortridge, 1987; Valanis et al., 1992).

Three studies included participants who were members of ONS (Mahon et al., 1994; Martin & Larson, 2003; Valanis & Shortridge, 1987) and one recruited participants from a national ONS conference (Polovich & Martin, 2008, February). It is estimated that only 50 % of practicing oncology nurses in the United States are ONS members (A. Stengel [ONS Membership Services], personal communication, December 3, 2007). Because of the educational resources of the organization, ONS members may be biased toward better handling practices. No studies have examined use of PPE by nurses who administer HDs for non-oncology indications such as rheumatoid arthritis, multiple sclerosis, or tubal ectopic pregnancy. Thus, samples in these studies are not likely representative of all nurses handling HDs. The current study sought to include nurses who are not members of ONS as well as members in order to obtain a sample that is more representative of nurses handling chemotherapy in the U.S.

In summary, the use of PPE has improved over time. In the 20 years since the OSHA Guidelines, oncology nurses have incorporated the use of gloves for handling HDs into their practice. Some areas of concern remain, such as the fact that chemotherapy-designated gloves are not used in all settings; that double-gloves are used infrequently; that some nurses do not wear gloves for all HD handling activities; and that gown use continues to be low. Appropriate PPE may not always be available. Additionally, nothing is known about nurses' adherence to HD safe handling precautions outside of oncology settings.

Requirements for Hazardous Drug Handling

OSHA standards are part of the Code of Federal Regulations (CFR) and have the force of law. One example is the OSHA Bloodborne Pathogen Standard (U.S. Department of Labor-OSHA, 1991) which requires blood and body fluid precautions and use of safe needle devices in healthcare (OSHA, 2007). OSHA has the authority to cite and fine organizations that fail to provide appropriate safety equipment and precautions to its employees. In contrast, HD safe handling recommendations are guidelines rather than mandates from OSHA. This fact has led some organizations to consider the OSHA HD guidelines optional.

Selected aspects of the OSHA HD guidelines are required by other standards. These applicable standards include the Hazard Communication Standard (29CFR 1910.1200), which requires employers to inform employees of the risks of hazardous materials in their workplace and the methods of protecting themselves. The same standard requires Material Safety Data Sheets (MSDS) to be available for all chemical hazards (OSHA, 1994). Recent regulations regarding HD preparation (U.S. Pharmacopeial Convention, 2008) have elevated the OSHA recommendations to standards that are enforceable by the Food and Drug Administration (FDA).

Employers' responsibilities are outlined in the OSHA guidelines and the NIOSH recommendations. According to the recommendations, employers should have policies & procedures for safe handling; provide hazard communication training; provide a BSC for drug preparation; provide appropriate PPE for those handling HDs; have MSDS's available for all HDs, and monitor potentially-exposed employees in a medical surveillance program.

In summary, regulations regarding employee safety when handling HDs are not consistent with the recommendations. While some components of workplace HD safety programs are regulated, others are not. Consequently, organizations vary in their interpretation of HD safety requirements, resulting in variable implementation of HD safe handling precautions.

Factors Influencing Adoption of Protective Behaviors

The use of safe handling precautions can be described as protective behavior. Little is known about the factors contributing to nurses' decision to use safe handling precautions when handling HDs; however, use of protective equipment for protection against other occupational hazards such as blood and body fluids (Gershon et al., 1995) high noise (McCullagh et al., 2002), industrial chemicals (Geer, Curbow, Anna, Lees, & Buckley, 2006) and eye injury (Forst et al., 2006) has been examined. Worker protective behavior for other occupational hazards is thought to be influenced by personal factors (Gershon et al., 1999; Gershon, Sherman, et al., 2007; Hong et al., 2005; McGovern et al., 2000), knowledge about the hazard, (Geer et al., 2006; Gershon et al., 1995; Raymond, Hong, Lusk, & Ronis, 2006), perceived risk of harm, (Gershon et al., 1995; Levin, 1999; Martin, 2006), self-efficacy (Kerr, Lusk, & Ronis, 2002; Lusk, Kerr, Ronis, & Eakin, 1999; Lusk, Ronis, & Baer, 1995; Lusk et al., 1997; Lusk, Ronis, Kerr, & Atwood, 1994; Raymond et al., 2006; Ronis et al., 2006) barriers (Forst et al., 2006; Gershon et al., 1995; Kerr et al., 2002; Lusk et al., 1994; McCullagh et al., 2002) organizational influences (Gershon et al., 2000; Gershon et al., 1995; Stone et al., 2007; Stone & Gershon, 2006) interpersonal influences, [modeling and encouraging PPE use by co-workers] (Lusk et al., 1997; McCullagh et al., 2002; Raymond et al., 2006; Ronis et

al., 2006) and situational factors (Gershon et al., 1995; Hong et al., 2005; McCullagh et al., 2002).

Personal Factors

Individual characteristics may affect the adoption of protective behaviors. The effect of years of experience on precaution use reported in the literature is inconsistent. More years of experience was associated with higher UP use in healthcare workers (McGovern et al., 2000) and HPD use among White automotive manufacturing workers (Hong et al., 2005). In contrast, years of working in a plant negatively predicted HPD use among automotive manufacturing workers (Raymond et al., 2006) and construction workers (Lusk et al., 1997; Ronis et al., 2006). In two large descriptive studies of nurses handling HDs (Martin, 2006; Martin & Larson, 2003), nurses with fewer years of oncology experience were more likely to wear gowns when handling HDs and nurses with more years of experience generally had a lower perceived risk of harm from HD exposure. Since personal factors are not modifiable, this is not a primary variable of interest in this study. However, these data were collected for descriptive purposes and for their potential use as covariates.

Knowledge of the Hazard

People must be aware of the existence of a hazard in order to know that they should protect themselves from the hazard (Weinstein 1988; Weinstein, Lyon, Sandman, & Cuite, 1998; Weinstein & Sandman, 1992). In studies of dermal chemical exposure in industrial settings, workers' lack of knowledge about characteristics of chemicals that affect skin absorption was associated with lower use of protective equipment (Geer et al.,

2007; 2006). In healthcare settings, more knowledge about human immunodeficiency virus (HIV) transmission (Gershon et al., 1995; McGovern et al., 2000) and training in PPE use (Gershon et al., 1995; McGovern et al., 2000) have been associated with statistically significant better UP compliance.

Regarding HD safe handling precautions, Ben Ami and colleagues found that lower use of precautions was related to lack of knowledge (Ben Ami, Shaham, Rabin, Melzer, & Ribak, 2001) and Harrison and colleagues found that education and training improved HD safe handling (Harrison, Godefroid, & Kavanaugh, 1996).

In a study of nurses working in outpatient and office-based oncology settings, Martin and Larsen (2003) found that oncology certified nurses were less likely than those nurses who were not oncology certified to use gowns while disposing of chemotherapy and handling excreta contaminated with HDs. Since certification examinations measure knowledge, nurses with a higher level of knowledge would be expected to be more aware of the risks of HD exposure, and thus more likely to use PPE. No workplace characteristics were suggested to account for this unexpected finding, which warrants further exploration.

Perceived Risk of Harm from HD Exposure

Risk perceptions are important in situations where individuals make decisions to engage in a protective behavior (Brewer et al., 2007). Brewer asserts that there are three dimensions of perceived risk: perceived likelihood, perceived susceptibility and perceived severity, and that each is related to the threat of harm when no action is taken. In a meta-analysis, Brewer and colleagues examined thirty-four studies (N = 15,988) to test the hypotheses that higher perceived likelihood, perceived susceptibility and severity

are associated with adults obtaining vaccinations. All three dimensions of risk perception significantly predicted vaccination behavior, showing a consistent relationship between risk perception and the adoption of a specific protective behavior (Brewer et al., 2007).

Only three descriptive studies have reported perceived risk related to PPE use for HD handling. In the first, a study of 632 nurses who mix and/or administer antineoplastic drugs, 25% reported they did not believe there is danger as one reason for not using PPE (Valanis & Shortridge, 1987). Valanis and others (1991) reported a lack of awareness of risk associated with HD handling among 9% of nurses and physicians. In the third study, Martin (2006) examined the relationship between the degree of perceived health risk associated with handling chemotherapy and the use of precautions by 500 randomly-selected nurses working in outpatient oncology settings. Fifty percent of nurses indicated that the drugs were "minimally hazardous" and 5% described the drugs as "not hazardous." Since these nurses worked in outpatient and office-based oncology practices primarily administering chemotherapy, there is no reason to suspect that these nurses handled drugs that were less hazardous than their colleagues. The degree of perceived risk of harm from HD exposure was lower among nurses with more years of oncology and chemotherapy experience. More importantly, the use of gowns was significantly lower among those nurses with lower perceived risk. Similar results were found in studies of compliance with UP in general (Gershon et al., 1995) and the use of gloves when potentially exposed to blood (Levin, 1999).

Self Efficacy for use of Personal Protective Equipment

Perceived self efficacy is "the judgment of personal capability to organize and carry out a particular course of action" (Pender et al., 2006, p. 53), and is an important

concept in several health behavior models. In the context of occupational health, this variable was found to predict HPD use (Kerr et al., 2002; Lusk et al., 1999; Lusk et al., 1995; Lusk et al., 1997; Lusk et al., 1994; Raymond et al., 2006; Ronis et al., 2006). Self efficacy is not well studied in relation to blood and body fluid exposure. The effect of self-efficacy on UP compliance has been mixed, with one study finding a relationship (Sinclair, 1998) and two studies finding none (Mitchell, 1995; Patros, 2002), although the latter studies may have been under-powered because of small sample size. Self efficacy for PPE use was not significantly related to protective behavior for chemical exposure in industrial settings (Geer et al., 2007). This variable has not been studied in HD handling, but was included because of its relationship to some other health protective behaviors and conceptual links in the model.

Barriers to Using Personal Protective Equipment

Barriers interfere with workers' use of protective behaviors. They may be practical (such as lack of available protective equipment), psychosocial (e.g. peer or patients' attitudes) or situational (such as time constraints). Perceived barriers are negatively related to HPD use (Kerr et al., 2002; Lusk et al., 1994; McCullagh et al., 2002), UP compliance (Gershon et al., 1995) and workers' use of eye protection (Forst et al., 2006). The most commonly reported barriers to using PPE across occupational settings are time pressure or lack of time, peer acceptability, and negative outcome expectancy (Geer et al., 2006).

A few studies have reported barriers to using HD safe handling precautions. Three studies reported reasons for not wearing PPE identified by nurses or pharmacists (Mahon et al., 1994; Valanis et al., 1991; Valanis & Shortridge, 1987). The findings were similar,

and included all of the following: lack of time, lack of availability of or accessibility to PPE, lack of awareness that non-use is potentially hazardous, not being convinced of the need for PPE, cost of protective equipment, discomfort associated with wearing PPE, and concern that PPE would upset patients. In a study of chemotherapy gown effectiveness, Harrison and Kloos (1999) asked participants to rate the subjective comfort of several gowns. Those gowns that provided the best protection were rated the least comfortable to wear. The heat-retaining quality of chemical protective gowns is a potential barrier to use. None of these studies measured the effect of barriers on use of precautions or the relative importance of certain barriers. Since all barriers cannot be eliminated, it is essential to gain a better understanding of those factors having the most impact.

Organizational Culture and Safety Climate

The aspects of organizations affecting protective behaviors have been variously referred to as "organizational culture," "organizational climate" and "safety climate." These terms are defined in the following section.

Organizational culture refers to the underlying principles, norms, values, beliefs, and assumptions within an organization (Ostroff, 2001). Culture is a highly abstract construct that encompasses all aspects of work and the work setting. There are many cultures within healthcare organizations, such as ethical conduct and patient safety (DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004; Gershon, Stone et al., 2007). Employee safety is the specific culture of interest for this study.

Organizational climate is how culture is experienced by workers, and refers to employees' collective perceptions of organizational attributes, such as decision making, leadership, and norms (Ostroff, 2001). *Safety climate* is a specific aspect of

organizational climate, and is defined as employees' collective perceptions about an organization's commitment to providing a safe work environment (Committee on the Work Environment of Nurses and Patient Safety Board on Health Care Services, 2004; Cooper & Phillips, 2004). The terms culture and climate are sometimes used interchangeably, and they are related. Their relationship is described as follows: "Climate follows naturally from culture or, put another way, organizational culture expresses itself through organizational climate" (Guldenmund, 2000, p. 221). The distinction is important. Culture is an abstract, more "holistic" construct that encompasses the social and cultural context of the work situation and is difficult to define (Lymer et al., 2004). Climate is a concept that is less abstract and has specific components or dimensions that can be described and defined. There are empirical indicators of safety climate that can measure those dimensions. Safety culture may be inferred from safety climate, but cannot be directly measured.

Safety climate can be described along a continuum, as positive, neutral or negative, depending on workers' perceived level of the organization's commitment to a safe work environment. Employees of the same organization tend to agree about their perceptions of safety climate (D Zohar, 1980) as evidenced by greater variance of safety climate scores between workplaces as opposed to within workplaces. Safety climate has been studied in industrial settings and found to affect safety performance since the 1970's, and recent work indicates that the same relationship of safety climate to safety behavior exists in healthcare occupational settings (Dejoy, Gershon, & Schaffer, 2004; Stone, Pastor, & Harrison, 2006).

There is, however, some disagreement about the components that contribute to a better, more positive safety climate. The literature suggests anywhere from three to twenty-four dimensions of safety climate (Guldenmund, 2000). For example, Zohar (1980) suggested several organizational dimensions based on industrial safety literature, and used principle component factor analysis to determine eight important factors. They are employees' perceptions of:

- Importance of safety training programs
- Management attitudes toward safety
- Effects of safe conduct on promotion
- Level of risk at work place
- Effects of required work pace on safety
- Status of safety officer
- Effects of safe conduct on social status
- Status of safety committee.

Cooper and Phillips (2004) adapted Zohar's questionnaire and determined that there are seven dimensions, adding management actions toward safety, while combining social status with promotion and status of the safety officer with the safety committee. One author (Guldenmund, 2000) suggests that variation in the dimensions making up safety climate is likely explained by the difference in industries, populations studied, and theoretical model used to frame the research.

In healthcare organizations, five components have been suggested as indicators of a positive safety climate (DeJoy, Murphy, & Gershon, 1995; DeJoy, Searcy, Murphy, & Gershon, 2000; Gershon, Stone et al., 2007; Moore et al., 2005):

- safety policies and procedures exist and compliance with safety policies is expected
- education and training in safe practice are provided
- equipment and supplies necessary for safety are made available
- the organization provides feedback and reinforcement for safety
- management provides support for safety programs

It is expected that these aspects of an organization's safety climate influence individual healthcare worker's adoption of protective behaviors. The effects of these dimensions are described in the following section.

Safety Policies and Procedures

The existence of policies related to employee safety is one indicator of a positive safety climate (DeJoy, Schaffer et al., 2004). Policies and procedures are overt actions on the part of management to affect workplace safety. In several early studies related to the use of HD safe handling precautions, the majority of organizations (> 90%) reported having written policies regarding HD handling (Mahon et al., 1994; Nieweg, deBoer, Dubbleman, & et al., 1994; Valanis, McNeil, & Driscoll, 1991). Most participants in these studies worked in inpatient hospital oncology departments, which were the most common setting for cancer treatment at the time. In the 1990's, economic factors shifted cancer treatment to outpatient settings. In a recent study of outpatient and office-based oncology settings, Martin and Larson (2003) reported that 85% of outpatient oncology treatment settings had written policies for HD handling. Polovich and Martin (2008, February) found that only 71% of physician-based oncology practices had written HD handling policies, as compared to 90% in all other types of oncology settings. Thus, the

shift of treatment from hospitals to other types of organizations has impacted the availability of policies related to HD safe handling.

Policies and procedures requiring the use of personal protective equipment (PPE) have been shown to enhance the use of such equipment. For example, overall adherence with universal precautions (UP) for protection against blood and body fluid exposure increased from 44% to 73% over one year in an emergency department when a policy mandating UP compliance was instituted (Kelen et al., 1991). In a study outside of healthcare, Mexican factory workers' use of hearing protection devices (HPDs) in high-noise environments was 72% - 100% in organizations requiring their use, and 0-27% in organizations that did not (Kerr, Lusk, & Ronis, 2002). Nurses who reported double gloving for HD handling were significantly more likely to practice in organizations where policies required double gloves (Polovich & Martin, 2008, February). The lack of a policy mandating the use of protective equipment was given as a reason for not using PPE by nurses for HD safe handling (Nieweg et al., 1994; Valanis et al., 1991; Valanis & Shortridge, 1987) and by farmers' for not wearing eye protection (Forst et al., 2006).

The presence of policies alone, though important, may not lead to appropriate use of PPE; the congruence of policies with existing guidelines was also an important concern. In two U.S. studies (Valanis et al., 1991; Valanis, Vollmer, Labuhn, Glass, & Corelle, 1992), the investigators found that policies requiring PPE for various HD handling activities were less stringent than the OSHA (1986) guidelines. In a European study, policies were compared to the Netherlands Association of Hospital Pharmacists (NAHP) guidelines and fell short of those recommendations (Nieweg et al., 1994). More recently, Polovich and Martin (2008, February) found that 52% of respondents'

organizations had not updated their HD safe handling policies to reflect the recommendations made by the NIOSH (2004) two years after their publication.

Individual employees may vary in their compliance with policies. This may be due to lack of familiarity with the content of policies. In a study by Nieweg and others (1994), 11% of the nurses indicated that there were no guidelines for HD handling in their work areas, when in fact all the hospitals involved in the study did have policies. In another study (Valanis et al., 1991), nurses incorrectly identified the required PPE for certain HD handling tasks. Interestingly, when nurses assumed that specific PPE was required by policy, they were more likely to use the PPE, whether or not that was the case. The authors in both studies concluded that staff members' knowledge of their facility's policies was poor. Other reasons for non-compliance are not well understood.

In summary, policies and procedures are an important aspect of safety climate in healthcare organizations. The presence of policies influences workers' use of protective behaviors. However, organizations vary in their activities related to ensuring that policies are congruent with current safety recommendations; communicating the content of safety policies and procedures; and encouraging compliance with policies.

Education and Training

Providing safety training is an important aspect of safety climate. Safety education and training affect the adoption of safety-related behaviors. Education refers to providing information, while training is defined as forming by "instruction, discipline or drill" (Mish, 2004). Safety education provides information to increase knowledge about workplace hazards. The effect of knowledge on use of precautions was discussed previously. Safety training concerns actions or behaviors that an employee learns to

prevent hazardous exposures. In addition to enhancing the knowledge and skills necessary for implementing safety precautions, the fact that employers provide education and training regarding safety emphasizes its importance to employees.

Training related to chemical hazards in the workplace is required by the Hazard Communication standard (OSHA, 1994) as follows: "at the time of their initial assignment and whenever a new physical or health hazard the employees have not previously been trained about is introduced into their work area" (p. 470). This training must include the health risks associated with the hazards as well as what precautions will protect the employee from exposure. Most often, training occurs during orientation of new employees. Hospitals generally provide annual updates to comply with requirements of other regulatory agencies (e.g., The Joint Commission). Other organizations may vary in the type, specificity (e.g., chemicals or drugs), frequency and duration of training.

Safety knowledge, education and training affect the adoption of safety-related behavior. The impact of safety training has been measured in several different occupational settings. Training has been associated with safety behavior as measured by a safety checklist among manufacturing workers (Cooper & Phillips, 2004); with increased use of HPDs by automotive factory workers (Lusk et al., 2003); compliance with UP by nurses (DeJoy et al., 1995; Gershon et al., 1995; McGovern, Gershon, Rhame, & Anderson, 2000); the use of safe needle precautions among hospital workers (Vaughn et al., 2004); and the use of infection control practices by dentists (Gershon, Karkashian, Vlahov, Grimes, & Spannhake, 1998).

The effect of training on the use of HD safe handling precautions is not well-studied. One study in Israel reported that lack of compliance with safety measures was

related to lack of education (Ben Ami, Shaham, Rabin, Melzer, & Ribak, 2001). Two studies on HD handling (Martin & Larson, 2003; Stajich, Barnett, Turner, & Henderson, 1986) reported that nurses had received education about HD handling; however, the relationship between training and use of precautions was not evaluated. Little is known about what constitutes the most important content of training and what the most effective training methods are for increasing the use of HD safe handling precautions.

Equipment and Supplies

In order for workers to use appropriate precautions, safety equipment must be both available and readily accessible (DeJoy et al., 2000; Moore et al., 2005). In two large studies of nurses potentially exposed to blood and body fluids, the availability of PPE was a predictor of the nurses' compliance with PPE (DeJoy et al., 1995; DeJoy et al., 2000). In one of those studies, PPE availability not only predicted its use, but in combination with performance feedback, it accounted for 30% of the variance in a measure of safety climate (DeJoy et al., 1995). Moore also suggests that by making adequate supplies of PPE readily available, employees may have increased perceptions of the effectiveness of PPE in preventing exposure (Moore et al., 2005).

Nurses have reported that appropriate PPE for HD handling is not always available (Martin & Larson, 2003; Polovich & Martin, 2007, March; Valanis & Shortridge, 1987). NIOSH recommends that only chemotherapy-tested gloves should be used for handling HDs. Despite the availability of chemotherapy-designated gloves for over 15 years, Mahon et al. (1994) reported that only 44% of the nurses used the special gloves for HD preparation. A more recent study in outpatient chemotherapy settings

(Martin & Larson, 2003) revealed that 84% of nurses mixing HD's and 60% of nurses administering HD's wore chemotherapy-designated gloves.

For HD handling, cloth gowns or lab coats are not considered PPE because they do not provide protection from chemical penetration. Several studies found that cloth gowns were used during HD handling because they were the only protective garments available (Mahon et al., 1994; Martin & Larson, 2003; Nieweg et al., 1994; Valanis & Shortridge, 1987; Valanis et al., 1992). PPE availability varied with the type of clinical setting. Nurses working in private physician office practices where chemotherapy is prepared and administered were less likely than nurses working in hospital inpatient or outpatient settings to have access to appropriate PPE (Polovich & Martin, 2008, February). The organizations' commitment to safety may be an explanation for the variability in availability of PPE and use of precautions. Organizations with a positive safety climate both provide appropriate PPE and encourage its use.

Feedback and Reinforcement for Safety

Use of safety equipment is often associated with extra work effort, slower work pace, and personal discomfort. Because of these barriers, reinforcement for the use of safety equipment is necessary. Performance feedback is "social approval or disapproval received from coworkers, supervisors and managers" for worker behavior (Dejoy, Gershon et al., 2004, p. 51).

In an interrupted time-series study in an industrial setting, supervisors provided regular safety-related interactions, showing approval for safe behavior and disapproval for unsafe behavior (Zohar, 2002). This use of feedback resulted in significant changes in the minor injury rate, the use of earplugs for hearing protection, and safety climate scores

in the experimental group. Feedback has also been associated with a positive safety climate and compliance with safety precautions by healthcare workers (Dejoy, Gershon et al., 2004; Grosch, Gershon, Murphy, & DeJoy, 1999) and retail workers (Dejoy, Gershon et al., 2004). In another study involving healthcare workers, peer feedback improved handwashing and glove use for Thai healthcare workers (Moongtui, Gauthier, & Turner, 2000), although the results were not sustained. Gershon and colleagues (2000) found that failure to provide safety-related feedback was related to increased workplace exposure incidents. No studies have evaluated safety feedback in settings where HDs are handled.

Management Support of Safety

Management support for safety programs has been studied for over thirty years in industrial settings; however this has not been well-studied in healthcare settings. DeJoy suggests that if workers perceive that productivity is more important than safety concerns, unsafe behavior is encouraged (Dejoy, 1986).

In a small qualitative study of five nurses with self-reported adverse health outcomes following occupational HD exposure (Polovich & Minick, 2008), nurses discussed barriers that existed in adopting HD safe handling precautions because of characteristics of the organizations in which they worked. Lack of knowledge about the risks of exposure by persons in authority and monetary issues affected the implementation of HD safe handling programs. These nurses reported a general mistrust of their employers related to worker safety and believed that lack of PPE, safety procedures, and administrative support for HD safe handling programs contributed to their HD exposure. They implied that if their employers had been more responsible, they might not have experienced adverse health outcomes. Although the sample size was

small, this study was the first to suggest the importance of safety climate in use of HD safe handling precautions.

Characteristics of an organization are likely to influence individual worker's behavior related to health and safety. This concept is especially applicable to nurses who practice as employees in a health care setting. Activities of organizations that encourage safety include having safety goals, allocating resources for safety, having policies that promote safety, and providing safety training. Gershon (1995) reported a significant ($p <$ .001) positive relationship between 'perceived organizational commitment to safety' and UP compliance in hospitals and the findings have been consistent across healthcare worker populations (Gershon et al., 2000; Gershon, Stone, Bakken, & Larson, 2004). HPD use was predicted by positive "union climate" (Raymond et al., 2006) and "supervisor climate" for non-Hispanic Whites (Hong et al., 2005; Raymond et al., 2006).

Lack of an organizational mandate for use of PPE was stated as a reason for farmers' failure to wear eye protection (Forst et al., 2006) and nurses' failure to use appropriate PPE for HD handling (Valanis et al., 1991). Nurses who reported double gloving for HD handling were significantly more likely to practice in organizations that had updated polices since NIOSH published this recommendation ($X^2_{(1)} = 17.5$, $p <.01$) (Polovich & Martin, 2008, February).

Several studies have reported lack of availability of appropriate PPE for HD handling (Martin & Larson, 2003; Polovich & Martin, 2008, February; Valanis & Shortridge, 1987). Spill kit availability and use in the event of a HD spill was significantly lower ($p = .01$) in physician private practice settings than in hospital inpatient or outpatient settings (Polovich & Martin, 2008, February). Because both the

availability and use of appropriate equipment and precautions varies by type of setting, the organizations' commitment to safety may be an explanation for this variability.

Interpersonal Influences on Protective Behavior

Interpersonal influence refers to the impact of important others' attitudes toward, support for and modeling of a particular behavior. Levin (1999) found that attitudes of co-workers toward glove use did not influence glove use for potential blood exposure; however, interpersonal influence was found to be a predictor of HPD use in several studies (Hong et al., 2005; Kerr et al., 2002; Lusk et al., 1999; Lusk et al., 1997; McCullagh et al., 2002). These studies indicate that workers are more likely to use protective equipment if their co-workers do. In one study, modeling accounted for more variance in HPD use by construction workers than any other predictor (Lusk et al., 1997). Interpersonal influences have not been studied in the use of HD precautions. **Perceived Conflict of Interest**

Health care workers may report a conflict between the need for self-protection and the need to provide timely and safe patient care. This type of situational influence is unique to health care when staff work closely with patients and when the exposure risks are related to the patients themselves or to patient care. With respect to UP, workers who reported high levels of conflict of interest were half as likely to be compliant with UP as those who reported low conflict levels (Gershon et al., 1995). This kind of influence has not been measured in HD handling, but was suggested in two studies. Nurses reported that PPE use "might upset patients" (Valanis & Shortridge, 1987) or "interfere with staff's relationship with patients" (Valanis et al., 1991).

Summary

This study addresses several gaps in the literature. First of all, although researchers have measured how often nurses use HD safe handling precautions in many studies over the last twenty years, very few studies have measured the impact of specific factors on nurses' use of HD safe handling precautions. All studies have been descriptive. There have only been a few studies examining relationships between PPE use and selected characteristics of nurses (age and experience) (Martin & Larson, 2003; Polovich & Martin, 2008, February); characteristics of the workplace (type of setting and geographical location) (Martin & Larson, 2003; Polovich & Martin, 2008, February); and perceived risk (Martin, 2006). Therefore, the use of precautions has been well-documented, but reasons for using or failing to use HD safe handling precautions have not. This study examined theoretical predictor variables—knowledge of chemotherapy exposure, perceived risk of harm from HD exposure, self efficacy for PPE use, and perceived barriers to PPE use—and their relationship to the use of HD safe handling precautions.

Safety climate, or employees' collective perceptions about an organization's commitment to providing a safe work environment, is an important factor in the occupational safety literature. However, this has never been explored in the area of HD safe handling. This study examined the influence of this aspect of organizations on nurses' use of precautions.

Finally, the notion of a nurses' need to choose between patient care and use of safe handling precautions has been suggested, but not measured. This study evaluated

perceived conflict of interest between protecting self and caring for patients as a potential moderator of nurses' use of HD safe handling precautions.

Since HD safe handling precautions will reduce nurses' exposure to HDs, it is essential to promote their use. This study provides important information about factors that affect nurses' decision to use HD safe handling precautions.

CHAPTER III

METHODOLOGY

This chapter describes the methods used in conducting the study. The following sections are included: research design, sample and recruitment, data collection and instruments, study procedures, data management and analysis plan, and methods used to protect human subjects.

Research Design

A cross-sectional, correlational design was used to determine the relationships among nurses' use of HD safe handling precautions and knowledge about HD exposure, perceived risk of harm from HD exposure, self-efficacy for using PPE, barriers to use of PPE, organizational influences, interpersonal influences, and perceived conflict of interest between protecting self and caring for patients. The interaction effect of nurses' perceived conflict of interest (need to protect self vs. need to provide medical care) and self-efficacy for PPE use and the use of HD safe handling precautions were also examined. A mail survey method was used to reach nurses who are currently involved in handling HDs. In addition, managers' perspectives on use of safe handling precautions in the workplace were explored using a semi-structured telephone interview.

Sample and Recruitment

The participants for the study were registered nurses (RNs) who were employed in oncology settings and who reported handling antineoplastic chemotherapy agents (preparation, administration, disposal or handling contaminated excreta) in the previous year. The exclusion criterion was reporting no chemotherapy handling in the last year. Although a random sample is recommended for a correlational design, it was not feasible for this study. The population of all U.S. nurses handling HDs was not easily identifiable. Using a membership list from the Oncology Nursing Society [ONS] was not appropriate, since it is estimated that only 50% of nurses involved in cancer care are members of ONS (A. Stengel [ONS Membership Services], personal communication, December 3, 2007). In order to include both members and non-members of ONS, oncology nurses were identified through their places of employment, using a national sample frame.

Participants were selected from a membership mailing list purchased from the Association of Community Cancer Centers (ACCC). Surveys were mailed to potential participants. The Tailored Design Method (Dillman, 2007) was used to increase the response rate, which includes multiple contacts with the questionnaire recipient by first class mail, the use of a small incentive, stamped return envelopes, and a respondent-friendly survey. Participant characteristics were obtained, including demographic data, years of experience in nursing, information about workplace characteristics, and geographic location.

Another potential source of information about nurses' use of safe handling precautions is the manager or supervisor of nurses who handle HDs. Manager-

participants identified themselves as holding a formal organizational position where part of their responsibility included the supervision of nurses who handle chemotherapy. Managers were also recruited by mail using the ACCC mailing list.

Sample Size

Required sample size was determined using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). The recommended sample size was 159 participants. This was based on performing multiple regression with the eight predictor variables in the conceptual model. This sample size should result in sufficient power to detect a moderate effect size of the model (power = .80, α = .05, effect size f^2 = .10). To achieve the minimum sample size, surveys were mailed to 320 nurses to account for non-response, with a target enrollment of 160 nurses. In addition, 20 managers were recruited.

Data Collection and Instruments

In correlational studies, accurate measurement of variables is essential to the validity of the results. Several strategies were used. Because several of the study instruments measuring the variables were adapted from tools used with different populations, the first step was to assess the validity and reliability of the questionnaires.

A content validity assessment (CVI) of the questionnaires measuring the predictor variables (chemotherapy exposure knowledge, self efficacy for using PPE, perceived barriers to using PPE, perceived risk of harm from HD exposure, and workplace safety climate) was conducted using an online survey. Three consultants, two with expertise in HD handling, and one with expertise in occupational safety and health, scored the instruments using the following rating scale for each item: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = very relevant. Scores were dichotomized so

that items scoring 1 or 2 were considered "not relevant" and those scoring 3 or 4 were considered "relevant." The CVI was calculated using the universal agreement method (Polit, Beck, & Owen, 2007) for each item and each scale.

After the first assessment, several items were revised due to low item-CVI. Following a second evaluation, all items had a CVI of 1.0, which Polit and colleagues (2007) suggest is appropriate when five or fewer experts assess an instrument.

The instruments were pilot tested to evaluate them for internal consistency and test-retest reliability with a non-random sample of 20 oncology nurses who handle HDs. The surveys were administered twice, approximately two weeks apart, and a correlation coefficient computed for the relationship between the scores. A Cronbach's alpha measure of internal consistency was also computed. Instruments measuring most of the predictor variables performed well in the pilot study, with good to excellent internal consistency (.72-.95) and test-retest reliability (.70-.92) (See Table 3).

The scale measuring chemotherapy exposure knowledge did not perform as well in the pilot study. Internal consistency reliability was acceptable ($\alpha = .70$), but test retest reliability was only .35. Scores ranged from 10-12 in both rounds of the pilot study, but several individuals improved their scores from time one to time two, resulting in the poor test-retest reliability.

One item ("Reuse of disposable PPE makes me feel less protected") was removed from the Self Efficacy for Using PPE Scale based on low internal consistency in the pilot study (Cronbach's Alpha = .67). Removing that item from the analysis improved the internal consistency ($\alpha = .83$) and test-retest reliability of the scale ($R = .69$). Because of the small number of participants in the pilot study, the item was retained for the larger

study, with the intent to evaluate its reliability with a larger sample size. Reliability of the 7-item scale improved, but remained higher with the six items (α = .79 and .86, respectively). Therefore, results from the six-item scale were used for hypothesis testing in the final study. An overview of the revised instruments is provided in Table 2. Pilot study results are presented in Table 3. The complete study instruments are found in Appendix A.

Table 2

Overview of Study Instruments

Variables	Instrument	# Items / Scoring	Interpretation
Outcome Measures:			
Safe Handling Precaution Use	Revised Hazardous Drug Handling Questionnaire	Preparation: 6 items Administration: 5 items Disposal: 5 items Excretion: 6 items 0 = never to 5 = always Total precautions (Mean score for Admin + Disposal) Range 0-5	Higher score indicates higher use of safe handling precautions.
Predictor Variables:			
Knowledge of the Hazard	Chemotherapy Exposure Knowledge	12 items: True, False, Don't know. Items 3, 6, 8, 9, 11 are false; all others true. Correct answers=1, all others = 0. Range: 0-12 (Sum)	Higher score indicates higher knowledge
Self Efficacy	Self-efficacy for Using PPE	6 items, 1 = strongly agree to 4 = strongly disagree. Items are reverse-scored Range: 6-24 (Sum)	Higher score indicates higher self efficacy

(Table 2 Continues)

(Table 2 Continued)

Variables	Instrument	# Items / Scoring	Interpretation
Perceived Barriers	Barriers to Using PPE	13 items, 1 = strongly disagree to 4 = strongly agree. Range: 13-52 (Sum)	Higher score indicates higher perceived barriers
Perceived Risk	Risks of Chemotherapy Exposure	3 items, 1 = strongly disagree to 4 = strongly agree. Items are reverse-scored. Range: 1-4 (Mean)	Higher score indicates higher perceived risk
Organizational Influences	Workplace Safety Climate	21 items, 1 = strongly disagree to 5 = strongly agree Range: 21-105 (Sum)	Higher score indicates better safety climate
Perceived Conflict of Interest	Conflict of Interest Scale	6 items, 1 = strongly disagree to 4 = strongly agree. Range: 6-24 (Sum of items)	Higher score indicates higher conflict of interest.
Interpersonal Influences	Interpersonal Norms	4 items, importance to others of using PPE, 0 = not at all, 1 = sort of, 2 = a lot Range: 0-2 (Mean)	Higher score indicates higher belief that others think PPE is important.
	Interpersonal Modeling	3 items, frequency of others' use of PPE, 0 = never to 3 = usually Range: 0-3 (Mean)	Higher score indicates higher use of PPE by co-workers.

Table 3

Pilot Study Results: Total Scale Scores, Cronbach's Alpha and Test-Test Reliability for Predictor Variables

Scale	M (SD)	Range	Observed Range	Cronbach's Alpha	Correlation Coefficient T1 - T2*
Chemotherapy Exposure Knowledge	11.2 (.77)	0-12	10-12	.70	.35
Self Efficacy For Using PPE	22.9 (3.31)	6-24	11-24	.83	.70
Barriers to Using PPE	25.6 (5.83)	13-52	13-37	.77	.72
Risks of Chemotherapy Exposure	3.16 (.54)	1-6	2-4.5	.72	.78
Workplace Safety Climate	81.2 (16.89)	21-105	52-105	.95	.86
Conflict of Interest Scale	11.9 (4.18)	6-24	6-21	.89	.70
Interpersonal Influence	1.9 (.58)	0-3	.57-2.5	.91	.92

Note. Time 2 data collected 2 weeks after Time 1

Safe Handling Precautions Use

Nurses' use of HD safe handling precautions was measured by the **Revised Hazardous Drug Handling Questionnaire**. It is a survey developed by Martin and Larsen (2003) and adapted by Polovich and Martin (2008, February). It is based on the current guidelines for the handling of HDs (NIOSH, 2004). Following the pilot study, the instrument was further revised so that items measuring the use of protective equipment were changed from a 3-point scale (usually, occasionally, rarely) to a 5-point scale in order to capture additional variability. Additional items were added to distinguish between nurses' use of chemotherapy-designated PPE and other types of PPE. For

example, use of "other gloves" and "other gowns" (e.g. not tested for use with chemotherapy) were added.

The final instrument included 25 scored items, which are Likert-type items that indicate the frequency of PPE use (5 = Always, 4 = 76-99%, 3 = 51-75%, 2 = 26-50%, 1 = 1-25% and 0 = Never) for various handling activities. An example is "Please indicate how much of the time you use the following when administering hazardous drugs: gloves labeled for use with chemotherapy." Higher mean scores indicate higher use of safe handling precautions. Mean scores were determined for safe handling practices and PPE use for all handling activities, including drug preparation, drug administration, chemotherapy disposal, and handling of excreta. Additional items collected information such as the availability of PPE, spill kits, and safe handling policies.

Knowledge, Self-Efficacy, Barriers and Perceived Risk

Three subscales from the **Occupational Dermal Survey,** the knowledge, self-efficacy, and barriers subscales, and three items about perceived risk (Geer et al., 2007; Geer et al., 2006) were used. They were originally developed for dermal chemical exposure in the industrial setting, and were adapted for HD exposure in healthcare settings. This survey was initially developed based on a literature review of factors influencing protective behaviors for dermal chemical exposure. Content validity was demonstrated using a panel of experts in industrial hygiene, PPE and survey design. Two focus groups of industrial employees who work with chemicals reviewed the instrument for face and content validity, and then the scale was pilot tested (Geer et al., 2006).

The Chemotherapy Exposure Knowledge scale consists of 12 items with the response options of true, false, and do not know. Correct answers are scored 1 point and

all others are scored 0. The possible range of scores is 0-12. This scale had a Cronbach's alpha of .70 in the final study.

The Barriers to Using PPE scale is a 13-item Likert scale with four response options: 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Item scores are summed and higher scores indicate higher perceived barriers to PPE use. Scores have a possible range of 13-40. Cronbach's alpha was adequate (.77 in the pilot and .88 in the larger study).

The original survey had two items about perceived risk. The adapted scale included six items about perceived risk, which performed well in the pilot study (Cronbach's alpha = .72, test-retest .78). However, in the larger study, only three items had good internal consistency reliability (Items 5, 6, and 7). Each was scored 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree, and reverse scored so that higher scores mean higher perceived risk. Mean scores have a possible range of 1-4. Cronbach's alpha for the 3-item Risks of Chemotherapy Exposure scale was .70.

Organizational Influence and Perceived Conflict of Interest

Two subscales of the Healthcare Worker Questionnaire (Gershon et al., 1995; McGovern et al., 2000) were adapted for HD exposure for this study. These subscales were the Workplace Safety Climate (WSC) questionnaire and the Conflict of Interest Scale. The Healthcare Worker Questionnaire was developed to measure compliance with UP among HCWs at risk for occupational exposure to bloodborne pathogens. It has been used in several different settings, including hospitals, correctional facilities, and non-hospital based healthcare facilities (Gershon et al., 2005; Gershon, Qureshi et al., 2007; Gershon, et al., 1995). Factor analysis was used to assess the construct validity of the

Workplace Safety Climate (WSC) scale. It was tested with a sample of 789 hospital-based healthcare workers. Six organizational dimensions were determined. These are 1) PPE and engineering control equipment availability, 2) management support, 3) absences of job hindrances, 4) feedback and training, 5) cleanliness and orderliness, and 6) minimal conflict/ good communication. Minor changes were made to items to adapt them for HD handling (e.g. "chemicals" changed to "chemotherapy"). The items are scored 1 = strongly disagree to 5 = strongly agree (Gershon et al., 2000). Item scores are summed for a total WSC score. The potential range of scores is 21-105, with higher scores indicating a better safety climate. The scale was found to have adequate internal consistency in the final study ($\alpha = .93$).

Conflict of interest was measured using a 6-item scale adapted from a 4-item subscale of the Healthcare Worker Questionnaire. This subscale was originally a part of the "barriers to UP compliance" scale. Gershon (1995) reported that the reliability of the 4-item scale was ($\alpha = .72$) in a study of HCWs' use of UP. The reliability of the adapted scale was adequate ($\alpha = .89$) in both the pilot study and the larger study.

Interpersonal Influences

Interpersonal influences in the workplace, the impact of others on PPE use, was measured using an instrument adapted from McCullagh (McCullagh et al., 2002). The instrument measures two aspects of interpersonal influences, interpersonal norms and interpersonal modeling. Four items measure a person's beliefs regarding how much others (e.g. co-workers, supervisors) think they should use PPE. Response options are 0 = not at all, 1 = sort of, 2 = a lot. Three items measure how often other nurses use protective equipment (0 = never to 3 = usually). Higher scores indicate a more positive

view of co-worker's attitudes towards and use of PPE. Mean scores from the two scales are combined to obtain an Interpersonal Influence score. Internal consistency reliability of the original norms and modeling scales was .75 & .68 with farmers (McCullagh et al., 2002) and .76 & .86 (Lusk et al., 1997) with construction workers. Reliability of the interpersonal influence scale as adapted for HD handling was .91 in the pilot and .80 in the larger study.

Managers' Perspectives

The WSC Questionnaire was administered to the managers with instructions that they answer items like they thought the nurses they supervise would answer. Managers provided additional data through a telephone interview about the safety climate in their workplace and the barriers to use of HD safe handling precautions by nurses. The guide used for the semi-structured interview is in the Appendix.

Procedures

Instrument evaluation and data collection for the study began after obtaining approval from the Georgia State University Institutional Review Board. An address list was purchased from the Association of Community Cancer Centers. Three hundred nine members who identified themselves as nurses were selected for the nurse participant part of the study after sorting the list by state. Surveys were sent with a cover letter describing the importance of the study and urging nurses to participate. A token of appreciation, a $5.00 gift card, was included as an incentive. A pre-addressed, stamped envelope was provided for the return of the study instruments. Surveys were labeled with identification (ID) numbers linking them to the address of the recipient. This number was used only to track responders to identify non-responders for subsequent mailings. A thank-you

postcard was sent approximately one week after the original survey, encouraging them to respond soon. When surveys were returned, names and addresses were removed from the mailing list. Originally, there were to be multiple mailed reminders to the potential participants. However, the organization providing the mailing list rented the list for single use only. Due to budget limitations, only two mailings per participant were done. Additional members were selected from the original list to reach the planned accrual goal.

In addition to the paper study instruments, the questionnaire was made available electronically using a secure version of an online survey service. A web address was sent in the initial mailing with a link to the online survey.

Nurse surveys were returned to a post office box obtained for the study. A researcher retrieved the surveys from the post office box several times per week during the study period. The researcher recorded receipt of the survey by the ID number and deleted the participants' name and address from the mailing list.

Managers' Perspectives

Fifty-two members with titles that indicated they held manager or director positions were selected from the mailing list for the manager part of the study. Fifty were included in the initial mailing, and 2 additional were mailed to meet the accrual goal of 20. A cover letter explaining the importance of the study and encouraging them to participate was sent. A token of appreciation, a $5.00 gift card, was included as an incentive. A pre-addressed, stamped envelope was provided for a response card that indicated interest in participating. A web address was sent with a link to a website as an alternate way to respond. Letters and response cards were labeled with ID numbers

linking them to the address of the recipient. This number was used only to track responders to identify non-responders for subsequent mailings. The first fifty potential manager participants were also sent an envelope with a nurse survey and gift card, with a request that they give it to a nurse who handled chemotherapy in their workplace. A thank-you/reminder postcard was sent approximately one week after the original mailing.

Managers who responded by either mail or online were contacted by a member of the research team to schedule a telephone interview. Using telephone interviews rather than face-to-face interviews is more cost effective, less time-consuming, allows for including study participants from wide geographic areas (Waltz, Strickland, & Lenz, 2005) and reduces item non-response (Dillman, 2007). Since this plan was to include a sample of managers from across the nation, telephone interviews were the most appropriate data collection method.

Interviews were conducted using a semi-structured format, with both closed- and open-ended questions. One part of the interview included verbal administration of the WSC Questionnaire. Additional open-ended questions were used to elicit more detailed information about the concepts of interest. An d was developed to structure the interview to encourage each manager-participant to provide an answer to all of the questions. This reduced missing data.

A research assistant served as interviewer and was trained prior to conducting the interviews. An interview guide was used that included introductory information, complete instructions, the questions, and closing statements. The order of the questions was the same for all participants. Probes were provided as needed to encourage complete responses. Interviews were audio recorded for accuracy with the consent of the

participants. Most interviews were completed in approximately 30 minutes. They were scheduled at a time that was convenient to the participants.

Data Management Plan

A code book was developed to direct data entry and to determine how ambiguous data should be recorded. Data were double-entered, and compared for accuracy. A research assistant entered data into Excel, and the data were imported into Statistical Package for Social Sciences (SPSS) 17.0 (SPSS Inc., 2008). The original paper surveys will be retained for at least one year after completion of the data analysis. Back-up files of the data were made and stored after each data entry session. The final copy of the raw data will be kept by the researcher indefinitely.

The recorded interviews were transcribed verbatim using a transcriptionist. The answers to the open-ended questions comprised the text for the content analysis.

Data Analysis

Data were double entered by two members of the research team, compared for accuracy, and errors corrected. Data analysis began with standard data cleaning procedures. Patterns of missing data were determined. Missing data from predictor variables (barriers, self efficacy, workplace safety climate, conflict of interest, and interpersonal influence) were replaced with the participant scale mean only when less than 20% of the total scale data were missing. No missing data were replaced for the knowledge scale. Missing data from the outcome variable was replaced with the sample mean only when less than 20% of total scale data were missing. The reliability of the instruments was evaluated. Prior to hypothesis testing, data were assessed for normality,

outliers, and other assumptions of adequate variance, lack of multicolinearity, and homoscedasticity.

Descriptive statistics were used to characterize the distribution of the variables and the characteristics of the sample. Frequencies, means and standard deviations were determined for all continuous variables. Correlations were computed among the set of variables. A significance value of .05 was used for all statistical analyses.

Analysis for Specific Aims

The following section contains the approach to statistical analysis based on the study questions and hypotheses.

Specific Aim 1: Determine the influence of individual and organizational factors on nurses' use of safe handling precautions for nurses exposed to HD in their practice.

Hypothesis 1a: Nurses' individual characteristics (higher knowledge, higher perceived risk of harm from HD exposure, higher self-efficacy for using PPE and fewer perceived barriers to using PPE) will be associated with an increased use of HD safe handling precautions. Spearman's correlation coefficient was computed for the relationships between use of precautions and chemotherapy exposure knowledge, perceived risk, self efficacy and perceived barriers. Significant correlations in the expected direction support the hypothesis. A negative relationship between perceived barriers and precaution use was expected; all other relationships are positive.

Hypothesis 1b: Organizational factors (better workplace safety climate and interpersonal influences) will be associated with increased use of safe handling precautions. Spearman's correlation coefficient was computed for the relationships

between use of precautions, safety climate, interpersonal norms and interpersonal modeling. Positive, significant correlations support the hypothesis.

Hypothesis 1c: Nurses' individual characteristics (higher knowledge, higher perceived risk of harm from HD exposure, higher self-efficacy for using PPE, fewer barriers to using PPE) and organizational factors (better workplace safety climate and interpersonal influences) will each account for significant variance in use of safe handling precautions. Hierarchical multiple regression was performed with the individual predictor variables entered, followed by the organizational variables and examining for a significant change in R^2.

Research Question 1d: Does nurses' perceived conflict of interest (need to protect self vs. need to provide medical care) moderate the relationship between self-efficacy and use of safe handling precautions? Using hierarchical regression, in the first step, the predictor variables were entered. In the second step, an interaction term for self efficacy and conflict of interest was entered. A significant change in R^2 for the interaction term supports the hypothesis.

Secondary Aim

To determine nurse managers' perspectives on use of safe handling precautions in the workplace, both interview data and questionnaire data were analyzed. For interview data, a content analysis was used, in which the major categories of interest were derived from the theoretical model for the study. These were knowledge, self-efficacy, safety climate, perceived barriers, perceived risk, interpersonal influence, perceived conflict of interest and safe handling precautions. The categories derived from the concepts were

defined so that words and phrases could be coded to belong to only one category. Categories were added as needed based on the data.

To answer research question 2a (nurse managers' perceptions of the organizational climate for safe handling precautions), manager's responses on the WSC Questionnaire were analyzed in addition to interview data.

Protection of Human Subjects

This study involved nurses who are involved in the preparation or administration of hazardous drugs or the care of patients receiving hazardous drugs. The protocol, cover letter, manager consent, other correspondence and study instruments were approved by the Georgia State University Institutional Review Board (IRB).

Participants received a token of appreciation with the study instruments as an incentive to participate. This was a $5.00 gift certificate to a general store (Wal-Mart).

Risks to Subjects

Human Subjects Involvement and Characteristics

All study participants were RNs age 18 and over who are employed in an oncology setting and who report handling antineoplastic chemotherapy agents (preparation, administration, disposal or handling contaminated excreta) in the previous year. Participants were recruited by mail.

Sources of Data

The data obtained by this study was limited to nurse-participant responses to questionnaire items. To ensure confidentiality, no survey data contained names or personal identifiers. No protected health information was obtained. The completed surveys were mailed to a secure post office box. Twenty subjects completed the survey

instruments using a secure version of an online survey service. Responses were transferred from the paper questionnaires and the online survey to a computer file. All survey materials were secured and available only to the research team. (Note: The research team consists of the PI, the co-investigator, the research assistant, and the transcriptionist).

Managers' data were collected by telephone interview. Interviews were audio recorded with the consent of the participants. Participants were reassured that any information provided during the interview will be kept confidential. No identifiers were used that could connect the participants with their data. Recorded interviews and transcriptions were stored in a secure location in the researchers' office. Recordings were not available to anyone other than the research team.

Potential Risks

There were no known risks associated with participation in the survey. Involvement required about 15-20 minutes of time to complete the survey instruments. Providing information about their employer or place of employment may have been concerning to some participants. The cover letter assured the participants that they were free to stop the survey at any time or to skip any question for any reason.

There were no known risks associated with the managers' participation in the interview. Involvement required 30-60 minutes of time. Providing information about their place of employment may have been concerning to some participants. The consent form assured the managers that they were free to stop the telephone interview at any time or not respond to any question for any reason.

Adequacy of Protection against Risks

Data collection did not begin until IRB approval was obtained. In a cover letter sent with the survey instruments, prospective nurse-participants were informed of the study purpose, procedures, risks and benefits, confidentiality, and where to get more information. Participation in the study was strictly voluntary. Completing and returning the survey instruments constituted consent. Unique identification numbers were used only to track responders and non-responders for subsequent mailings. Names and addresses of participants were deleted from the mail list when surveys were returned. All data were entered without identifying information. The research assistant was instructed in confidentiality procedures related to handling of questionnaires.

For the managers, a consent form was sent to potential participants, which they were directed to keep for their records. Verbal consent was obtained by telephone before the interview, and participation in the interview constituted consent.

Potential Benefits of the Proposed Research to the Participants and Others

Participants received no direct benefit from participating in this study other than the token incentive and knowledge of their contribution to information about the factors that influence nurses' use of HD safe handling precautions.

With a better understanding of the factors that influence nurses' use of HD safe handling precautions, new strategies to improve nurses' workplace safety related to handling HDs may be developed.

CHAPTER IV

RESULTS

This chapter presents the results of this cross-sectional, correlational study to determine the relationships among nurses' use of HD safe handling precautions and several theoretical predictor variables (knowledge, self efficacy for PPE use, barriers to PPE use, perceived risk of harm from HD exposure, interpersonal influence, workplace safety climate, and conflict of interest); and managers' perspectives on the use of HD safe handling precautions by nurses in their workplace. A description of sample characteristics and results of hypotheses testing are reported.

Study Response Rate

Surveys were mailed to nurses from the ACCC mailing list. The overall response rate was 46%. Figure 2 provides details about the nurse survey response.

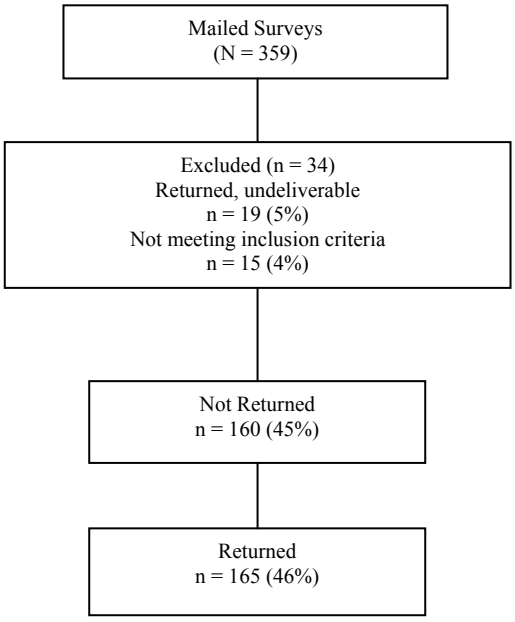

Figure 2. Response Rate for Nurse Participants

Nurse Participants

The majority of nurses were White, female and middle-aged, although ages ranged from 23-70 years. Most nurses were very experienced in nursing, oncology nursing and chemotherapy handling, reported being an ONS member, and were certified in oncology nursing. Most nurses reported practicing in outpatient settings. Nurses reported a wide range (0-400) of number of patients receiving chemotherapy per day in their practice setting (*M* = 25.0, *Mdn* = 18, *SD* = 35.2), and the average number of patients for whom they personally handled chemotherapy per day as = 6.8 (*Mdn* = 6.0, *SD* = 5.2). Table 4 summarizes the descriptive statistics for characteristics of nurse participants in the study.

Table 4

Nurse Characteristics (n = 163)

Characteristic	*M*	*(SD)*	*n*	(%)
Age (years)	46.4	9.26		
Gender				
Female			160	(98.2)
Male			3	(1.8)
Experience (years)				
Nursing	21.2	(9.25)		
Oncology	15.8	(7.59)		
Chemotherapy	15.2	(7.62)		
ONS Member *(n = 162)*				
Yes			140	(86.4)
No			22	(13.6)
Nursing Certification *(n = 159)*				
Not certified			21	(13.2)
Oncology (OCN, Advanced Oncology)			136	(85.5)
Other			2	(1.3)

(Table 4 Continues)

(Table 4 Continued)

Race / Ethnicity				
White			139	(85.3)
American Indian/Alaskan Native			2	(1.2)
Asian			7	(4.3)
Black/African American			7	(4.3)
Hispanic/Latino			2	(1.2)
Multi-cultural			4	(2.5)
Unspecified			2	(1.2)
Highest Level of Nursing Education				
Diploma			12	(7.4)
Associate Degree			49	(30.1)
Bachelor's Degree			76	(46.6)
Masters Degree			24	(14.7)
Doctoral Degree			2	(1.2)
Geographic Location *(n = 165)*				
Northeast			43	(26)
Southeast			40	(24.2)
Midwest			47	(28.5)
Southwest			10	(6.1)
West			25	(15.2)
Type of Setting				
Inpatient			24	(14.7)
Outpatient			112	(68.7)
Both			27	(16.6)
Type of Facility				
Academic health center			7	(4.3)
Community non-teaching hospital			56	(34.4)
Community teaching hospital			36	(22.1)
Private physician office			46	(28.2)
Public/government hospital			9	(5.5)
Other			9	(5.5)
Treatment Volume	*M*	*(SD)*	Range	
Number of patients per nurse	6.8	(5.2)	0-35	*Mdn* = 6
Number of patients per practice setting	25	(35.2)	0-400	*Mdn* = 18

Note: *n* varied due to missing data.

Manager Participants

The desired sample of 20 managers was obtained by mailing fifty-two letters of invitation to managers selected from the ACCC mailing list. Figure 3 provides details about the response rate for manager participants.

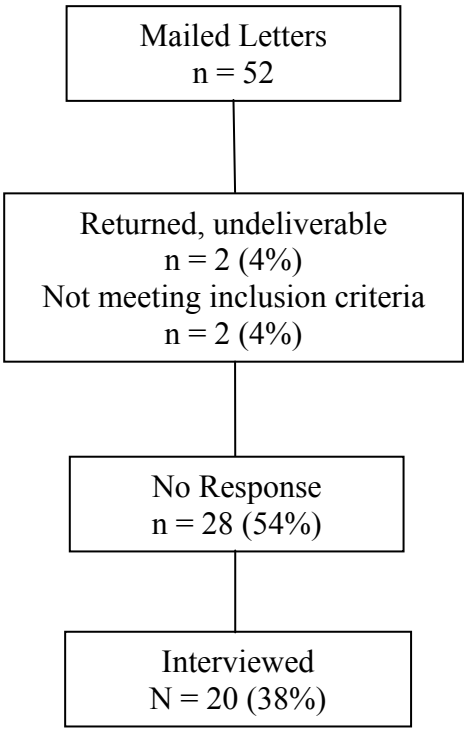

Figure 3. Response Rate for Manager Participants

One manager was a radiation therapist and the others were nurses. The majority of managers were White, female and middle-aged, although ages ranged from 30-70 years. They held titles of manager, director, and supervisor, and two identified themselves as clinical nurse specialists with management responsibilities. Managers were generally experienced in their role (1-29 years), had up to 49 years of nursing experience and were responsible for 10-300 employees (M = 55.6, SD = 63.2, Mdn = 44.5). The majority of managers worked in outpatient settings (80%) where between 2 and 450 patients received chemotherapy per day (M = 61, SD = 108.5, Mdn = 30). Table 5 summarizes the descriptive statistics for characteristics of manager participants in the study.

Table 5

Manager Characteristics (n = 20)

Characteristic	*M*	(*SD*)	*Min/Max*	n	(%)
Age (years)	48.8	(10.2)			
Gender					
Female				19	(95)
Male				1	(5)
Experience (years)					
Manager role	9.0	(8.8)	1-29		
Nursing[1]	22.4	(11.8)	0-49		
Race / Ethnicity					
White				16	(80)
American Indian/Alaskan Native				1	(5)
Black/African American				1	(5)
Other/No response				2	(10)
Geographic Location					
Northeast				6	(30)
Southeast				3	(15)
Midwest				6	(30)
Southwest				3	(15)
West				2	(10)
Type of Setting					
Inpatient				4	(20)
Outpatient				12	(60)
Both				4	(20)
Type of Facility					
Academic health center				2	(10)
Community non-teaching hospital				10	(50)
Community teaching hospital				6	(30)
Private physician office				2	(10)
Treatment Volume					
Patients per day (workplace)	61.0	(104.3)	2-450	*Mdn* = 30	

Min/Max = Observed minimum/ maximum
[1]One participant was not a nurse

Descriptive Statistics for Major Study Variables

Prior to addressing the hypotheses, data were examined for normal distribution, presence of outliers, and missing data. None of the results from the theoretical predictor

variables were normally distributed. Results for the Barriers scale and Conflict of Interest scales were positively skewed. The results for the following variables were negatively skewed: Knowledge scale, Self-Efficacy scale, Perceived Risk scale, Workplace Safety Climate scale, Interpersonal Influences scale. Data transformation did not improve the distribution. The outcome variable results were normally distributed without outliers.

Theoretical Predictor Variables

Table 6 displays the results of all of the instruments measuring the theoretical concepts, including chemotherapy exposure knowledge, self efficacy for using PPE, barriers to using PPE, perceived risk of harm from HD exposure, interpersonal influence, conflict of interest, and workplace safety climate.

Table 6

Descriptive Statistics for Theoretical Predictor Variables

Variable	*M*	*(SD)*	*Observed Range*	*Possible Range*	*Cronbach's Alpha*
Chemotherapy Exposure Knowledge	10.9	(1.07)	7-12	0-12	.70
Self Efficacy for using PPE	20.8	(2.96)	12-24	7-24	.79
Perceived Barriers	21.94	(6.50)	13-40	13-52	.88
Perceived Risk	3.14	(.58)	1.6-4	0-4	.72
Interpersonal Influence	2.21	(.44)	.5-3	0-3	.80
Conflict of Interest	1.83	(.62)	1-3.5	1-4	.89
Workplace Safety Climate	88.39	(12.03)	60-105	21-105	.93

Knowledge of the Hazard

Total scores on the Chemotherapy Exposure Knowledge scale ranged from 7-12 (M = 10.9, SD = 1.07), indicating that most nurses were fairly knowledgeable about chemotherapy exposure. The three scale items that nurses lacked knowledge about were:

"A surgical mask provides protection from chemotherapy aerosols" [false] for which 40% of nurses answered incorrectly; and "Chemotherapy cannot enter the body through contact with contaminated surfaces [false], and "Alcohol hand sanitizer is as effective as soap and water in removing chemotherapy residue" [false] which were each answered incorrectly by 15% of respondents.

Nurses reported high self efficacy for using PPE (M = 20.8, SD = 2.96), and moderate barriers to using PPE for HD handling. Four individual items on the barriers scale had mean scores at or above the midpoint of the 0-4 scale. These included the following items: PPE is uncomfortable (M = 2.4, SD .95); PPE makes me feel too hot (M = 2.6, SD 1.0); PPE interferes with job (M = 2.0, SD = .87); and others do not use PPE (M = 2.0, SD = .97).

On average nurses perceived high risk of harm from HD exposure with a mean of 3.14 on a 4 point scale. Nurses generally reported a low conflict of interest between the need to protect themselves and care for patients while handling chemotherapy.

Based on the Interpersonal Influence scales, nurses perceived that co-workers valued and used HD precautions when handling chemotherapy (M = 2.21, SD = .44). Nurses rated their employing organization's commitment to safety high, with an average total score of 88.4 (SD = 12.03) on the WSC Questionnaire.

Nurses' Use of Safe Handling Precautions

In the initial data analysis for the use of safe handling precautions two major issues were identified. First, not all nurses participated in all aspects of HD handling and the instrument for safe handling had a low reliability coefficient.

In this sample not all nurses reported all handling activities. Most nurses reported that they administered HDs (99%, *n* = 164) and disposed of HDs (93%, *n* = 154), but only 73% (*n* = 120) handled excreta and 19% (*n* = 32) prepared HDs. In order to have a sufficient sample size for hypothesis testing, the main outcome variable, total HD safe handling precautions, was measured using the scales for administration and disposal. Data related to the use of HD safe handling precautions for the preparation and handling of contaminated excreta scale are reported descriptively but not included in the total HD safe handling score.

To address the second problem of the low reliability coefficient (Cronbach's alpha <.60), the scale reliability data were examined. To improve internal consistency, items with the lowest item-to-total correlations were removed one by one, until an acceptable reliability was obtained. The items with the lowest item to total correlations were closed system transfer devices, “other gloves” (non-chemotherapy labeled) “other gowns” and re-use of disposable gowns. The 5 items remaining in each of the administration and disposal scales (10 items total) were related to use of chemotherapy gloves, double gloves, chemotherapy gowns, eye protection and respirators. The internal consistency reliability for these 10 items was adequate, with $\alpha = .83$. The mean score for these 10 items was used for the hypothesis testing. Five items make up the mean score for the excreta scale, and six items make up the mean score for HD preparation scale (the 5 above, plus use of biological safety cabinet). These data are reported descriptively.

As stated above, the total HD precaution use score was defined as the mean score for use of chemotherapy gloves, double gloves, gowns, eye protection and respirators for HD administration and disposal. Total HD precaution use was 1.9 (*SD* = 1.1). The

possible range of scores was 0-5, with an observed range of 0-5. Table 7 and 8 summarize safe handling precaution use during the four HD handling activities.

Table 7

Means Scores and Standard Deviations for Nurses' Use of Safe Handing Precautions during Various HD Handling Activities

	Preparation	Administration	Disposal	Handling excreta
	N = 32 M (SD)	N = 164 M (SD)	N = 154 M (SD)	N = 120 M (SD)
BSC	4.8 (.87)	-	-	-
Gloves	4.6 (1.2)	4.0 (1.7)	3.8 (1.9)	2.9 (2.3)
Double Gloves	1.0 (1.7)	1.2 (1.9)	1.1 (1.8)	1.3 (1.8)
Gowns	3.5 (1.9)	3.0 (2.2)	2.9 (2.2)	1.9 (2.1)
Eye Protection	1.5 (2.0)	1.3 (1.7)	1.0 (1.6)	1.2 (1.8)
Respirator	.58 (1.1)	.61 (1.1)	.59 (1.2)	.67 (1.4)
Overall Precautions	*2.7 (.76)*	*2.0 (1.1)*	*1.9 (1.2)*	*1.6 (1.3)*

Response options: 0 = Never; 1 = 1-25%; 2 = 26-50%; 3 = 51-75%; 4 = 76-99%; 5 = Always. Possible range = 0-5

Table 8

Nurses Reporting Use of HD Precautions 'Always' or 76-99% of the Time

Precaution	Preparation N = 32 n (%)	Administration N = 164 n (%)	Disposal N = 154 n (%)	Handling Excreta N = 120 n (%)
Biological Safety Cabinet	31 (97)	-	-	-
Chemotherapy Gloves	29 (90)	128 (78)	114 (74)	66 (55)
Double gloves	4 (12)	31 (19)	28 (18)	22 (18)
Chemotherapy Gowns	20 (64)	92 (56)	82 (53)	36 (30)
Eye protection	8 (25)	28 (17)	18 (12)	20 (17)
Respirator/mask	2 (6)	7 (4)	8 (5)	11 (9)

Approximately one-fifth of nurses reported that they are responsible for chemotherapy preparation. All of these nurses worked in outpatient settings, and most of them (n = 27) worked in private physician offices. HD safe handling precaution use was high for biological safety cabinets and chemotherapy gloves. Gown use was low and very few nurses used double gloves, eye protection or respirators for drug preparation.

Glove use was high for all handling activities except for handling excreta. Gown use was low for all handling activities. Double gloves, eye protection and respiratory protection were rarely used by nurses in this sample. Overall precaution use was highest for HD preparation (M = 2.7, SD = .76) and lowest for handling HD contaminated excreta (M = 1.6, SD = 1.3).

Relationships Among Nurse Characteristics, Organizational Characteristics, and Use of Safe Handling Precautions

Bivariate correlations were evaluated. Because of the non-normal variable distributions, Spearman rank correlation coefficients (r_s) were calculated and are reported in Tables 9 and 10. Chemotherapy exposure knowledge was not associated with any nurse characteristics or organizational characteristics. Higher self efficacy for PPE use was associated with more years of nursing and chemotherapy experience, higher perceived risk of harm from HD exposure, higher interpersonal influence (co-workers valued and used precautions), better workplace safety climate, lower conflict of interest and fewer barriers. Fewer barriers to safe handling practices were associated with lower conflict of interest, higher self efficacy for PPE use, higher perceived risk of harm from HD exposure, higher importance of PPE and use of PPE by co-workers, fewer patients per day per nurse, and better workplace safety climate. Lower perceived risk of harm

from HD exposure was associated with more years of chemotherapy experience. Higher perceived risk of harm from HD exposure was associated with higher importance of PPE and use of PPE by co-workers, lower conflict between the need to protect self and care for patients, and better workplace safety climate. Lower conflict of interest between the need to protect self and care for patients was associated with more years of oncology and chemotherapy experience, higher importance of PPE and use of PPE by co-workers, and better workplace safety climate.

The correlations among nurse characteristics and the theoretical predictor variables are displayed in Table 9 and correlations among the theoretical predictor variables in Table 10.

Table 9

Relationships among Nurse Characteristics, Theoretical Predictor Variables, and Total HD Precaution Use

	Chemotherapy Exposure Knowledge	Self efficacy	Barriers	Risk	Inter-personal influence	Conflict of interest	Total HD Precaution Use
Age	.15	.14	-.50	-.06	.00	.01	.06
Nursing experience[1]	.03	.21**	-.09	-.11	.10	-.08	.03
Oncology experience[1]	.03	.29**	-.13	-.15	.13	-.17*	.06
Chemotherapy experience[1]	-.00	.29**	-.14	-.17*	.14	-.19*	.08
Patients per day (per nurse)	.03	-.11	.23**	-.04	-.08	.16	-.28**

r_s = *$p < .05$, **$p < .01$ (2-tailed)

[1]Experience in years

Table 10

Relationships among Theoretical Predictor Variables

	Knowledge	Self efficacy	Barriers	Risk	Conflict of interest	Interpersonal influences
Knowledge						
Self efficacy	.03					
Barriers	-.04	-.62**				
Risk	.13	.24**	-.38**			
Conflict of interest	.07	-.52**	.68**	-.29**		
Interpersonal influences	-.08	.43**	-.51**	.13*	-.36**	
Workplace safety climate	.07	.67**	-.65**	.19**	-.58**	.40**

r_s = *$p < .05$, **$p < .01$ (1-tailed)

Hypothesis Testing

There were no significant relationships between total HD safe handling precaution use and nurse characteristics, including education level ($F_{(4,158)} = .953$, $p = .44$), age ($r_s = .06$), nursing experience ($r_s = .03$), oncology experience ($r_s = .06$), and chemotherapy experience ($r_s = .08$). Safe handing precaution use was significantly different based on facility type. Nurses in private physician offices personally handled chemotherapy for an average of 10.7 ($SD = 6.0$) patients per day compared to 4.5 – 5.0 ($SD = 2.9$-3.7) patients per day in other types of facilities. Analysis of variance and post hoc testing demonstrated that the mean patients per day was significantly higher in private physician office settings ($F_{(5,152)} = 11.8$, $p < .01$). Because there was a relationship between higher number of patients per day per nurse ($r_s = -.28$, $p < .001$) and lower total HD precaution

use, this variable was considered a covariate in further analysis. Table 11 reports the relationships between HD precaution use and the theoretical predictor variables.

Table 11
Correlations between HD Precaution Use and Knowledge, Perceived Risk, Self Efficacy, Perceived Barriers, Workplace Safety Climate and Interpersonal Influences

	Preparation precautions[1,2] N = 32	Administration precautions[2] N = 164	Disposal precautions[2] N = 154	Excretion precautions[2] N = 120	Total HD precautions[3] N = 159
Knowledge	-.19	.10	.13	.06	.12
Perceived risk	.18	.21**	.18*	.10	.21**
Self efficacy	.38*	.38**	.38**	.21*	.40**
Perceived barriers	-.42*	-.47**	-.47**	-.24**	-.48**
Workplace safety climate	.52**	.37**	.42**	.25**	.43**
Interpersonal influences	.56**	.23**	.21**	.22*	.24**

r_s = * $p < .05$ ** $p < .01$ (2-tailed)
[1]Biological safety cabinet
2Chemotherapy Gloves, double gloves, chemotherapy gowns, eye protection and respirators
[3]Precautions for administration and disposal *only*

Hypothesis 1a: Nurses individual characteristics (higher knowledge, higher perceived risk of harm from HD exposure, higher self-efficacy for using PPE and fewer perceived barriers) will be associated with an increased use of HD safe handling precautions.

Higher chemotherapy exposure knowledge was not significantly associated with higher total HD precaution use. Higher total HD precaution use was associated with higher perceived risk of harm from HD exposure ($r_s = .21$, $p < .01$); higher self efficacy for using PPE ($r_s = .40$, $p < .01$); and fewer perceived barriers to using PPE ($r_s = -.48$, $p < .01$). These findings partially support hypothesis 1a. See Table 11.

Hypotheses 1b: Organizational factors (better workplace safety climate and positive interpersonal influences) will be associated with higher safe handling precaution use.

Higher total HD precaution use was associated with better workplace safety climate (r_s = .43, p < .01), and positive interpersonal influences (r_s = .24, p < .01). These findings support hypothesis 1b. See Table 11.

Hypothesis 1c: Nurses' individual characteristics (knowledge, perceived risk of harm from HD exposure, self efficacy for using PPE, barriers to using PPE) and organizational factors (workplace safety climate and interpersonal influences) will each account for significant variance in HD safe handling precaution use. Because chemotherapy exposure knowledge was not related to total HD precaution use, it was not included in the regression model. The number of patients per day for whom nurses personally administered chemotherapy was included as a covariate.

The initial regression equation included patients per day in step one as a covariate, and perceived risk of harm from HD exposure, self efficacy for using PPE, barriers to using PPE, workplace safety climate and interpersonal influences in the second step. Only two variables (patients per day and workplace safety climate) were significant, with barriers having a larger β than workplace safety climate without being significant (p = .056). A more parsimonious model including only the significant variables was used. The number of patients per day for whom nurses personally administered chemotherapy, barriers to PPE use and workplace safety climate were significant (R^2 = .29, $F_{(2, 155)}$ = 24.6, p < .001). In the final model, fewer patients per day, fewer barriers to using PPE and better workplace safety climate were associated with higher total HD precaution use,

explaining 29% of the variance. Table 12 has the results of the hierarchical regression. Hypothesis 1c is partially supported.

Table 12

Summary of Hierarchical Regression Analysis for the Variables Predicting Use of Hazardous Drug Safe Handling Precautions (N = 159)

	B	SE	β	*t*	*p-value*
Step 1					
Constant	2.29	.139		16.5	.000
Patients per Day	-.05	.016	-.24	-3.09	.002
Step 2					
Constant	1.20	.96		1.26	.209
Patients per Day	-.03	.015	-.16	-2.23	.027
Barriers	-.05	.015	-.28	-3.06	.003
Workplace Safety Climate	.02	.008	.25	2.80	.006

Note R^2 = .06 for Step 1, p = .002; ΔR^2 = .23 for Step 2, p <.001

Research question 1d: Does nurses' perceived conflict of interest (need to protect self vs. need to provide medical care) moderate the relationship between self efficacy and safe handling precaution use?

Hierarchical regression was performed with Patients per day as a covariate in the first step, barriers to using PPE, patients per day, workplace safety climate, self efficacy for using PPE, and conflict of interest in the second step, and an interaction term between self efficacy for using PPE and conflict of interest in the third step. There was no change in R^2 following the addition of the interaction between self efficacy and conflict of interest. Therefore, conflict of interest did not moderate the relationship between self-efficacy and total HD precaution use.

Research Questions about Nurse Managers' Perceptions of Safe Handling Precautions

Research Question 2a: What are nurse managers' perceptions of the organizational climate for safe handling precautions?

Research Question 2b: For nurses they supervise, what are nurse managers' perceptions of nurses' use of safe handling precautions?

Written policies regarding HD safe handling precautions were present in 100% of workplace settings, according to the managers. All policies addressed the following aspects of chemotherapy handling: required qualifications of personnel for chemotherapy handling; required personal protective equipment for chemotherapy handling; procedures for chemotherapy disposal; procedures for transporting chemotherapy; and procedures for HD spill management. Two aspects of HD handling were not always addressed in policy. Sixteen (80%) organizations had policies that address acute exposure management, and only nine (45%) addressed health monitoring of personnel who handle HDs. Policies developed by multidisciplinary committees included all recommended elements. Policies addressed exposure management and health monitoring in organizations where safety officers and employee health professionals were included in policy development and review.

All managers reported that there were existing written policies that addressed PPE use in their organization; however, five of 20 organizations did not require staff to wear gowns during HD handling. One manager reported that gown use was not required by OSHA guidelines, when in fact gowns have been recommended by OSHA since 1986.

Most orientation programs for chemotherapy handling included classroom education and supervised practice with a preceptor. Sixty percent of managers reported using a skill checklist during orientation that included HD precautions. Five (25%) of 20 practice settings had a formal mechanism in place for ongoing monitoring of nurses' compliance with safe handling policies; ten reported using informal "spot checks" to monitor nurses' use of HD precautions; and five sites (25%) had nothing in place to monitor nurses' safe handling precaution use.

When the managers were asked why the nurses they supervised might not wear gowns or gloves for HD handling, three managers reported that there was good compliance with PPE in their setting. Other managers cited the following reasons for nurses not wearing PPE: gowns not provided by employer (5); too busy or rushed (5); gowns uncomfortable or cumbersome (4); lack of concern for exposure (4); urgent patient situations (3); lack of knowledge (3); forgetting (3); poor fitting gloves (1); concern for cost containment (1); patients' objections (1); and precautions "too extreme" (1).

One manager stated emphatically that patients object to nurses wearing gowns, because they do not understand why nurses are "afraid of a drop" of chemotherapy. Another stated that "there's noncompliance if you require gowns." One manager, who personally handled chemotherapy, admitted not wearing a gown for years because of discomfort. Another expressed that recommended precautions are too "extreme" and should be more realistic.

Managers scored 67-104 ($M = 92.7 \pm 8.6$, (potential score = 21-105; Cronbach's alpha = .92) on the WSC questionnaire, indicating a positive workplace safety climate.

Summary

This chapter presented the results of a cross-sectional, correlational study to determine the relationships among nurses' use of HD safe handling precautions and several predictor variables and managers' perspectives on the use of safe handling precautions in the workplace. A description of participants' characteristics, findings from the questionnaires and results of hypothesis testing were reported.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Chapter V presents a discussion of the study results and the conclusions regarding the hypotheses. This chapter concludes with a discussion of the limitations, implications for practice, theory development and future research.

This study adds to the limited body of knowledge about factors influencing the use of HD safe handling precautions. Previous studies have focused on the frequency of HD precaution use and some individual factors that are associated with HD safe handling precaution use. This study was not the first to study organizational factors influencing HD safe handling precaution use, but it is only the second to measure their impact on use of HD handling precautions. In a study over 15 years ago, Valanis and others (1991) reported that the presence of hospital policies increased HCW's use of HD safe handling precautions. The use of HDs has become more widespread with administration in different settings and for non-oncology indications, such as the autoimmune disorders rheumatoid arthritis, lupus nephritis, and multiple sclerosis, increasing the importance of promoting the use of safe handling precautions in all settings where HDs are given.

Evaluation of HD Safe Handling Precaution Use

Overall, in this sample of nurses who were knowledgeable about HD use, experienced in handling chemotherapy, confident in how to use safe handling

precautions, and who perceived HD exposure to be a risk to their health, use of HD safe handling precautions was low. Every HD handling activity represents an opportunity for exposure, and when precautions are not used, the likelihood of exposure increases. The most frequently used precaution was biological safety cabinets for HD preparation and in this sample most nurses were not involved in preparing HD for administration. The second most frequently used precaution was wearing chemotherapy gloves for most handling activities. Although these precautions are important, they are insufficient to prevent HD exposure in all situations. As exposure increases, the chance for adverse health outcomes increases. Currently, few organizations have programs for monitoring health effects of HD exposure, which was consistent with reports from managers in this study, making the adverse health effects from HD exposure less likely to be recognized and documented. This differs from other health threats in the workplace such as hepatitis B exposure, tuberculosis exposure, and radiation exposure, where health care workers are monitored regularly. Without data on the exposure to HDs, the full impact of this exposure may not be realized. Routine medical surveillance of nurses involve in HD handling activities could provide important data about exposure.

In testing the model relationships, individual nurse characteristics were not associated with HD safe handling precaution use, whereas organizational characteristics were. This has important implications since factors in the workplace environment seem to be the most salient concepts affecting safe handling practices. An unexpected finding was that a higher number of patients per day per nurse was associated with lower use of HD safe handling precautions.

Several authors (Geer et al., 2006; Mahon et al., 1994; Valanis et al., 1991; Valanis & Shortridge, 1987) have reported that workers cite time pressure or lack of time as one of the barriers to PPE use across occupational settings. Based on the findings in this study, that seems to be an accurate assessment. The number of patients assigned to a nurse in a day, an objective measure of workload, interfered with HD precaution use. The lack of time was also a reason cited by managers in this study about reasons why nurses may not use PPE for HD handling in their setting.

Not only has chemotherapy administration moved to outpatient settings over the last twenty years, but treatment has also migrated away from hospitals to physician private practices. In this study, nurses working in physician private practice settings cared for the highest numbers of patients per day—twice that of nurses working in other settings. It is important to determine the optimal workload for nurses handling chemotherapy that allows sufficient time for use of safe handling practices. The number of patients assigned to a nurse each day for administration of HD is a workplace characteristic over which nurses have little control. Managers of nurses where chemotherapy is handled must carefully consider workload, not only for safe patient care, but also to reduce interference with nurses' use of HD safe handling precautions.

The use of HD safe handling precautions while handling contaminated excreta was the poorest, with nurses reporting overall use of PPE less than 50% of the time. Since Universal Precautions (UP) also require barrier precautions for handling blood and body fluids, this low compliance is difficult to explain. Although most nurses administered and disposed of HD routinely, the overall use of safe handling precautions was lower for

administration of HD than for preparation of HD which few nurses were involved in, and lower still for disposal and handling patient excreta. The low use of HD safe handling precautions in handling patient excreta may be due to a reduced concern for exposure because of perceptions about the lower concentration of HDs in body fluids. In ambulatory settings, it may be that excreta handling is not required as frequently, since patients are more likely to toilet independently. PPE may not be conveniently located to facilitate ease of use. Poor use of HD safe handling precautions for handling excreta may be related to lack of knowledge about drug residue in excreta, but that is unknown in this sample since the Chemotherapy Exposure Knowledge scale did not measure knowledge about contaminated excreta. Another possible explanation is that this aspect of HD handling may not emphasized in education in these settings.

Individual Predictors

Chemotherapy exposure knowledge was not related to use of HD safe handling precautions. In this study, the lack of relationship between knowledge and the other theoretical predictor variables is likely due to the lack of variance in this factor. The vast majority of the nurses answered all of the questions correctly. This indicates that the knowledge scale used may need to be revised to better discriminate chemotherapy exposure knowledge levels. However, even with this high knowledge level, HD safe handling precaution use was poor, indicating that knowledge alone is insufficient to ensure HD precaution use.

These findings concerning the relationship between knowledge and precaution use are inconsistent with earlier studies. Ben Ami and colleagues (2001) found that

failure to comply with HD safe handling precautions was related to lack of education and Harrison found improved use of precautions following education (Harrison, et al., 1996). The study samples were obtained from one or two institutions, and one study was set in Israel. Since both of the previous studies were conducted some time ago, it may be that HCW knowledge about chemotherapy exposure has improved over the years. The current study had representation from all regions in the U.S. which is more representative than several earlier studies about HD use (Mahon et al., 1994; Stajicj et al., 1986; Valanis et al., 1991).

Although nurses' perceived risk of harm from HD exposure was related to higher total HD precaution use, it was not a predictor in the final regression model. Interestingly, lower perceived risk of harm from HD exposure was associated with more years of chemotherapy experience. It is unclear if more years of experience was related to a decreased concern about the occurrence of exposure or a decreased concern about the potential adverse outcomes of exposure. Lower perceived risk of harm from HD exposure was associated with lower gown use in a previous study (Martin, 2006). Other authors (Gershon et al., 1995; Levin, 1999) have reported a positive relationship between perceived risk and UP use. Those findings were based on simple correlations and not tested with more advanced statistical tests incorporating multiple variables.

Nurses were more confident about their ability to use HD safe handling precautions with more years of experience and when their co-workers valued and used precautions. Self efficacy for using PPE was higher for nurses who reported better workplace safety climate and fewer barriers to using PPE, but higher self efficacy for

using PPE was not associated with HD safe handling precaution use in the final model. Factors in the workplace were more salient for nurses' use of HD safe handling precautions. Self efficacy may be a more important concept for behaviors where individuals have more control over the situation.

Nurses reported lower conflict of interest between protecting self and providing patient care when their co-workers valued and used precautions and when they worked in a better workplace safety climate. Nurses who did not perceive a conflict between their own safety and patient needs reported higher total HD precaution use. In a study of UP use (Gershon et al., 1995), workers who reported high levels of conflict of interest between caring for themselves and their patients were half as likely to use UP as those who reported low conflict levels. This was the first study to measure the effect of conflict of interest on HD safe handling precaution use, although it's influence was suggested in two early studies (Valanis et al., 1991; Valanis & Shortridge, 1987). Although conflict of interest between self protection and caring for patients did not account for any variance in HD precaution use in this sample, lower conflict of interest was associated with a better workplace safety climate, more confidence in using PPE, and fewer barriers. This may be additional evidence that a strong emphasis on workplace safety may convey that the health and safety of the nurse (worker) is as important as the patient's care. Safety climate and interpersonal influences reflect workplace influences on behavior. The study findings suggest that actions and attitudes of co-workers and other workplace issues can influence whether or not nurses experience a conflict between protecting themselves from HD exposure and providing patient care.

Organizational Factors

This study is the first to investigate the relationship between workplace safety climate and HD safe handling precaution use. A better workplace safety climate was associated with better HD safe handling precaution use by nurses. This finding is similar to Gershon's findings in studies of UP compliance in hospitals and other HCW populations (Gershon et al., 2000; Gershon et al., 2004). Only barriers to using PPE had a stronger association with HD precaution use.

Initially, it was assumed that nurses in the sample would be responsible for all HD handling activities except for HD preparation. Previous studies have not always asked nurses to respond about whether they perform these functions, and thus measured more general use of safe handling precautions. In this study, precaution use varied with the handling activity, suggesting that nurses may consider the activities separately when deciding whether or not to use protective equipment. While NIOSH recommends a "universal precautions approach" to HD handling (2004, p. 31), this has not happened.

Few nurses in the current study sample prepared chemotherapy, but precaution use for preparing chemotherapy was better than for other handling activities. Our findings clearly indicate that precaution use for HD administration, disposal and handling of contaminated excreta is below recommendations and this must be addressed.

This study included the manager's perspectives of the organizational safety climate. Managers reported that their organizations have policies related to HD safe handling precautions; however, the policies were not always reflective of the scope of the current OSHA, ONS, ASHP, and NIOSH recommendations. Some managers indicated

that HD safe handling policies had been developed by an interdisciplinary group, and those policies addressed all recommended safe handling precautions. Interdisciplinary safety committees are a characteristic of organizations where worker safety is valued, and reflects a better workplace safety climate.

Limitations of the Study

The study findings must be considered in the context of some limitations. The first limitation is related to the representativeness of the sample. The sample size was adequate to power the study; however, the sample may not be representative of all nurses handling chemotherapy. Participants were recruited using the ACCC membership list with the plan to recruit both ONS and non-ONS members. Despite this strategy, 86% of study respondents reported being ONS members, whereas it is estimated that only 50% of oncology nurses belong to ONS. While the age and racial diversity of the sample was similar to that of nurses in the U.S., men were underrepresented. A large number of study participants were certified in Oncology Nursing, which may make their responses different from non-oncology certified nurses.

The second limitation relates to the study instruments. Since several of the questionnaires were adapted for the study, this is the first time they have been used in nurses responsible for HD handling. The Chemotherapy Exposure Knowledge questionnaire requires further refinement so that it can distinguish between levels of knowledge related to the concept. There are no questions related to exposure to contaminated excrement, for example, since the instrument was originally developed for chemical exposure in industrial settings where workers do not handle excreta. Low

knowledge about the potential for HD exposure related to handling excreta may have helped to interpret the poor HD safe handling precaution use for that handling activity. The perceived risk scale did not measure some potentially important aspects or risk, such as immediacy and frequency of adverse outcomes. The conflict of interest scale has only been used in two studies, and should be tested in larger samples to establish validity and reliability.

Strengths of the Study

This study had several strengths. First, it used a national sampling frame to increase representativeness of the sample of oncology nurses handling chemotherapy. Second, this study was the first to evaluate relationships between organizational factors and nurses' use of HD safe handling precautions. Third, no other study to date has included the managers of nurses who handle HDs. While the sample of managers was small, the results provide a unique perspective about the impact of workplace safety climate on nurses' use of HD safe handling precautions. Finally, this study adds to the knowledge about nurses' use of HD safe handling precautions by moving beyond a descriptive design to a correlational design, which represents an advancement in the understanding of the phenomenon.

Implications for Practice

As the use of antineoplastic and other HDs increases, more nurses are potentially exposed as they provide patient care. Based on the study findings, the workplace climate created by the organization is very important in the routine activities of nurses. This indicates a very different focus for efforts to improve nurses' HD precaution use.

Managers need to be versed in the HD handling safety requirements in order to develop and support safe handling policies. In this study, not all managers were familiar with current recommendations for HD safe handling. Some managers minimized the importance of nurses complying with HD safe handling precautions, and few had a formal mechanism in place to monitor nurses' use of PPE.

Current strategies to improve HD precaution use have stressed education to increase chemotherapy exposure knowledge. Nurses must be knowledgeable about the potential adverse outcomes from HD exposure and how to prevent exposure. Education is a necessary component for precaution use, especially for nurses new to chemotherapy handling. However, even nurses who are knowledgeable and confident in their ability to use HD safe handling precautions may not always use safe handling precautions without specific expectations in the work setting. Much of the previous research has focused on the influence of individual nurse characteristics on whether nurses used safe handling precautions instead of the influence of the workplace. We know from research in UP that the workplace has a strong influence (Gershon et al., 2000; Gershon et al., 1999; Gershon et al., 1995) and this is a fruitful area of inquiry.

Findings from this study indicate that because circumstances in the workplace interfere with use of precautions, organizational factors must be considered if HD safe handling precaution use is to improve. Three specific factors—barriers to using PPE, workplace safety climate and patients per day—are organizational factors that are related to and likely to have an impact on use of HD safe handling precautions.

One barrier to HD precaution use is availability of PPE. Nurses cannot use PPE unless it is available, and providing PPE that is appropriate to a hazard is the employers' responsibility. Supervisory personnel may be unaware of the need for precautions or may not support precaution use. Adequate supplies of gowns, gloves, and other protective equipment must be provided and its use must be encouraged (DeJoy et al., 1995; DeJoy et al., 2000; Moore et al., 2005).

Encouragement for using PPE is a component of workplace safety climate. Studies in other populations have reported the definite influence of supervisors providing positive feedback and reinforcement for safe practices (Dejoy, Gershon et al., 2004; Grosch, Gershon, Murphy, & DeJoy, 1999; Dov Zohar, 2002). Nurses must not be sent actual or implied messages to limit PPE use, which is negative reinforcement for precaution use. Our findings suggest that supervisors' support for and encouragement of HD precautions will increase their use.

Budget and staffing may interfere with consistent HD safe handling precaution use. Since patient care workload impacts nurses' use of precautions, the number of patients assigned to a nurse is an important consideration. This may create a conflict for organizations, since staffing ratios have an economic impact on the organization. Nurses caring for patients receiving chemotherapy should not be too busy to take time to protect themselves from HD exposure. This study provides evidence for the influence of nurse-patient ratio on nurse safety.

Implications for Theory Building

Based on these study findings, the model components are insufficient to explain HD safe handling precaution use. In this study, nurses' individual characteristics were not associated with HD safe handling practices, as proposed in the PHDP model. It may be that the individual nurse characteristics have an indirect relationship with HD safe handling precaution use, but this was not evaluated. Future research with larger samples, using more sophisticated statistical analysis such as structural equation modeling may be helpful in elucidating relationships.

This model was adapted from one used to explain workers' use of hearing protection. There are differences in that use of hearing protection devices requires only the insertion of ear plugs or the use of ear muffs. Use of HD safe handling precautions is more complicated in that it requires selecting several pieces of protective equipment from among different types designated for different purposes (e.g. blood and body fluids precautions or HD protection). Eye and respiratory protection are cumbersome and uncomfortable. Additionally, HD precaution use occurs in the context of caring for patients, so is not a fully independent activity. These may be reasons why the influencing factors differ with the specific type of self-protective behavior.

Further study in larger samples may identify additional variables and relationships. Different theories related to motivation or theories of organizational behavior may be more useful in addressing HD safe handling practices.

Implications for Research

The findings of this study suggest several suggestions for future investigation. First, this study should be replicated using a larger, more representative sample of chemotherapy nurses. Little is known about HD precaution use among non-ONS members, since most studies have not included these nurses. It remains an unanswered question.

Secondly, additional research is needed to discover other factors that are relevant to HD precaution use, since the factors in PHDP model were inadequate. Continued model development using path analysis and structural equation modeling may refine the relationships among the predictors.

Since fewer barriers to using HD safe handling precautions were a strong predictor of safe handling precaution use, future research should address ways of reducing barriers. Some identified barriers that interfere with HD precaution use are related to the discomfort of wearing PPE are difficult to overcome; however, involving staff members in the evaluation and selection of PPE may be one effective strategy.

Managers of nurses who handle HDs are an appropriate population for further study, since they can have a strong influence on nursing practice in their setting. The impact of positive reinforcement of HD safe handling precaution use by supervisors should be evaluated. This type of intervention has not been studied in HD safe handling, and may provide useful information. In addition, managers may identify opportunities for improvement in PPE use by implementing systematic methods of evaluation of HD safe

handling precautions that includes checklists as well as random observations of nurses' practice on their units.

Conflict of interest is a concept unique to HCWs that has not been fully explored. Two early studies suggested that conflict of interest may interfere with HD safe handling precaution use (Valanis et al., 1991; Valanis & Shortridge, 1987). The managers in this study listed "urgent patient situation" and "patient objections" as reasons nurses may not use PPE, which are indications that the concept is relevant in this population. Its effects on precaution use should be further studied in oncology nursing. The scale that was used in this study to measure the concept requires additional development.

Finally, since HD precaution use other than gloves is below current recommendations, it is essential to evaluate both the occurrence of exposure and its biological effects. There is currently no registry of data connecting nurses' exposure history and health outcomes. A longitudinal, epidemiological study of oncology nurses, comparing HD-exposed and unexposed nurses, is essential to quantify the occurrence of adverse effects from HD exposure. Studies that include objective measures of HD exposure, for example using urine samples, may be helpful in identifying the extent of exposure. New methods of evaluating the biological consequences of occupational exposure to HDs are essential.

Conclusions

This study adds to the body of literature regarding oncology nurses' use of HD safe handling precautions. Nurses have often been held entirely responsible for their own practice, including the use of HD safe handling precautions. These study findings

emphasize the influence that organizations have on nurse's adoption of self-protective behaviors; it is clear that safe practice is a shared responsibility between employers and nurses.

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APPENDIX A

Institutional Review Board Approval

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
Atlanta, Georgia 30302-3999

In Person: Alumni Hall
30 Courtland St, Suite 217

Phone: 404/413-3500

Fax: 404/413-3504

November 25, 2008

Principal Investigator: Clark, Patricia

Protocol Department: B.F. Lewis School of Nursing

Protocol Title: Nurses' Use of Hazardous Drug Safe Handling Precautions

Submission Type: Protocol H09149

Review Type: Expedited Review

Approval Date: November 20, 2008

Expiration Date: November 19, 2009

The Georgia State University Institutional Review Board (IRB) reviewed and approved the above referenced study and enclosed Informed Consent Document(s) in accordance with the Department of Health and Human Services. The approval period is listed above.

Federal regulations require researchers to follow specific procedures in a timely manner. For the protection of all concerned, the IRB calls your attention to the following obligations that you have as Principal Investigator of this study.

1. When the study is completed, a Study Closure Report must be submitted to the IRB.

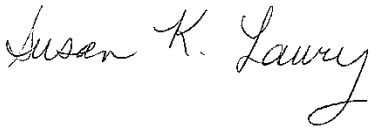
2. For any research that is conducted beyond the one-year approval period, you must submit a Renewal Application 30 days prior to the approval period expiration. As a courtesy, an email reminder is sent to the Principal Investigator approximately two months prior to the expiration of the study. However, failure to receive an email reminder does not negate your responsibility to submit a Renewal Application. In addition, failure to return the Renewal Application by its due date must result in an automatic termination of this study. Reinstatement can only be granted following resubmission of the study to the IRB.

3. Any adverse event or problem occurring as a result of participation in this study must be reported immediately to the IRB using the Adverse Event Form.

4. Principal investigators are responsible for ensuring that informed consent is obtained and that no human subject will be involved in the research prior to obtaining informed consent. Ensure that each person giving consent is provided with a copy of the Informed Consent Form (ICF). The ICF used must be the one reviewed and approved by the IRB; the approval dates of the IRB review are stamped on each page of the ICF. Copy and use the stamped ICF for the coming year. Maintain a single copy of the approved ICF in your files for this study. However, a waiver to obtain informed consent may be granted by the IRB as outlined in 45CFR46.116(d).

All of the above referenced forms are available online at https://irbwise.gsu.edu. Please do not hesitate to contact Susan Vogtner in the Office of Research Integrity (404-413-3500) if you have any questions or concerns.

Sincerely,



Susan Laury, IRB Chair

Federal Wide Assurance Number: 00000129

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999 In Person: Alumni Hall
Atlanta, Georgia 30302-3999 30 Courtland St, Suite 217
Phone: 404/413-3500
Fax: 404/413-3504

November 19, 2009

Principal Investigator: Clark, Patricia

Protocol Department: B.F. Lewis School of Nursing

Protocol Title: Nurses' Use of Hazardous Drug Safe Handling Precautions

Funding Agency: Oncology Nursing Society Foundation

Submission Type: Continuing Review #1 for H09149

Review Type: Expedited Review

Approval Date: November 19, 2009

Expiration Date: November 18, 2010

The Georgia State University Institutional Review Board (IRB) reviewed and approved the above referenced study and enclosed Informed Consent Document(s) in accordance with the Department of Health and Human Services. The approval period is listed above.

Federal regulations require researchers to follow specific procedures in a timely manner. For the protection of all concerned, the IRB calls your attention to the following obligations that you have as Principal Investigator of this study.

1. When the study is completed, a Study Closure Report must be submitted to the IRB.

2. For any research that is conducted beyond the one-year approval period, you must submit a Renewal Application 30 days prior to the approval period expiration. As a courtesy, an email reminder is sent to the Principal Investigator approximately two months prior to the expiration of the study. However, failure to receive an email reminder does not negate your responsibility to submit a Renewal Application. In addition, failure to return the Renewal Application by its due date must result in an automatic termination of this study. Reinstatement can only be granted following resubmission of the study to the IRB.

3. Any adverse event or problem occurring as a result of participation in this study must be reported immediately to the IRB using the Adverse Event Form.

4. Principal investigators are responsible for ensuring that informed consent is obtained and that no human subject will be involved in the research prior to obtaining informed consent. Ensure that each person signing the written informed consent form (ICF) is given a copy of the ICF. The ICF used must be the one reviewed and approved by the IRB; the approval dates of the IRB review are stamped on each page of the ICF. Copy and use the stamped ICF for the coming year. Maintain a single copy of the approved ICF in your files for this study.

All of the above referenced forms are available online at https://irbwise.gsu.edu. Please do not hesitate to contact Susan Vogtner in the Office of Research Integrity (404-413-3513) if you have any questions or concerns.

Sincerely,

Susan K. Laury

Susan K. Laury, IRB Chair

Federal Wide Assurance Number: 00000129

APPENDIX B

Informed Consent

Georgia State University
Byrdine F. Lewis School of Nursing
Informed Consent

Title: Nurses' Use of Hazardous Drug Safe Handling Precautions
Principal Investigators: Patricia Clark
Student Investigator Martha Polovich

I. Purpose:

You are invited to take part in a research study. The purpose of the study is to learn about the factors that affect nurses' use of safety precautions when handling chemotherapy. You are invited to be in the study because you are a manager of nurses who handle chemotherapy. As many as twenty managers will be asked to be in this study. The study will require about 45 minutes of your time.

II. Procedures:

If you are willing to take part in this research study, a study assistant will call you to ask you some questions. The questions will be about your work place, and about how the nurses in your workplace feel about chemotherapy safety precautions. You will also be asked some general questions about yourself. The telephone interview will be done at a time that is convenient for you. The interview will last about thirty to forty-five minutes and will be tape recorded. The recording will be transcribed. No one except the research team and transcriptionists will hear the tapes.

III. Risks:

In this study, you will probably not have any more risks than you would in a normal day of life. However, it is possible that talking about your workplace may cause you to be upset. You are free to stop the interview or refuse to answer any question at any time or seek counseling at your own expense. However, Georgia State University and the Oncology Nursing Society Foundation have not set aside funds to pay for care.

IV. Benefits:

Being in this study will not benefit you personally. We want to gain information about the nurses who handle chemotherapy and the places where they work. This study may help reduce chemotherapy exposure for nurses in the future.

V. Voluntary Participation and Withdrawal:

Taking part in research is voluntary. You have the right not to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop being in the study at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:

We will keep your records private to the extent allowed by law. We will use a study number rather than your name on study records and tapes. Only the research team and the persons transcribing the tapes will

Consent Form Approved by Georgia State University IRB November 25, 2008 - November 19, 2009

APPENDIX C

Study Instruments

Thank you for agreeing to participate in this study of nurses who handle chemotherapy. "Handling" refers to chemotherapy preparation, administration, disposal, and coming into contact with patient's excreta that may be contaminated with chemotherapy.

- By **preparation**, we mean transferring chemotherapy drugs from vials or ampoules to syringes or IV containers.
- By **administration**, we mean giving chemotherapy to patients by IV, injection, orally, etc.
- By **disposal**, we mean discarding equipment used in chemotherapy preparation or administration.
- By handling **excreta**, we mean emptying bedpans, urinals or emesis basins.

Do you personally handle chemotherapy at work, either chemotherapy **preparation** or **administration**?

☐ Yes

☐ No → If you answered "No" **STOP HERE** and return the questionnaire.

If you answered "Yes":

1. Please enter the ID number that is printed on the study letter:
2. Please read each item carefully
3. Place a check in the box next to your selection from the list of options
4. Please answer all of the questions that apply to your chemotherapy handling.

ID Number				

Section 1

Select one answer to each of the following statements about chemotherapy **exposure**.

	True	False	Don't Know
1. Chemotherapy can enter the body through breathing it in	☐	☐	☐
2. Chemotherapy can enter the body through ingesting it	☐	☐	☐
3. Chemotherapy cannot enter the body through contact with contaminated surfaces	☐	☐	☐
4. Chemotherapy can enter the body through contact with spills and splashes	☐	☐	☐
5. Chemotherapy gas and vapor in air can enter the body through skin and mucous membranes	☐	☐	☐
6. Oral forms of chemotherapy do not have the potential to be absorbed	☐	☐	☐
7. Chemotherapy in liquid form can be absorbed through the skin	☐	☐	☐
8. A surgical mask provides protection from chemotherapy aerosols	☐	☐	☐
9. All types of gloves provide the same level of protection	☐	☐	☐
10. Chemotherapy can more easily enter the body through damaged skin	☐	☐	☐
11. Alcohol hand sanitizer is as effective as soap and water in removing chemotherapy residue	☐	☐	☐
12. Chemotherapy can enter the body through contaminated foods, beverages, or cosmetics	☐	☐	☐

Section 2

Indicate your level of agreement with each of these statements about using personal protective equipment (PPE) when handling chemotherapy.

SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree:

	SA	A	D	SD
1. I am confident that I can use PPE properly	☐	☐	☐	☐
2. I am confident that I can protect myself from chemotherapy exposure	☐	☐	☐	☐
3. I am given enough information on how to protect myself from chemotherapy exposure	☐	☐	☐	☐
4. My supervisor goes out of his/her way to make sure I am protected	☐	☐	☐	☐
5. Reuse of disposable PPE makes me feel less protected	☐	☐	☐	☐
6. I am provided with the best available PPE	☐	☐	☐	☐
7. My supervisor goes out of his/her way to make sure I am provided with proper fitting PPE	☐	☐	☐	☐

Section 3

Does your workplace have written policies and/or procedures for handling chemotherapy?

☐ Yes

☐ No

Where is chemotherapy prepared in your workplace?

Pharmacy	☐
Drugs are delivered to the infusion area (prepared in an off-site location)	☐
Specially designated **room** separate from the patient care area	☐
Area within the patient treatment area / room	☐
Other (specify) _____	☐

What personal protective equipment is **available** for performing the following chemotherapy handling activities? Check all that apply.

	Gloves	Gowns	Eye Protection	Respirator/ Mask
Preparation	☐	☐	☐	☐
Administration	☐	☐	☐	☐
Handling Excreta	☐	☐	☐	☐
Disposal	☐	☐	☐	☐
Cleaning Spills	☐	☐	☐	☐

Section 4 Chemotherapy Preparation:

Are you responsible for preparing chemotherapy?

☐ Yes ☐ No → If you answered "No" **proceed to Section 5.**

Complete this section ONLY if you prepare chemotherapy drugs.

What type of gloves do you wear while preparing chemotherapy?

None	☐
Chemotherapy designated gloves	☐
Vinyl (polyvinyl chloride, PVC)	☐
Latex examination gloves	☐
Sterile surgical gloves	☐
Other (specify) _____	☐

What type of protective clothing do you wear while preparing chemotherapy?
(Check all that apply.)

None	☐
Chemotherapy-designated gown	☐
Personal lab coat	☐
Lab coat provided by office	☐
Cloth gown	☐
Isolation gown	☐
Other (specify) _____	☐

Please indicate how much of the time you use the following while **preparing chemotherapy**:

	Always	76-99%	51-75%	26-50%	1-25%	Never
Biological Safety Cabinet	☐	☐	☐	☐	☐	☐
Closed system transfer device	☐	☐	☐	☐	☐	☐
Gloves labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gloves (e.g. vinyl)	☐	☐	☐	☐	☐	☐
Double gloves	☐	☐	☐	☐	☐	☐
Gowns labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gowns (e.g. cloth)	☐	☐	☐	☐	☐	☐
Do you re-use disposable gowns?	☐	☐	☐	☐	☐	☐
Eye protection	☐	☐	☐	☐	☐	☐
Respirator/mask	☐	☐	☐	☐	☐	☐

Section 5 Chemotherapy Administration:

Are you responsible for administering chemotherapy?

☐ Yes ☐ No → If you answered "No" **proceed to Section 6.**

Complete this section ONLY if you administer chemotherapy.

What type of gloves do you wear while administering chemotherapy?

None	☐
Chemotherapy designated gloves	☐
Vinyl (polyvinyl chloride, PVC)	☐
Latex examination gloves	☐
Sterile surgical gloves	☐
Other (specify) _____	☐

What type of protective clothing do you wear while administering chemotherapy?

Check all that apply.

None	☐
Chemotherapy-designated gown	☐
Personal lab coat	☐
Lab coat provided by office	☐
Cloth gown	☐
Isolation gown	☐
Other (specify) _____	☐

Please indicate how much of the time you use the following while **administering chemotherapy**

	Always	76-99%	51-75%	26-50%	1-25%	Never
Closed system transfer device	☐	☐	☐	☐	☐	☐
Gloves labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gloves (e.g. vinyl)	☐	☐	☐	☐	☐	☐
Double gloves	☐	☐	☐	☐	☐	☐
Gowns labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gowns (e.g. isolation)	☐	☐	☐	☐	☐	☐
Do you re-use disposable gowns?	☐	☐	☐	☐	☐	☐
Eye protection	☐	☐	☐	☐	☐	☐
Respirator/mask	☐	☐	☐	☐	☐	☐

Section 6 Chemotherapy Disposal:

Are you responsible for disposing of chemotherapy?

☐ Yes ☐ No → If you answered "No" **proceed to Section 7.**

Complete this section ONLY if you dispose of chemotherapy.

Please indicate how much of the time you use the following when **disposing of chemotherapy**:

	Always	76-99%	51-75%	26-50%	1-25%	Never
Gloves labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gloves (e.g. vinyl)	☐	☐	☐	☐	☐	☐
Double gloves	☐	☐	☐	☐	☐	☐
Gowns labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gowns (e.g. isolation)	☐	☐	☐	☐	☐	☐
Do you re-use disposable gowns?	☐	☐	☐	☐	☐	☐
Eye protection	☐	☐	☐	☐	☐	☐
Respirator/mask	☐	☐	☐	☐	☐	☐

Section 7 Handling Contaminated Excreta:

Are you responsible for handling chemotherapy-contaminated excreta?

☐ Yes ☐ No → If you answered "No" **proceed to Section 8.**

Complete this section ONLY if you handle chemotherapy-contaminated excreta.

Please indicate how much of the time you use the following when **handling excreta:**

	Always	76-99%	51-75%	26-50%	1-25%	Never
Gloves labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gloves (e.g. vinyl)	☐	☐	☐	☐	☐	☐
Double gloves	☐	☐	☐	☐	☐	☐
Gowns labeled for use with chemotherapy	☐	☐	☐	☐	☐	☐
Other gowns (e.g. isolation)	☐	☐	☐	☐	☐	☐
Do you re-use disposable gowns?	☐	☐	☐	☐	☐	☐
Eye protection	☐	☐	☐	☐	☐	☐
Respirator/mask	☐	☐	☐	☐	☐	☐

Section 8

Are chemotherapy **spill kits** available in your work area? ☐ Yes ☐ No

During the most recent chemotherapy spill in your workplace, did you use the materials in the spill kit? ☐ Yes ☐ No ☐ N/A

Please write the name of three chemotherapy drugs that you handle most frequently:

_____

_____

_____

Section 9

Indicate your level of agreement with each of the following statements.

SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree:

Some reasons that I may not wear PPE regularly when handling chemotherapy are:	SA	A	D	SD
1. I don't think PPE is necessary	☐	☐	☐	☐
2. I don't think PPE works	☐	☐	☐	☐
3. I don't have the time to use PPE	☐	☐	☐	☐
4. I was not trained to use PPE	☐	☐	☐	☐
5. PPE is uncomfortable to wear	☐	☐	☐	☐
6. PPE makes it harder to get the job done	☐	☐	☐	☐
7. PPE is not always available	☐	☐	☐	☐
8. Others around me don't use PPE	☐	☐	☐	☐
9. There is no policy requiring PPE	☐	☐	☐	☐
10. People would think I am overly cautious	☐	☐	☐	☐
11. It is hard to get chemotherapy-designated PPE	☐	☐	☐	☐
12. PPE is too expensive to use it all the time	☐	☐	☐	☐
13. PPE makes me feel too hot	☐	☐	☐	☐

Section 10

Indicate your level of agreement with each of the following statements about the risks of chemotherapy exposure.

SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree:

	SA	**A**	**D**	**SD**
1. Exposure to chemotherapy is a serious problem at work	☐	☐	☐	☐
2. I am concerned about chemotherapy exposure at work and how it might affect my health	☐	☐	☐	☐
3. Compared to co-workers, my chance of harm from chemotherapy exposure is lower	☐	☐	☐	☐
4. If exposed to chemotherapy, there is a real chance that I might experience bad effects	☐	☐	☐	☐
5. Chemotherapy exposure is not as harmful as some people claim	☐	☐	☐	☐
6. Compared to other work-related health risks, chemotherapy exposure is less serious	☐	☐	☐	☐
7. I am not worried about future negative health effects from chemotherapy exposure	☐	☐	☐	☐

Section 11

How often do the following people wear personal protective equipment when handling chemotherapy?

	Never	Sometimes	About Half	Usually	Does not apply
Your co-workers	☐	☐	☐	☐	☐
Other nurses you know	☐	☐	☐	☐	☐
Oncology nurses in general	☐	☐	☐	☐	☐

According to the following people, how important is wearing PPE when handling chemotherapy?

	Not at all important	Sort Of important	Very important	Does not apply
Your co-workers	☐	☐	☐	☐
Other nurses you know	☐	☐	☐	☐
Your supervisor or manager	☐	☐	☐	☐
Your employer	☐	☐	☐	☐

Section 12

Indicate your level of agreement with each of the following statements.

SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree:

	SA	**A**	**D**	**SD**
1. Personal protective equipment keeps me from doing my job to the best of my abilities.	☐	☐	☐	☐
2. Wearing personal protective equipment makes my patients worry.	☐	☐	☐	☐
3. Patient care often interferes with my being able to comply with using precautions.	☐	☐	☐	☐
4. I cannot always use safe handling precautions because patient's needs come first.	☐	☐	☐	☐
5. Sometimes I have to choose between wearing PPE and caring for my patients	☐	☐	☐	☐
6. Wearing personal protective equipment makes my patients feel uncomfortable.	☐	☐	☐	☐

Section 13

Indicate your level of agreement with these statements regarding safety in your work place:
SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree:

	SA	A	N	D	SD
1. Chemotherapy gloves are readily accessible in my work area	☐	☐	☐	☐	☐
2. Chemotherapy gowns are readily available in my work area	☐	☐	☐	☐	☐
3. The protection of workers from occupational exposure to chemotherapy is a high priority with management where I work	☐	☐	☐	☐	☐
4. On my unit, all reasonable steps are taken to minimize hazardous job tasks	☐	☐	☐	☐	☐
5. Employees are encouraged to become involved in safety and health matters	☐	☐	☐	☐	☐
6. Managers on my unit do their part to insure employees' protection from occupational exposure to chemotherapy	☐	☐	☐	☐	☐
7. My job duties do not often interfere with my being able to follow chemotherapy safe handling precautions	☐	☐	☐	☐	☐
8. I have enough time in my work to always follow chemotherapy safe handling precautions	☐	☐	☐	☐	☐
9. I usually do not have too much to do so that I can follow chemotherapy safe handling precautions	☐	☐	☐	☐	☐
10. On my unit, unsafe work practices are corrected by supervisors	☐	☐	☐	☐	☐
11. My supervisor talks to me about safe work practices	☐	☐	☐	☐	☐
12. I have had the opportunity to be properly trained to use personal protective equipment so that I can protect myself from chemotherapy exposures	☐	☐	☐	☐	☐
13. Employees are taught to be aware of and to recognize potential health hazards at work	☐	☐	☐	☐	☐
14. In my work area, I have access to policies and procedures regarding safety	☐	☐	☐	☐	☐
15. My work area is kept clean	☐	☐	☐	☐	☐
16. My work area is not cluttered	☐	☐	☐	☐	☐
17. My work area is not crowded	☐	☐	☐	☐	☐
18. There is minimal conflict within my work area	☐	☐	☐	☐	☐
19. The members of my work area support one another	☐	☐	☐	☐	☐
20. In my work area, there is open communication between supervisors and staff	☐	☐	☐	☐	☐
21. In my work area we are expected to comply with safe handling policies and procedures	☐	☐	☐	☐	☐

Section 14

In what type of setting you do handle chemotherapy?

☐ Inpatient ☐ Outpatient ☐ Both

Please indicate the type of facility you work in:

☐ Academic health center ☐ Private physician office

☐ Community non-teaching hospital ☐ Public/Government hospital

☐ Community teaching hospital ☐ Home care

☐ Health Maintenance organization ☐ Other _____

Please indicate the primary state in which you work: _____

What is your gender? ☐ Male ☐ Female

What is your RACE or ETHNIC IDENTITY?

☐ American Indian/Alaskan Native ☐ Hispanic/ Latino ☐ Two or more

☐ Asian ☐ Native Hawaiian ☐ Other

☐ Black/African American ☐ White

What is your highest level of NURSING education?

☐ Diploma ☐ Bachelor's degree ☐ Doctoral Degree

☐ Associate degree ☐ Masters degree

Are you a member of the Oncology Nursing Society?

☐ Yes ☐ No

Are you certified in nursing?

☐ Not certified ☐ AOCN® ☐ NP ☐ Other _____

☐ OCN® ☐ AOCNS® ☐ AOCNP®

Please enter the number requested:

Your age in years:			
Years of nursing experience:			
Years of oncology nursing experience:			
Years of chemotherapy handling experience:			
Number of patients for whom you personally prepare and/or administer chemotherapy per day			
Number of patients receiving chemotherapy per day at your work place:			

Nurses' Use of Chemotherapy Safe Handling Precautions
Interview Guide for Managers

Introduce yourself as follows:

My name is _____. I am a research assistant at Georgia State University. I am calling you for an interview about nurses' who handle chemotherapy in your workplace.

Did you receive the consent form? (If no, ask for a fax number so that you can send a copy of the consent form and reschedule the interview.)

Do you have any questions about the information in the consent form?

START RECORDING. DO NOT USE THE PARTICIPANT'S NAME DURING THE RECORDING.

Do you agree to be interviewed for this study? This interview will be audio recorded. Do you agree to have the interview recorded? By answering questions in this telephone interview you are indicating your consent to participate in this research. You need not return the consent form to us; the consent form is for your records.

1. Do you manage or supervise nurses who handle chemotherapy, including preparation, administration, disposal or handling of contaminated excreta?
   If answer is no, say: We want to interview people who manage or supervise nurses who handle chemotherapy. Thank you for your interest in this research. (End the interview.)
   If answer is yes, continue with question 2.

2. What is your title? (The official title for the position you hold at work—manager, supervisor, director. Write this down reference later.)
   _____

3. Have you personally handled chemotherapy, including preparation, administration, disposal or handling contaminated excreta in the past year? (**If asked for clarification**: By chemotherapy **preparation** I mean transferring chemotherapy drugs from vials or ampoules to syringes or IV container.

   By **administration**, I mean giving chemotherapy to patients by IV, injection, or other route. By **handling excreta**, I mean activities like emptying bedpans, urinals or emesis basins).

   If answer is yes, ask: Is this a regular part of your responsibility as (title) _____

   How frequently do you personally handle chemotherapy?
   (Such as: Daily, weekly, occasionally)
   If answer is no, go on to the next question.

4. Do the nurses that you supervise prepare or mix chemotherapy? By chemotherapy **preparation** I mean transferring chemotherapy drugs from vials or ampoules to syringes or IV container. (**If no**, ask who prepares chemotherapy in their workplace.)

5. Do the nurses that you supervise administer chemotherapy? By **administration**, I mean giving chemotherapy to patients by IV, injection, or other route.

6. Do the nurses that you supervise handle contaminated excreta of patients who receive chemotherapy? By **handling excreta**, I mean activities like emptying bedpans, urinals or emesis basins.

7. Tell me about the policies regarding safe handling of chemotherapy in your workplace. [Such as, are they written or unwritten? Who wrote them? Who was involved in decisions about safe handling policies? Are the policies the same for everyone in the workplace such as pharmacy, if applicable? Are the policies readily available to the nurses? What aspects of chemotherapy handling are addressed in the policies? (Ask about these if they do not mention them). **Does your policy specifically address**:
   who may give chemotherapy
   what personal protective equipment is required when handling chemotherapy
   disposal
   transporting chemotherapy
   spill cleanup
   exposure management
   health monitoring of employees

8. How do you ensure that the policies regarding safe handling of chemotherapy are complied with? (Such as planned, formal evaluation of practice? Informal "spot checks."Ask for a description).

9. How often are policies regarding safe handling reviewed and updated?

10. Tell me about the training and orientation that a new nurse receives in your workplace before handling chemotherapy. (Formal, informal; who conducts; how long is it. Does it include safe handling precautions?)

11. How do you evaluate nurses' knowledge and performance of safe handling precautions? (formal, informal; who conducts and how; how often?)

12. I want you to answer the following questions about your workplace the way that you think the nurses you supervise would answer them.

(Verbal administration of the Safety Climate Questionnaire follows.)

13. If nurses do not wear gloves or gowns when preparing or administering chemotherapy, why do you think that is? (If they do not, have you ever asked the nurses why?

14. Do you think that chemotherapy exposure is a problem in your work site? (Why or why not?)

15. The following questions are about your work site. What kind of organization do you work in?

☐ Inpatient

☐ Outpatient

☐ Both

Academic health center	☐
Community non-teaching hospital	☐
Community teaching hospital	☐
Health maintenance organization	☐
Private physician office	☐
Public/ Government hospital	☐
Home Care	☐
Other (please describe)	☐

16. Please indicate the primary state in which you work: ☐☐

17. Your Gender ☐ Female ☐ Male

18. Are you a nurse? ☐ Yes ☐ No

19. Your age in years: ☐☐
20. Number of years in your current position: ☐☐
21. Number of years of nursing experience: ☐☐
22. How many employees do you supervise? ☐☐
23. Number of patients treated /day at your worksite ☐☐
24. Is there anything else you would like to tell me about safe handling precautions in your workplace?

Thank you very much for participating in this study. When we contacted you originally, we sent you one questionnaire for a nurse in your workplace to complete. Are you willing to give a questionnaire to another nurse in your workplace who handles chemotherapy?

If NO—Thank you. [End recording]. We really appreciate your willingness to participate in this study. The information you have shared with us will help us understand managers' perspectives on the use of chemotherapy safe handling precautions. We will use the results to help improve safety for oncology nurses. [End interview].

IF YES: Thank you. We will send another nurse questionnaire to you at the same address we used to contact you for the study. Is that OK? [End recording] (Or, please tell us where to send the questionnaire and write down the address). [Do not audio-record the address].

We really appreciate your willingness to participate in this study. The information you have shared with us will help us understand managers' perspectives on the use of chemotherapy safe handling precautions. We will use the results to help improve safety for oncology nurses. [End interview].