Implementation of the ONS Hazardous Drugs Safe Handling Toolkit in the Outpatient Infusion Unit

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Abstract

Chemotherapy medications are highly beneficial for treating and managing cancer, but the cytotoxicity of these medications that provides them with the ability to damage and destroy cancer cells are harmful to healthy tissue. Nurses who engage in unsafe medication handling practices with hazardous medications, in particular, can contaminate the practice setting and cause risks of patient and provider harm via exposure to these hazardous drugs (Boiano, Steege, & Sweeney, 2014). The nursing initiative involved the implementation of a toolkit developed by the Oncology Nursing Society (ONS) for the safe handling of hazardous medications in the outpatient infusion unit. The ONS toolkit implementation strategy involved oncology nurses taking part in various training sessions, as well as the introduction of safety equipment, personal protective gear, appropriate decontamination agents and closed system transfer device for use with hazardous medications. In addition, implementation of new safety guidelines and standards for the unit based on ONS toolkit contents; best practices guidelines, and current research evidence were implemented. The effectiveness of the nursing initiative assessed nursing knowledge by utilizing a knowledge assessment administered to unit nurses before and after the training sessions, and by comparisons of pre- and post-intervention levels of environmental contamination according to CHEMOALERT™ surface sampling test with gas chromatography and mass spectrometry analysis. The outcomes could be used to inform future safety practices within any practice setting that administer hazardous drugs.

Keywords: occupational exposure, hazardous drugs, outpatient infusion, oncology nurses, PPE

Dedication

I dedicate this Doctor of Nursing Practice project to my husband Oliver R. Gordon, who provided me with undying love and support during my coursework, project development, data collection, data analysis and final presentation. To my children Armani Antonio Austin and Tatianna Xiomara Austin, thank you for hanging in there with me, helping around the house, taking care of one another and understanding when I could not make every school performance, game or school trip. Lastly, I dedicate this project to my mother Carmen R. Lodge-Freeman and my grandfather Eloy Lodge, may he rest in peace. They taught me perseverance, strength and commitment. Although, I chose my path, God ordered my steps and this mission is complete.

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Executive Summary

Purpose: The purpose of this project was to implement the Oncology Nursing Society (ONS) Hazardous Drugs Safe Handling toolkit over ten weeks to meet safety standards, Occupational Safety and Health Administration (OSHA) safe handling recommendations, and current evidenced-based hospital policies.

Background and Significance: Safety concerns have existed for approximately 40 years about how hazardous drug (HD) exposure contributes to long- and short-term health outcomes for healthcare workers. Oncology nurses rank among the highest in occupational exposure to hazardous drugs due to the lack of standardized government guidelines on the handling and safety of antineoplastic chemicals and lack of government regulations on exposure limits (Borges, Silvino, Dos Santos & Galvao, 2015). Careless handling of HDs may cause toxic residues to infiltrate hospital environments, patient care areas and traced to patients' homes. New government regulations will require healthcare organizations to minimize exposure risks by fully implementing the U.S. Pharmacopeia (USP) Convention Chapter 800: Hazardous Drugs: Handling in Healthcare Settings (USP, 2016) on December 1, 2019. This will represent an essential step in reducing occupational exposure for nurses, other healthcare professionals, and patients.

Methods: The ONS toolkit interventions and evaluation was completed within ten weeks. The implementation strategy involved 27 oncology nurses taking part in an educational training session for one hour, as well as the introduction of safety equipment, personal protective equipment, closed system transfer devices, and appropriate decontamination agent for use with chemotherapy medications. The effectiveness of the interventions evaluated environmental contamination using CHEMOLAERT™ surface sampling test results, and nursing awareness and

safety practices evident by the chemotherapy handling questionnaire developed and validated by Polovich (2010) consisting of 14 sections that have multiple choice and forced-choice responses.

Findings: 20 CHEMOLAERT™ surface sample tests were completed and revealed that there was not a significant decrease in environmental contamination of hazardous drugs, however when rank transformation was used to convert the distributions of contamination to normal distributions, significant decreases of environmental contamination was detected. Among the 27 nurses that participated in the chemotherapy handling questionnaire, five out of the ten domains showed a significant improvement, one out of the ten domains showed a significant decease and four out of the ten domains revealed no significant change.

Conclusion: Both individual and organizational factors are a critical points of focus in seeking to promote a culture of safety and is a strong indication that healthcare facilities must place greater emphasis on workplace safety. Practice recommendations must target both nurses and organizations. Appropriate interventions are those that seek to achieve behavioral change in nurses and strive for organizational change, as the organization is the immediate environment within nurses' practice. Personal protective equipment has been determined as best practice, especially considering the initiation of the USP 800 mandates. Therefore, there is a need to improve healthcare protection standards and protocols for oncology nurses. The outcomes w inform future safety practices at other practice settings that handle hazardous drugs.

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CHAPTER 1: INTRODUCTION

Oncology nurses risk occupational exposure risk to cytotoxic substances, antineoplastic chemicals, and other hazardous chemicals used in the outpatient setting. Studies on dangerous chemical exposure tested atmospheric levels, surface contamination, and urine samples of oncology staff. They found that constant exposure to hazardous chemicals used in chemotherapy suggested that oncology staff is not adequately protected from hazards in the workplace (Connor et al., 2014). Due to the nature of services in oncology, contamination is one of the most significant sources of occupational risk among oncology nurses. Compliance with known safe handling practice guidelines is the best way to protect nurses from exposure to hazardous substances. The primary sources of hazardous drug exposure include absorption through the skin and mucous membranes, accidental ingestion from contaminated items and food, inhalation from vapor, and injection through puncture injury (Brent, 2016). The highest risk of exposure for nurses is through surface contamination (Brent, 2016).

The purpose of the project was to implement the Oncology Nursing Society (ONS) safe handling toolkit interventions for oncology nurses to reduce occupational exposure to hazardous substances in the workplace. The goal of the project was to increase awareness about safe handling practices of hazardous drugs (HD), reduce risky workplace behavior among oncology nurses, and reduce the overall risk of environmental surface contamination in the outpatient infusion unit. By incorporating ONS HD safe handling toolkit interventions, it would prevent contamination and greater compliance with safe handling practice guidelines.

Problem Statement

For oncology nurses in the outpatient infusion unit, does the implementation of ONS safe handling of HD toolkit, compared to the standard practice, reduce the incidence of environmental

contamination within ten weeks? The purpose of the project was to implement the ONS safe handling toolkit interventions for oncology nurses in the outpatient infusion unit to reduce occupational exposure to hazardous substances within the workplace. The targeted population was the outpatient infusion oncology nursing staff within a single healthcare facility with an anticipated sample size of approximately 15 nurses. Targeted interventions recommended from the ONS safe handling of HD toolkit included safe handling practice education, standardization of personal protective equipment (PPE), utilization of closed system transfer devices, and use of appropriate HD decontamination agents. The impact of the interventions was measured by obtaining pre and post-implementation CHEMOALERT™ surface contamination and chemotherapy handling questionnaire results.

Objectives and Aims

The project aimed to implement the ONS safe handling of HD toolkit for oncology nurses to improve staff safety practices in the outpatient infusion unit in a healthcare organization. The objective of the study was to increase awareness, enhance safe handling practices and reduce environmental contamination of HD in the outpatient infusion unit.

Significance of the Practice Problem

Workplace HD exposure is a challenge for healthcare organizations. Among oncology nurses, occupational exposure to dangerous substances is the leading cause of adverse events among the target population (Meade et al., 2017). Systemic treatments for cancer increase the occupational risk among nurses to carcinogenic, teratogenic, mutagenic substances, and cytotoxic chemicals used in chemotherapy (Finnel & Crickman, 2017). Oncology nurses rank among the highest in occupational exposure to adverse events (9%) because of the lack of government standardized guidelines on the handling and safety of antineoplastic chemicals, in

addition to lack of government regulations on exposure limits to antineoplastic and substances used for chemotherapy (Borges, Silvino, Dos Santos, & Galvao, 2015).

According to the National Institute for Occupational Safety and Health (NIOSH) and the U.S. Department of Labor Occupational Safety and Health Administration (OSHA), healthcare workers are at a higher risk for exposure to deadly chemicals due to the lack of industry-standard guidelines on antineoplastic and poisonous substance exposures at work (Meade et al., 2017). The Bureau of Labor Statistics reports that 6.4% of all healthcare workers experience occupational adverse events in the workplace (Brent, 2016). Needle sticks, back injuries, and exposure to harmful substances are the three most common adverse events a nurse will experience (Brent, 2016).

Many states are creating laws that mandate safe handling practices of chemotherapy drugs. Research studies indicated that nurses self-report a higher use of appropriate safe handling practices but when compared to observed use of the same nurses safe handling practices are inconsistent (Colvin et al., 2016). A lack of awareness of safe handling practices has indicated a failure to adhere to policies and guidelines for handling chemotherapy drugs. According to one study, non-adherence to these policies are as high as 27%, and erroneous beliefs tend to be associated with these behaviors (Boiano, Steege, & Sweeney, 2014). For example, nurses who did not wear gloves while handling medications frequently claim that they have minimal skin exposure (Boiano et al., 2014).

There is a need to improve healthcare protection standards and protocols for oncology nurses in terms of personal protective equipment (PPE) use, safety protocol adherence, hazard identification and controls, and environmental monitoring for chemotherapy drugs and antineoplastic drugs (Borges, Silvino, Dos Santos, & Galvao, 2015). With an estimated eight

million healthcare workers working routinely with hazardous substances, hospitals have the responsibility to protect their staff from occupational hazards through hospital and departmental-specific programs that promote safety from persistent occupational hazards like exposure to dangerous substances. ONS safe handling practices during compounding, administration, and disposal are consistent with U.S. Pharmacopeia 800 (USP 800), NIOSH, OSHA, and the American Society of Health-System Pharmacists (ASHP) recommendations. However, the American Society of Clinical Oncology standards does not coincide with the recommendations from those national organizations. Using the 2018 Toolkit for Safe Handling of HD for Nurses in Oncology led to a reduction in HD exposure, a reduction in contamination of the environment, and improvement and increase in safety levels of oncology treatment (ONS Voice, 2019).

Proactively implementing the ONS toolkit in the outpatient infusion unit along with the positive support and collaboration from professional nursing organizations, professional medical organizations, faculties of nursing and medicine, nursing managers, and directors of nursing will increase the confidence of oncology nurses in upholding the ONS recommendations. Safe practice is a shared responsibility between employees and organizations, thereby creating a workplace climate that fosters and supports positive change toward safer handling of HD by oncology nurses.

Synthesis of the Literature

Healthcare workers provide essential services to patients, thus are widely considered as the backbone of the industry and the safety of the staff related to the work environment and the nature of work that they engage in. About 18 million doses of antineoplastic drugs are administered to adults annually, therefore the occupational risk for oncology nurses is particularly high. Oncology nurses face occupational exposure to cytotoxic substances,

antineoplastic chemicals, and other hazardous chemicals used in chemotherapy (Connor et al., 2014). Contamination is a leading source of occupational risk among oncology nurses, given the nature of services provided in oncology. Primary sources of dangerous substance exposure include absorption through the skin and mucous membranes, accidental ingestion from contaminated items or food, inhalation from vapor, and injection through puncture injury (Brent, 2016) is located in Appendix A. Exposure occurs through dispensing, compounding, and administration of HD by nurses, as well as during the performance of various patient care activities. Further occurrences of exposure are associated with spills and the transportation of drugs. Different drug administration, such as injection, irrigation, inhalation, and topical application, may aerosolize, putting nursing staff at high risk (Randolph, 2018).

Bernabeu-Martínez et al. (2018) described antineoplastic drugs as a subgroup of HD (refer to Appendix B). These drugs are a significant chemical hazard in the healthcare sector, besides being one of the most lethal chemical agents ever developed. The potential dangers with handling these drugs indicated why organizations promote occupational safety. Healthcare organizations are giving more attention to strategies aimed at enhancing the safety of healthcare workers and others who manage these drugs in all settings. These organizations included the Joint Commission, OSHA, the Pan American Health Organization, and the European Agency for Safety and Health at Work.

Antineoplastic drugs are widely used to treat cancer as they have proven efficacy in improving quality of life, decreasing the length of illness, and curing cancer (Connor et al., 2014). Despite the high number of health workers exposed to highly toxic drugs used to treat cancer, safety precautions that could reduce the risk of exposure are underutilized (Celano et al., 2019). Even in areas where PPE use occurs, observance of this standard is dismally low. Given

that, they repeatedly handle these drugs, and often for several years, the risk of exposure for oncology nurses is exceptionally high. Adverse outcomes are possible even when exposure is minimal. Some of the effects of exposure include abdominal pain, allergic reactions, hair loss, and nausea, disruption of skin health, nasal sores, and dizziness. Exposure can lead to chronic effects such as difficulties in conceiving, spontaneous abortion, and genotoxic changes (Graeve et al., 2016). Patients receiving therapeutic doses of antineoplastic drugs have experienced adverse effects. Concerns have arisen about the impact of longer-term low-level exposure amongst healthcare workers who handle HD in occupational settings (Celano et al., 2019).

Graeve et al. (2016) observed while these hazards are recognized, there has been inconsistency in enforcing standards across the industry. State laws reflect this inconsistency which may explain why healthcare workers have different levels of knowledge and attitudes towards safe handling practices. However, inconsistent compliance does not mean there is low awareness of the importance of taking measures to increase the personal safety of healthcare workers. He et al. (2017) noted that in the past 30 years, there have been efforts to improve the use of PPE and observance of safe handling guidelines. Regardless, studies showed the incidence of work surface contamination and exposure to skin, eyes, and inhalation among oncology nurses who reported hazardous drug spills.

Workplace HD exposure is a persistent problem amongst healthcare workers, as published by NIOSH. To prevent HD exposure, healthcare workers use chemotherapy-tested gloves, single-use disposable gowns, respirators/masks, eye protection, and closed-system transfer devices. Sheldon (2019), stated that a critical basic safety guideline for oncology nurses requires them to wear gowns and double chemotherapy-tested gloves during all handling of antineoplastic drugs. Medical and healthcare institutions play a vital role in establishing safety

standards in the healthcare industry. Randolph (2018) stated that USP and NIOSH have established requirements to promote worker safety in healthcare facilities. The NIOSH requirements included double gloving during administration, disconnecting, and disposing of HD, as well as during spill cleaning. PPE comprises various items, including gloves, gowns, covers for hair or head, eye and face protection, and respiratory protection. Therefore, employers must establish clear guidelines, depending on the specific risks involved.

He et al. (2017) observed that in healthcare facilities, the use of PPE is inconsistent, and the commitment to usage is not reliable. In other cases, equipment may not be accessible to nurses, which hampers efforts to promote personal safety. Sheldon (2019) observed that the utilization of PPE by oncology nurses is alarmingly low. The percentages of pregnant nurses who do not follow safety measures are significantly high, despite their awareness of the risk of adverse reproductive health outcomes arising from exposure to chemotherapeutic drugs. Eisenberg (2016) observed that while the use of PPE has improved in healthcare settings, much more has been done to ensure safety standards. Of concern is the safety of nurses who frequently handle antineoplastic drugs during the administration of these medications to patients. Other roles that nurses perform also expose them to risk, such as the removal of patient excreta. It is essential that healthcare organizations enforce a culture of safety, especially in oncology settings. Notable challenges that continue to hamper efforts to implement a sound safety culture include a lack of understanding of the dangers in handling HD and a lack of efficient structures and systems to enforce guidelines. Graeve et al. (2016) observed that antineoplastic drugs have toxic health risks, and many drugs are classified as carcinogenic to humans by the International Agency for Research on Cancer (IARC). Potential side effects related to HD exposure are in Appendix C.

The exposure rate to healthcare workers is particularly worrisome, given the nature of their work. Adverse outcomes are possible even with minimal exposure to these drugs. There are numerous drugs available on the market for the treatment of cancer, and they still pose a risk to patients. However, for many patients, the benefits of treatment outweigh the risk of developing tumors in the future. In the case of healthcare workers, occupational hazard remains a matter of concern. Despite the hazards associated with the handling of antineoplastic drugs, and the observation of PPE usage such as gloves, double gloving, and chemotherapy gowns, healthcare workers are inconsistent as illustrated in Appendix D. Nurses perform several tasks involving chemotherapy such as dispensing and handling drugs, and patient excreta, which put them at high risk of exposure. For pharmacists, their involvement with chemotherapy is mainly during the preparation of medications. Certain factors are known to influence the adoption of safe handling practices positively, for instance, positive safety culture and a smaller nurse to patient ratio (Graeve et al., 2016).

Organizational factors that play a role in lowering exposure to HD include lower workloads, nurse participation and decision-making, adequate staffing, and two-nurse order verification. These organizational factors present persistent challenges to improve access and adoption of safe handling practices in healthcare settings. In developing appropriate interventions to improve the safety culture in work settings, healthcare organizations must strive to gain insights into structures and processes that can enhance the protection of oncology nurses from potential exposure to HD. The problem of inadequate attention to HD handling underscored the importance of focusing on developing effective interventions to address the issue on a personal and organizational level. Appendix E shows how certain organizational factors influence the use of PPE in ambulatory practice (He et al., 2017).

The problem statement stresses that oncology nurses face high occupational risk in handling antineoplastic drugs. Connor et al. (2014) linked this exposure to the handling of cytotoxic substances, antineoplastic chemicals, and other hazardous chemicals used in chemotherapy. Handling harmful drugs created a high-risk level for oncology nurses through contamination, which relates to the nature of the tasks they perform. Brent (2016) cited absorption through the skin and mucous membranes, accidental ingestion from contaminated items and food, inhalation from vapor, and injection through puncture injury as primary sources of exposure to dangerous substances. Considering the previous concerns as they relate to exposure risk for oncology nurses, an appropriate intervention would be one that aims to boost protection for nurses.

The implementation of the ONS Safe Handling Toolkit as an intervention for oncology nurses in outpatient settings reduced occupational exposure to hazardous substances within the workplace (Oncology Nursing Society [ONS], 2019). The interventions aimed to increase awareness, enhance safe handling practices, and reduce environmental contamination among oncology nurses in the outpatient infusion unit. The best way to protect nurses from exposure to HD was to enforce compliance with known safe handling practice guidelines. Given the high risk of exposure faced by oncology nurses, the use of PPE was the first line of defense in promoting personal safety.

The ONS and the American Society of Clinical Oncology highly recommended consistent use of PPE to reduce drug spills and subsequent exposure (ONS Voice, 2019). Increasingly incorporating nurses in decision-making would lead to an increase of PPE, thus enhancing personal safety for nurses. One way of encouraging the use of PPE in the outpatient setting is by engaging nurses in the purchasing of equipment and encouraging open

communication with administrators of facilities. An achievement in this area would lead to better outcomes elsewhere, notably patient safety, as well as health outcomes for patients (He et al., 2017). Healthcare organizations should encourage the participation of nurses in the selection of PPE supplies that are comfortable and easy to use, as this plays a significant role in nurse usage. Incorporating nurses at the outset is one way of promoting wider adoption in practice (Sheldon, 2019). Surface contamination is a primary source of contamination for those handling HD. There is a link between surface contamination and hand contamination. Since the skin is a primary source of uptake, wearing PPE an essential measure in reducing exposure (Eisenberg, 2016).

Healthcare organizations must do everything within their reach to promote compliance with safety standards. Callahan et al. (2016) observed that when adherence to hospital policies and procedures is high, this yields positive outcomes by significantly reducing the number of exposures. Healthcare organizations must invest more effort and resources into educating nurses about the factors that contribute to a low frequency of exposure to HD to enlighten nursing staff about safe practices. Training and education have essential implications for safe nursing practice and patient care. He et al. (2017) emphasized that those in managerial positions in healthcare organizations must do much more to promote the use of PPE. Increasing observance of engineering and administrative measures, as well as enforcing PPE measures, would improve the protection of healthcare workers. Sheldon (2019) emphasized the role of healthcare institutions in promoting safety practices and recommended that organizations develop and enforce policies and procedures that support the use of engineering controls, safe work practices, and use of PPE. Connor et al. (2017) recommended evidence-based materials and quality measurement programs be used in implementing and assessing practice safety programs in order to promote a culture of

safety. Additionally, the various stakeholders must embrace dialogue in creating a culture of safety.

Collaboration amongst stakeholders are especially vital, considering the interdisciplinary aspect in handling of antineoplastic drugs. Bernabeu-Martínez et al. (2018) observed that various individuals involved in the administration of HD increase the risk of errors. Because of the vast number of individuals involved, it makes HD a high-risk therapy that carries grave risks for patients, healthcare workers, and other professionals involved in the handling of these drugs. The interdisciplinary element involved in the handling of HD makes it essential to promote collaboration amongst stakeholders to establish practical measures aimed at developing a safety culture. The multidisciplinary aspect also calls for standardization of processes, because the various professionals who handle HD have different interpretations of safety guidelines and their implementation. Standardization would help to reduce variability, improve quality, as well as minimize the risks associated with the use of HD.

Randolph (2018) recommended the involvement of occupational and environmental health nurses in the training and documentation of those handling HD. Organizations must reassess those handling HD on an ongoing basis to ensure that individual competencies meet the specified standards. When introducing new HD or equipment, or change occurs in treatment processes, training is critical. Training would help to ensure that healthcare workers are always current in their knowledge of the use and administration of HD, thus promoting personal safety. Connor et al. (2017) stated that leadership plays a crucial role in establishing a culture of safety. Healthcare leaders must identify effective ways of disseminating clear information to oncology healthcare workers about existing standards that aim to promote a culture of safety. Leaders

should clearly explain the rationale behind the standards adopted in their organizations, as increasing worker knowledge plays a crucial role in enhancing safety in workplaces.

Eisenberg (2016) recommended that healthcare organizations must first raise awareness among nurses about the risks associated with the handling of HD, and various methods and mediums can achieve this objective, which involves the dissemination of information to nurses. However, for such a measure to achieve, communication must be clear and concise. Second, healthcare organizations should make use of evidence-based research to change the safety culture. Third, the implementation of legislative and regulatory measures will promote discipline in adhering to safety standards in practice settings. Healthcare organizations should adopt a zero-tolerance approach to prevent exposure in healthcare settings.

Practice Recommendations

Oncology nurses face a high risk of exposure to highly toxic drugs used in the treatment of cancer and are indicative of a weak safety culture in practice settings. The literature review highlighted both individual and organizational factors as critical points of focus in seeking to promote a safety culture and is a strong indication that healthcare facilities must place greater emphasis on workplace safety. Practice recommendations must target both nurses and organizations. Appropriate interventions are those that seek to achieve behavioral change in nurses and strive for organizational change, as the organization is the immediate environment where nurses practice.

Nurses

Interventions that aim to promote the culture of safety are geared to nurses who provide care to oncology patients. The interventions aimed to achieve behavioral change among nurses and through education of nurses to promote understanding of safety standards and guidelines.

The ONS safe handling toolkit is a suitable intervention that aims to reduce risk exposure for oncology nurses in the outpatient infusion unit. Education is an essential component of the toolkit because safe handling begins with education (ONS, 2019). The toolkit comprehensively addresses safety concerns. Educating nurses empower them by increasing their understanding of safe handling practices, thus promoting a culture of safety in practice settings to reduce environmental contamination and, consequently, reduce adverse outcomes caused by exposure to hazardous substances. Notably, the ONS safe handling toolkit emphasized the importance of wearing PPE, the use of closed system transfer devices, and the use of appropriate HD decontamination agents. The toolkit provided comprehensive information on the types of equipment available, the context for use, selection criteria, and other useful information aimed at empowering nurses in this area.

Organizations

Organizational factors play a vital role in improving access and adoption of PPE in practice settings. By focusing on specific structures and processes, organizations can enhance protection from potential exposure to HDs. One key area relates to integrating nurses in decision-making processes. Organizations should welcome nurses in activities that relate to enhancing personal safety. When nurses participate in activities of this nature, it motivates use and adoption, as well as promotes a sense of personal responsibility in adhering to safety practices. Healthcare organizations should invest in educating nurses because there is a great need to build awareness amongst oncology nurses related to safe handling practices. Organizations should disseminate evidence-based materials on safe handling practices and establish quality measurement programs to assess safety initiatives. When nurses are more aware of the factors

that contribute to a low frequency of exposure to HD, they can act from a well-informed position that has important implications for safe nursing practice and patient safety.

Even as organizations implement various measures to promote a culture of safety, it is also imperative that they enforce compliance with policies that promote safe handling practices. As highlighted in the literature review, adherence to safe handling practices is not due to the lack of policies and procedures. However, there is laxity in observing safe handling practices, both at the individual and organizational level. It is necessary for organizations to enforce compliance with established standards and guidelines with a zero-tolerance approach to achieve this objective. The implementation of regulatory mechanisms in healthcare settings can help promote adherence to safety standards.

Evidence Based Intervention: Chosen Option

Healthcare workers face a high risk of exposure to HD. The risk is even higher for oncology nurses who frequently prepare and administer substantial volumes of antineoplastic drugs. Appropriate interventions strive to boost protection for nurses. The implementation of the ONS toolkit for safe handling of HD in an outpatient infusion unit is an evidence-based intervention that comprises the best available information on safe handling practices in a quick reference format to meet current safety standards. The toolkit possesses appropriate interventions in efforts to reduce occupational exposure to hazardous substances in practice settings by increasing awareness amongst oncology nurses, reducing environmental contamination, and therefore improving safe handling practices.

CHAPTER 2: THEORETICAL FRAMEWORK

The problem under focus regards the high occupational risk faced by oncology nurses in practice settings. Occupational risk is linked to the handling of antineoplastic drugs used in the treatment of cancer. The risk of contamination for nurses comes about when administering HD to patients, assisting patients in actions they cannot perform, and in other tasks, such as disposal of patient excreta. All these activities place oncology nurses at high risk of exposure, primarily through skin contamination and inhalation. Ideally, nurses and other healthcare workers who handle antineoplastic drugs should strictly adhere to safety guidelines, notably, wearing PPE. Utilizing safety guidelines offers the first line of defense against exposure to HD. However, laxity in observing safety measures is an issue that is a weak safety culture in healthcare organizations and failure to implement safety standards actively.

The Health Belief Model was developed in the 1950s by four social scientists at the U.S. Public Health Service Department to help understand the failure of people to use preventive services offered by public health departments. However, it has since evolved to address recent concerns in prevention and detection, as well as lifestyle behaviors. People's beliefs about their risk of exposure to a health problem or disease and their perceptions regarding the benefits of taking action to avoid adverse outcomes most readily influence their readiness to act. Given the specifics of the problem, the Health Belief Model is a suitable theoretical framework to guide intervention efforts. Wearing PPE is a fundamental measure that significantly enhances safety for nurses and others who handle HD in healthcare settings. As has been highlighted in previous sections of this paper, the scenario that prevails in the healthcare sector indicated a weak compliance of safety standards. Poor adherence to safety standards, such as wearing PPE, is not due to lack of awareness or nonexistent policies and regulations in healthcare organizations.

Instead, there seems to be laxity amongst healthcare workers in adhering to safety standards that assure safety during practice, and specifically in the context of this paper, during handling of HD. Therefore, a suitable intervention is one that seeks to achieve behavioral change amongst oncology nurses who face a considerably higher risk of exposure by their interactions with patients and the tasks they perform.

The primary reason for choosing the ONS toolkit for implementation is that it carries the tremendous potential to reduce exposure of nurses to HD. Moreover, the objective of the toolkit is to increase awareness, enhance safe handling practices, reduce environmental contamination, and reduce exposure-related adverse effects among oncology nurses in the outpatient infusion unit. The best way to protect nurses from exposure to hazardous substances is by enforcing compliance with known safe handling practice guidelines. The implementation of the ONS safe handling toolkit aimed to reduce the overall risk of environmental contamination in the outpatient infusion unit by incorporating appropriate and standardized PPE to prevent contamination and foster greater compliance to safe handling practice guidelines. The intervention reflected an approach that strived to achieve behavioral change; hence, the Health Belief Model is an appropriate theoretical framework.

The ONS toolkit provided guidelines for the safe handling of hazardous substances in practice. Moreover, education is an essential aspect of safe handling. The toolkit also provided comprehensive information regarding safety measures, which was a vital measure in promoting a culture of safety. The Health Belief Model is a suitable theoretical framework that guided the intervention (Batras, Duff & Smith, 2014). This framework is used in public health interventions and deemed appropriate for the current context because the theory addressed a health behavior problem amongst oncology nurses. The Department of Health and Human Services (2019) stated

that a critical factor in the success of public health initiatives is an understanding of health behaviors and the context in which they occur. Thus, interventions that aim to improve health behavior should be referred to as theories of behavior change. To achieve behavioral change amongst oncology nurses, the Health Belief Model made the appropriate conceptual framework. The model is an understanding of the social determinants of health and health behavior (Department of Health and Human Services, 2019). The ONS toolkit is a suitable intervention because it not only targets individuals but also aims to achieve change in interpersonal, organizational, and environmental aspects that influence health behavior.

Since the ONS toolkit intent is to prevent risks associated with exposure to HD, the Health Belief Model is an appropriate conceptual framework for the intervention. The Department of Health and Human Services (2019) emphasized that the model is relevant for reducing risk factors in healthcare. Core constructs of the Health Belief Model included perceived susceptibility and perceived severity, perceived benefits and perceived barriers, cues to action, and self-efficacy. Individual perceptions have led to modifying factors that promote the likelihood of taking recommended preventive health action, motivated by the perceived benefits of such action. The Health Belief Model is suitable for prevention-related interventions such as the ONS toolkit for oncology nurses.

Change Model

Kurt Lewin's Change Model is appropriate for guiding the chosen intervention, since the problem involves behavioral changes. Lewin's change model offered a suitable framework to guide the change management, involved in the ONS toolkit. As stated earlier, oncology nurses do not lack an understanding of the risks associated with exposure to HD or safety policies and guidelines in healthcare settings. Instead, the problem is weak adherence to safety standards and

a weak safety culture in the outpatient infusion unit. A suitable intervention is one that is intended to achieve change at both an individual and organizational level. Cummings et al. (2015) highlight three components of Lewin's model as an essential guide in managing a process of planned change: unfreezing, changing, and freezing. These three steps are the foundation for change management; hence, the theory may be applicable in implementing the intervention that seeks to achieve behavioral change amongst oncology nurses. Lewin's three-step model emphasized change as three steps, which involve unfreezing the old behavior, advancing toward new behavior, and refreezing new behavior.

A significant point of concern is the weak safety culture, which points to weak organizational structures, thus making the organization a primary area for focus in the planned change initiative. At the organizational level, the change should be aimed to enforce policies that encourage strict adherence to safety standards and guidelines in the outpatient infusion unit. Lewin's theory of change offered vital principles for achieving organizational change. Batras et al. (2014) stated that Lewin's theory explained that the status quo as a product of various forces in the social environment govern the behavior of individuals at any time. Change initiatives must, therefore, deliberately target the status quo, implement an alternative scenario, and re-stabilize the environment; which relates to unfreezing, changing, and freezing. Moreover, learning is a vital aspect of the planned implementation of the change process.

Lewin's theory underscores the impact of the social environment on governing individual behavior. Batras et al. (2014) observed that Lewin's three-step model reflected action research in the approach taken to managing change. In the unfreezing stage, the organization must unsettle the status quo. In this stage, performing a diagnosis determined the barriers to promoting a safety culture. The second stage involved changing or moving and mainly targets individuals. In the

context of the problem, since this is an action research, oncology nurses will have to learn what steps they must take to enhance responsibility at the individual level in observing safety standards and guidelines. In the third stage, known as the refreezing stage, the organization became the primary target. Refreezing involved the realignment of organizational norms, practices, and policies to support the change initiative. New organizational structures will support behavioral change amongst oncology nurses, thus leading to an improved safety culture.

In the context of the outpatient infusion unit, the organization stood out as a significant target, if the planned intervention yielded expected outcomes. The importance of targeting specific aspects of organizational culture was to achieve behavioral change among oncology nurses and promote a culture of safety. A weak organizational safety culture may be due to a lack of efficient structures and systems to enforce guidelines. In order to change these elements of the safety culture, it is necessary to target the organization. Oncology nurses operate within the outpatient infusion unit of a healthcare facility; hence, the organization serves as their social environment. Changes within the organization prompted behavioral change amongst oncology nurses. Efforts to improve access and adoption of PPE in healthcare settings encountered persistent challenges from the organizational framework, which underscored the importance of striving to gain insights into organizational structures and processes that can enhance the protection of oncology nurses from potential exposure to HDs. Such insights guided the development of appropriate interventions to improve safety culture in work settings. The ONS toolkit is a suitable intervention, as it not only targeted individuals but achieved a change in interpersonal, organizational, and environmental aspects that influence health behavior.

CHAPTER 3: PROJECT DESIGN AND METHODS

Many types of medications used in oncology care have the potential to cause harm to clinicians, patients other stakeholders, and nurses working in healthcare facilities have especially pronounced risks of exposure and complications from these drugs. The project introduced to an outpatient infusion unit the ONS toolkit that focused on the safe handling of HD as an evidence-based intervention intended to reduce contamination. This chapter presents an overview of the project's design and the activities used to implement the project, and begins by describing the organizational need for the project, the project's vision and guiding objectives, and the project's guiding Population, Intervention, Control, Outcome, and Time (PICOT) question. The sample affected the interventions is identified, along with a detailed systematic description for the implementation plan, the data collection strategy, and data analysis components of the project.

Organizational Need

The outpatient infusion unit served as the project site, which has a critical organizational need that prompted the development and proposal of this plan. The ONS noted that when the toolkit was used on a consistent basis, the precautions listed in the toolkit led to a reduction in exposure to HD, a reduction in contamination of the environment, and an improvement and increase in the safety level of oncology treatment (ONS Voice, 2019). Regarding the need for oncology nurses working at project site to use the ONS protocol for the safe handling of HD, a SWOT analysis was performed. At site, the focus of cancer treatment and care is on excellence and compassionate care. The goal of cancer care at project site is to offer and provide the best plan of care for all types of cancer, with the latest technology and research, as well as advanced levels of diagnosis and treatment planning and care (SNCH, 2019). These values and the

mission of project site cancer care unit serves as a strength of the hospital, and may also be an opportunity for continued commitment and improvement in care for their oncology patients.

In keeping with those goals, oncology nurses need to maintain high standards for safety when handling HD. The ONS defines HD as including "chemotherapy, antiviral drugs, hormones, some bioengineered drugs, and other miscellaneous drugs" (ONS, 2019, p. 4). Newer oncology therapies such as immunotherapy and targeted therapy may also involve the handling of HD (ONS Voice, 2019). The need for the oncology staff and hospital to continually assess new therapies and modalities of treatment might be seen by some as a weakness or threat to the oncology staff at the project site. In terms of cost, the hospital administrators, nursing managers, and nurses would need to be updated and educated as guidelines for safe handling of HD are revised. Another possible weakness is the attitudes of some nurses against following the ONS (2018) guidelines. An example of this noncompliance appeared in the ONS Toolkit for Safe Handling of HD for Nurses in Oncology, which described oncology nurses who might wear a lab coat rather than a chemotherapy-designed protective gown, even though they have the knowledge about HD exposure (ONS Voice, 2019). Wearing a regular lab coat rather than the appropriate gown could result in cross-contamination in the workplace, which could put coworkers at risk.

The ONS chief clinical officer, stated that "immunotherapy agents, cell therapies, tumor-infiltrating lymphocytes, live viruses, and vaccines" also need to be treated as HD until more research has been completed (ONS Voice, 2019, para. 3). In the SWOT analysis, nurses who are familiar and confident about these aspects of working with HD in oncology represent a strength. Safety risks in oncology care settings frequently involve exposure to toxic components such as chemotherapy. Chemotherapy drugs handled incorrectly or carelessly, especially with a lax

safety culture, can lead to inadvertent exposure or contamination via spills, repeated exposure to small amounts of compounds, and accidents (Boiano, Steege, & Sweeney, 2014).

All oncology nurses experience contamination risks when working with these drugs, such as when injecting them into patients, inhaling during administration, or applying them to the surface of a patient's skin (Crickman & Finnell, 2017). Nurses administer over 18 million doses of chemotherapy drugs each year and comprise the majority of the 18 million American health care employees exposed to HD such as antineoplastic medications (Kavanagh, 2017). Chemotherapy drugs are a primary reason that oncology nurses tend to experience higher than average safety and health risks and complications in their practice setting when compared to nurses working in other practice settings (Colvin, Karius & Albert, 2016). Despite the potential risks associated with spills of HD and accidental exposure to these compounds, the enforcement of the standards of health care organizations often fails to uphold regulatory or internal policy standards.

Project Schedule

The project implementation and data collection phases were completed in ten weeks, while the data analysis and reporting required two additional weeks to complete. A schedule for the project is in Appendix G. The schedule presented the allotted times for the project implementation, data collection, data analysis, and reporting activities.

Resources Needed

Several types of resources were required to succeed. A complete itemized budget for the project is in Table 1. The essential resources required to promote the use of safe handling practices with chemotherapy drugs include basic protective garments for nurses administering the medications, signs to remind employees of safe handling practices, and a set of training

materials, including a projector, an available room for staff education, handouts, and other materials developed from the ONS with the toolkit. Additionally, financial resources were necessary to purchase CHEMOALERT™ surface contamination test kits to evaluate project outcomes.

Project Manager Role

The project manager's role encompassed several responsibilities. The project manager framed the project's PICOT question, vision, and goals. After that, the project manager obtained clearance for the project while also securing administrative support and aiding the leadership team in providing visible support for the project among the staff. The project manager educated the outpatient infusion nursing team about the problem of unsafe medication handling practices and the potential consequences for personal safety, practice setting, and the patients' quality of care and health outcomes.

The project manager designed the interventions associated with the project based on current standards, medication handling guidelines, evidence-based practices from peer-reviewed literature, and the available safety toolkit. Also, the project manager delivered the training intervention and taught staff to use the safety tool kit, along with promoting an organizational safety culture. The project manager identified appropriate instruments for measuring the outcomes of the project, collected data on the project processes and outcomes, analyzed the data, and reported on the findings to organizational, academic, and nursing professional stakeholders.

Plans for Sustainability

Sustaining the project is vital for promoting lasting and meaningful change at the project site. The project will be maintained through several steps, beginning with reporting the project findings to organizational leaders and staff. The leaders and the project manager will decide

whether to sustain the project based on the outcomes. If the project is helpful to maintain, the he results will be reported to the staff as a progress report, noting improvements in safety and establishing new safety targets. Supplies will be available to provide training and toolkit support to new nursing staff upon hire and to provide existing employees with a brief refresher course annually. Policies will be developed to support these processes and will also assign responsibility for continuing to evaluate safety outcomes and process measures of adherence to the safety guidelines. These findings will be reported to the leadership team and staff annually and used as a basis for performance improvement goals and employee recognition.

Project Vision, Mission, and Objectives

The project site's vision, mission, and specific objectives guided this project. The guiding vision for the project is an oncology outpatient infusion that is free of adverse safety incidents due to a combination of organizational culture, standards, structural features, clinical practices, and the knowledge and behaviors of staff. The mission for the project would be to prevent staff and patient harm associated with hazardous medications by improving employees' knowledge of safe medication handling practices, their use of these practices, and the availability of safety equipment. The mission supported the overall vision by providing nursing staff with the tools to support safe handling of potentially hazardous medications, along with promoting staff and leadership understanding of, support for, and usage of safe handling behaviors (Crickman & Finnell, 2017). The project vision and mission aligned itself with the project site's vision of promoting safer, healthier communities by enabling safe employee practices and promoting safety culture. The vision and mission of the project also supported the project site's organizational mission of safe, evidence-based, effective oncology care by facilitating safer staff behaviors and perspectives that promote safety.

The project's short- and long-term objectives allowed the project's mission and vision to be fulfilled. The short-term objectives of the project included implementing a safety toolkit at the project site, improving staff knowledge of safe medication handling practices, making safety equipment available to the staff, and achieving staff compliance with the medication handling guidelines during the project. The long-term objectives of the project included integrating the project elements into organizational policies, practices, and culture in order to sustain change. Additional long term objectives included eliminating safety incidents, inadvertent staff exposure to HD, environmental contamination associated with improper handling of hazardous medications, promoting an enduring safety culture among leadership and staff, ensuring that safety knowledge, and training in safe medication handling is provided to present and future nursing staff.

The project did not have the possibility of producing risks and unintended consequences through its implementation. If the nursing staff did not understand or retain the knowledge gained from the toolkit resources or training material, there are risks of the staff members endangering themselves and other stakeholders through reverting to unsafe medication handling practices, or adopting new unsafe behaviors in the erroneous belief that they are adhering to the safety guidelines and standards. These practices could create risks of staff and patient harm from safety incidents. Unintended consequences included a rejection of the project content among staff, a perceived lack of support for the changes among the leadership due to the perspective that safety risks associated with hazardous medication handling is not severe, or beliefs that the safety practices will not yield any appreciable benefits.

PICOT Question

The following PICOT question guided the project: Among nurses in an outpatient infusion unit (P), does the implementation of an ONS safe handling of HD toolkit (I), compared to the current standard practice (C), reduce the incidence of environmental contamination (O) over ten weeks (T)?

Population

The population for the project consisted of all the oncology nurses providing outpatient chemotherapy services to patients in the outpatient infusion unit at a hospital located in an urban area of the northeastern United States. Approximately fifteen oncology nurses work at the outpatient infusion unit, and all the nurses will be included in the sample for the project through comprehensive sampling. While assessing the nurses' knowledge base on chemotherapy safe handling practice, informed consent was not necessary because the project is a quality improvement initiative. Ethical research principles recommended obtaining informed consent from all of the nurses prior to their participation in the project, which is particularly true if the project manager and other stakeholders deem informed consent appropriate, including the protocol review committee associated with the project site or an academic internal review board (IRB).

Intervention

The project involved the introduction of an evidence based ONS toolkit interventions to the nursing staff that focuses on the safe handling of HD, particularly the compounding of chemotherapy drugs handled and administered on a routine basis when delivering oncology care services to patients. Training for all nurses included safe handling requirements, standards, and behaviors, preventing and responding to environmental contamination and personal exposure to

HD, and contents covering the importance of medication handling safety and the possible risks of unsafe handling practices (ONS, 2019).

The interventions included making information and reminders about safe medication handling available to the nurses, along with the necessary safety equipment and protective garments to facilitate safe handling, medication handling, and the development of administration guidelines and standards following the toolkit. The combination of training, supplies, and standards improved medication handling behaviors and outcomes for oncology nurses, making this intervention approach appropriate for the project (Crickman & Finnell, 2017; Kavanagh, 2017). Since nurses do not necessarily evaluate their safe handling behaviors accurately, process measures and feedback should be given to promote safety behaviors among the nurses (Colvin et al., 2016). Appendix J shows the safe handling practice of HD educational plans for oncology nurses in the outpatient infusion unit.

Comparison

Currently there are no standard training protocols or toolkits used at the project site to promote safe medication handling practices. While safety standards exist at the outpatient infusion unit, they are not compliant with specific guidelines involving the safe handling and use of hazardous medications. These present conditions provided a basis for comparison with the project site following the implementation of the intervention.

Outcome

The measurable outcomes in this project is the reduction in environmental contamination within the workplace evident by pre- and post-environmental surface sampling tests and nursing staff awareness within the outpatient infusion unit evident by pre- and post-chemotherapy

handling questionnaire results. Pre- and post-intervention data allows for a comparison of outcomes associated with the intervention and comparison conditions.

Time frame

The timeframe for the project involved two practicum course sessions. The collection of the pre-intervention data occurred within the first-week post-project site protocol review committee and the academic IRB approval. The interventions implemented at the project site took place over eight weeks, and post-intervention data occurred one week immediately after the eight-week intervention period. This period allowed for a comparison of project outcomes within the ten-week timeframe.

Feasibility

The feasibility of the project to transpire within the 10-week timeframe since the toolkit developed by ONS is for rapid cycle change, allowing for implementation within two to three weeks (ONS, 2019). This time will also permit additional training related to safety equipment and feedback given to nurses before the measurement of any outcomes for the project. Research has determined that oncology medication safe handling training and toolkit implementation can transpire within a short timeframe (He, Mendelsohn-Victor, McCullagh, & Friese, 2017; Meade, 2015; Pfeiffer et al., 2017). By presenting the project plan to organizational leaders, and determining the availability for training in advance of other potential project team members, unit leadership and staff nurses, the project will adhere to its timeline as provided in Appendix G.

Sample and setting

The sample for this project included all the nursing staff who provide outpatient care services involving HD in the outpatient infusion unit at an urban hospital. Although this sample included approximately 15 nurses, the project collected process data directly from the nurses to

assess the nurses' safety-related perceptions regarding hazardous drug safe handling precautions. The sampling approach and sample size are appropriate for the project, and therefore will not compromise the statistical power of the project.

The setting for the project was the outpatient infusion unit at an urban hospital located in the northeastern United States. The hospital is a not-for-profit teaching facility. All the patients seen in this unit receive treatments for diagnosis of cancer. In many cases, the outpatient treatment regimens involve antineoplastic chemotherapy drugs given to the patients orally or intravenously. The patient base is economically and culturally diverse, as well. The vision of the hospital and its outpatient facilities is to promote a healthy, safe community, which is consistent with the mission of using safe, evidence-based, and effective care that promotes patient health, quality of care, and value-based care. The values of the organization include accountability, care that is both ethically delivered and excellent in quality and ensuring safety.

The project helped the facility deliver care that is safer and higher quality by reducing medication-handling risks. Additionally, it promoted a more ethical and accountable approach to care through reducing safety risks and facilitating the development of a safety culture in the oncology clinic. While the organizational culture is receptive to change, there was not always a formal focus on safety among the staff or leadership. However, with positive support and collaboration with the organization and professional nursing organizations, professional medical organizations, there will be an anticipated reduction in barriers to PPE usage and improvement in the safety climate of the workplace, which are, all be predictors of higher precaution used by oncology nurses.

Implementation Plan/Procedures

The project design and planned interventions, utilized evidence from peer-reviewed research, clinical guidelines, regulatory and industry safety standards, and organizational data to support the need for the project and the proposed solution. The project manager met with unit leaders and hospital leadership to obtain approval for the project and requested visible support from leaders to promote participation in the project and adherence to safety practices among the unit staff. Subsequent meetings with the leadership held before the implementation phase of the project were used to present the safety guidelines and standards that were implemented throughout the project, and obtained approval for the changes.

The project manager held a brief group meeting with the outpatient infusion nursing staff one week before the project implementation begins. At the meeting, the project manager presented the need for the project, briefly described the project, and discussed the roles that the nursing staff will have in improving safety on the unit. Through the hospital's oncology service line budget, once the organizational leadership approved it, the project manager purchased the necessary resources for the project, including protective equipment, closed system transfer devices, and the appropriate HD decontamination agent. The project manager scheduled a group-training session with the outpatient infusion unit's nurses, using available space in the facility.

The implementation of the interventions took place over one week. The project manager provided the training using ONS materials. Each of the oncology nurses participating in the training a training session, one hour in length. The training content covered several topics related to safe medication handling. These topics included education on HDs, the hierarchy of controls, safety precautions, waste disposal, and routine cleaning. The training session also covered the use of standardized PPE, and use of the closed system transfer devices for handling HDs.

The final topic for the training session included methods of responding to contamination from HDs by using appropriate personal and environmental decontamination agents. During the implementation phase, the project manager ensured that personal protective gear, safety equipment, and the closed system transfer devices were being used and that the new safety standards and guidelines are in place by observing clinical staff daily and conducting a structured debrief. At the end of the training and implementation period in week one, the interventions were completed. However, it was necessary to allow at least eight weeks for evaluating the project, with the evaluation period beginning as soon as the intervention period ended as illustrated in Appendix J.

Data Collection Procedures

There was two main evaluation processes in the project that assessed personal and environmental safety outcomes, as described above in the sections that detailed the elements of the PICOT question. Environmental contamination is the first variable addressed, and this variable will be continuous. The continuous variable measure for environmental contamination derived from the use of the CHEMOALERT™ surface-sampling test that measured this variable. The manufacturer received the samples and conducted a highly sensitive high-pressure liquid chromatography with tandem mass spectrometry (LC/MS/MS) analysis to quantify contaminant levels. The other evaluation process involved the assessment of nursing staff knowledge related to the safe handling of HDs. A 14-section chemotherapy handling questionnaire with forced-choice, multiple-choice responses validated by Polovich (2010), was used to collect the nursing staff knowledge variable (Oncology Nursing Society, 2019) seen in Appendix H.

The structure of the data collection involved pre- and post-intervention collection periods. During the week before the intervention, ten pre-intervention environmental surface sampling

tests was completed with the CHEMOALERT™ surface sampling kit and submitted to the manufacturer for LC/MS/MS analysis. After the intervention and evaluation period, another ten post-intervention surface sampling tests was conducted in the same locations and submitted for LC/MS/MS analysis. The knowledge assessment data was entered into a dataset as it was collected using anonymous participant numbers to avoid identifying nurses personally or associating individual nurses with performance scores in the dataset. Before each nurse took their training session, they completed the questionnaire developed by Polovich (2010) to assess nursing knowledge on safe handling of HDs as a pre-intervention measure. All the oncology nurses taking part in the training session during the project completed the same questionnaire after the project interventions and evaluation was completed.

Recruitment and Selection

All the outpatient infusion nurses that provided care services involving HD were recruited to participate in the project. One reason for recruiting all 15 nurses as a convenience sample was to participate in the project as a quality improvement initiative for the unit and organization. In contrast, another reason was to maximize the sample size for statistical analysis purposes. Because all members of the sample group took part in the training intervention, a control group was not available for comparison. Instead, comparisons of intervention and non-intervention conditions was structured into data collection pre- and post-test periods, and subsequently, pre and post-test comparisons of all data types would occur (Meade, 2015). The environmental contamination and nursing knowledge assessments provided a summative evaluation of the project outcomes.

Data Analysis Plan

After all the pre- and post-intervention data were collected, the data analysis proceeded in several steps. The analysis of the environmental contamination and nursing knowledge variables were in terms of frequency distributions, mean values, and standard deviations for the pre- and post-intervention periods, as appropriate. The analysis provided some insight into the shape of the data. The next set of analyses involved inferential statistics. For each one of the inferential statistical tests that evaluated the two variables of interest, a p-value of $p>0.05$ will be applied as a cutoff value to determine whether the differences between pre- and post-intervention means or event frequencies are statistically significant.

The results of the inferential statistical comparisons of the pre-intervention and post-intervention conditions of the project answered the PICOT question. The PICOT question examined the impact of the intervention on contamination events if the analytical results indicate that environmental contamination was significantly ($p<0.05$) reduced at post-intervention compared to pre-intervention, according to the t-test of that variable, then the intervention in the PICOT question was interpreted as reducing the environmental contamination, however, if the p-value is not statistically significant, and there was still a reduction in environmental contamination, then the interventions would be a success, and would justify the long-term implementation of the various training, practice, equipment, and policy changes associated with the intervention.

Instrumentation

The CHEMOALERT™ surface wipe sample test was used to collect data and analyze contamination on workplace surfaces both pre and post-intervention implementation. The test kit results directly related to the quality of the laboratory analysis. The chemotherapy handling

questionnaire developed by Povolich (2010) assessed nurses' knowledge of safe handling practices for HDs. This instrument is valid and required permission to use it. A complete copy of the instrument is located in Appendix I.

Instrument Reliability and Validity

The CHEMOALERT™ manufacturer conducted a highly sensitive high-pressure liquid chromatography with a tandem mass spectrometry (LC/MS/MS) analytical process to evaluate the surface contamination wipes. Elimination of false-positive results and differentiation of two HD are benefits of LC/MS/MS testing. The CHEMOALERT™ laboratory is accredited by the Industrial Hygiene Laboratory Accreditation Program (IHLAP) and included the Internal Organization for Standardization (ISO) 17025 accreditation. ISO 17025 is the standard for which most labs must hold accreditation to be deemed technically competent. Suppliers and regulatory authorities do not accept test or calibration results from a lab that is not accredited. The knowledge assessment instrument in Appendix I measured ten predictor variables. The variables are exposure knowledge, self-efficacy, chemotherapy administration, disposal, handling excreta, perceived risks, barriers, interpersonal influences, conflict of interest, and workplace safety climate, and all have a statistically reliable Cronbach alpha of 0.70 – 0.93. Both instruments have been determined to be reliable and valid.

Ethics and Human Subjects Protection

Ethical treatment of the nurses involved in the project was essential. Even though the organizational policy may not require informed consent of participating nurses, informed consent from all nurses involved in the project was recommended. There was no patient health information collected. The data are in data sets that lack personally identifiable information from the participants. The data sets are stored in encrypted formats to which only the project manager

will have the ability to decrypt. All paper records and materials are in a locked file drawer, with the project manager retaining the only key. Destruction of all physical and digital information from the project will take place after seven years or as required by academic policy.

CHAPTER 4: RESULTS AND DISCUSSION OF DNP PROJECT

Hazardous drugs can be harmful to clinicians, patients, and other stakeholders in outpatient infusion settings. Nurses are at higher risk of exposure to harmful medications and associated health risks when HD are not handled safely. The project employed the Oncology Nursing Society (ONS) toolkit for the safe handling of HD to an outpatient infusion unit as an evidence-based intervention to improve nurses' medication handling safety and reduce environmental contamination. This chapter describes the results of the intervention and discusses the findings from the data collection and analysis processes in the project. The chapter summarizes the methods and procedures that were used, including the data collection and analytical approaches, describes the sample involved in the project and the setting where the project took place, reports the main findings from the project and discusses them in the context of past research on safe medication handling, as well as the context of the project's theoretical basis.

Summary of Methods and Procedures

The methods and procedures were developed and implemented in order to answer the following PICOT question: "Among nurses in an outpatient infusion unit (P), does the implementation of the ONS safe handling of hazardous drugs toolkit (I), compared to standard practice (C), reduce the incidence environmental contamination (O) over ten weeks (T)?"

The summative evaluation consisted of two separate data collection approaches. The first summative evaluation approach that was used involved two separate one-week periods where 10 surface sampling tests were conducted at identical sites in the outpatient infusion unit. These environmental samples were collected by the project leader using the CHEMOALERT™ surface sampling test kit, and the samples were submitted to the manufacturer in order to obtain data on

the levels of surface contamination for two frequently used hazardous drugs such as oxaliplatin and 5-fluorouracil. The CHEMOALERT™ surface sampling tests were analyzed using descriptive statistics for pre- and post-intervention time periods, and two-tailed t-tests were used to compare oxaliplatin, and 5-fluorouracil contamination mean values for pre- and post-intervention using p-values of $p<0.05$ to determine significance.

The second summative evaluation consisted of administering the Chemotherapy Handling Questionnaire to all nurse participants. The questionnaire was administered in a paper and pen format at two-time points, with the pre-intervention questionnaire administered just before participation in the educational and training intervention, and the post-intervention questionnaire administered immediately after the eight-week evaluation period. The Chemotherapy Handling Questionnaire was developed and validated by Polovich (2010) and consisted of 14 sections that have multiple choice and forced-choice responses. The responses fit into ten domains, which are structured as Chemotherapy Exposure Knowledge, Self-efficacy for Using PPE, Chemotherapy Administration, Disposal, Handling Excreta, Perceived Barriers, Perceived Risks, Interpersonal Influence, Conflict of Interest, and Workplace Safety.

Initially, it was anticipated that only 15 clinical nurses working in the outpatient infusion setting would be involved in the intervention and provide data through this survey, but 27 clinical nurses participated because the participation was expanded to include both inpatient and outpatient nursing staff. Therefore, data was collected from all 27 clinical nurses at both time points. The data analysis approach began with demographic data. Frequency distributions and percentages were used to assess the demographic data, along with descriptive statistics for means and distributions of the staff members' ages, years of experience, and treatment volumes for patients per day per nurse at work. The Chemotherapy Handling Questionnaire was analyzed

using descriptive statistics in all ten domains of the questionnaire pre- and post-intervention. Paired-samples t-tests were also used to compare the pre- and post-intervention means in each domain, using a p-value of $p<0.05$ to determine significance. The pre- and post-intervention means for each domain type were compared using two-tailed paired-samples t-tests with p-values of $p<0.05$ to determine significance.

The formative evaluation approach that was used consisted of observational measures, where the project leader undertook periodic observations of all staff members involved in the intervention. Structured observational methods were used over eight weeks at pre- and post-intervention to obtain numbers of observations of events where the oncology nursing staff correctly followed medication administration, medication disposal, and handling excreta practices.

Summary of Sample and Setting Characteristics

The sample of oncology nurses who participated in the project and provided questionnaires, observational, and demographic data are summarized in Table 1. All 27 clinical nurses took part in the intervention and provided data for the project. The 27 clinical nurses who took part in the project included 25 (92.6%) females, 2 (7.4%) males, and 17 (63%) were White, 6 (22.2%) were Asian, 3 (11.1%) were African-American, and 1 (3.7%) identified as two or more races. Of the nurses in the sample, 3 (11.1%) had an associate degree, 22 (81.5%) had a bachelor's degree, and 2 (7.4%) had a master's degree. Most of the participants, 19 totals (76%), were ONS members. Eleven (40.7%) participants did not possess a nursing certification, 11 (40.7%) were certified in oncology, and 5 (18.6%) nurses had another type of certification. Eleven (40.7%) of the nursing participants worked in an inpatient oncology setting, 14 (51.9%) worked in the outpatient oncology setting, and 2 (7.4%) worked in both inpatient and outpatient

oncology settings. Among all the clinical nurses 4 (14.8%) worked in a community non-teaching hospital, 17 (63%) worked in a community teaching hospital, 2 (7.4%) worked in a private physician practice, 2 (7.4%) worked in a public or government hospital, and 2 (7.4%) worked in another type of health care facility. The sample characteristics are described in Table 2. The mean ± standard deviation (SD) age for the participants was 43.96 ± 11.95 years. The participants had a mean of 12.19 ± 9.68 years of experience working in the nursing field, 6.93 ± 6.48 years of experience working in oncology, and 6.68 ± 6.65 years of experience in handling chemotherapy. The average treatment volume included 2.73 ± 2.86 patients per nurse per day and 11.78 ± 13.00 patients per day at each work site.

Major Findings

One major finding involved the CHEMOALERT™ surface sample tests, which were used to assess environmental contamination before and after the intervention had been implemented. The pre- and post-intervention means, standard deviations, 95% confidence intervals, and t-test results for contamination from oxaliplatin and 5-fluorouracil are shown in Table 4. The means and standard deviations suggest that there were observed decrease in contamination from both oxaliplatin and 5-fluorouracil at the post-intervention sampling points compared to pre-intervention. However, the two-tailed t-tests did not indicate a significant ($p<0.05$) decrease in environmental contamination for either oxaliplatin or 5-fluorouracil. The lack of observed differences may be related to the skewness and kurtosis for both measures. When rank transformation was used to convert the distributions of contamination to normal distributions, significant ($p<0.05$) decreases of oxaliplatin contamination were observed at four sites, including the Unit Clerk Counter (pretest=15.3, posttest=5), Room 470 Alaris Pump (pretest=12.8, posttest=5), and Blood Pressure Machine #3 (pretest=11.6, posttest=-5). Similarly,

rank transformation revealed that significant ($p<0.05$) decreases in 5-fluorouracil were observed at three sites, including the Unit Clerk Counter (pretest=19.2, posttest=5), Portable Computer 07197 (pretest=105, posttest=5), and Portable Computer 07193 (pretest=9350, posttest=5).

Another major finding pertained to the Chemotherapy Handling Questionnaire results. The pre- and post-intervention means, standard deviations, 95% confidence intervals, and t-test results are depicted in Table 5. A series of paired-samples t-tests were used to compare the pre- and post-intervention means for the 27 participants for all ten domains. The paired-samples t-tests showed that there was not a significant ($p<0.05$) change in mean scores for the Chemotherapy Exposure Knowledge, Perceived Barriers, Perceived Risks, or Conflict of Interest domains. There was a significant ($p<0.05$) increase in mean scores for the Chemotherapy Administration, Disposal, Handling Excreta, Interpersonal Influence and Workplace Safety Climate domains. However, the ONS Safe Handling of Hazardous Drugs toolkit was associated with a significant ($p<0.05$) decrease in the Self-Efficacy domain.

The findings from the Chemotherapy Handling Questionnaire were somewhat unexpected, particularly when viewed considering past research. There were few significant changes between pre- and post-intervention that were observed in the questionnaire domains, including a lack of change in nursing knowledge about hazardous medications and self-efficacy regarding protective equipment. Previous studies using the same questionnaire or identical staff education toolkits were associated with increases in nursing staff knowledge related to chemotherapy exposure knowledge and self-efficacy in preventing environmental exposure to potentially hazardous drugs (Borges, Silvino, Dos Santos, & Galvao, 2015; Callahan et al., 2016). These studies also tended to find significant improvements in perceptions of perceived barriers and perceived risks of using hazardous medications (Borges et al., 2015; Callahan et al.,

2016; Pfeiffer et al., 2018). However, Colvin, Karius, and Albert (2016) had noted differences between self-assessment measures and observational measures of nurse safety when handling HD and this could possibly account for some of the unexpected findings.

The observed improvement in nurses' usage of correct precautions when administering medications, disposing medications, and handling excreta were consistent with previous research. Past studies generally found that oncology nurses adhered to safe medication handling protocols more closely following training and education (Borges et al., 2015; Callahan et al., 2016). As Colvin et al. (2016) noted, some nurses are more likely to handle hazardous medications correctly using safety protocols following education and training interventions, according to third-party observations, even if the nurses do not rate themselves as having improved in these regards according to self-assessment measures. This type of discrepancy would undoubtedly account for the findings where nurses did not rate themselves as more knowledgeable or possessing higher self-efficacy with handling hazardous medications yet adhering to safety standards more consistently after the toolkit intervention compared to standard practice.

CHAPTER 5: IMPLICATIONS IN PRACTICE AND CONCLUSIONS

The project addressed the issue of safe medication handling, which is a necessity for clinical practice due to the health risks that can adversely affect clinicians, patients, and other stakeholders if they experience inadvertent exposure to HD. The project delivered an educational and training intervention using the ONS safe medication handling toolkit as an evidence-based intervention to nurses in the outpatient infusion unit, and sought to answer the PICOT question, "Among nurses in an outpatient infusion unit (P), does the implementation of an ONS safe handling of hazardous drugs toolkit (I), compared to standard practice (C), reduce the incidence of nursing and environmental contamination (O) over ten weeks (T)?" This chapter describes the implications that the project and its findings have for nursing practice and concludes the project implementation and data analysis outcomes. The chapter discusses the implications that the project and its evaluation have for nursing and the health care system, summarizes the project findings, offers recommendations derived from the project findings to the nursing profession as well as specific nursing leaders, the strengths and limitations of the project and outlines a dissemination plan for the findings.

Implications for Nursing Practice

The project has implications for nursing and the health care system at micro, meso, and macro levels. At the micro-level, the outpatient infusion unit served as the project site, the project successfully promoted nurses' self-reported interpersonal influence regarding promoting safe medication handling, as well as their self-reported perceptions of workplace safety. The changes in the nurses' perspectives aligned with post-intervention improvements in observed safe medication handling practices among the nurses in the unit and decreases in contamination from two potentially hazardous medications at specific oncology unit sites.

However, health care and nursing leaders in the unit would still, perhaps, want to introduce evidence-based interventions that could improve the nurses' self-efficacy in using personal protective equipment (PPE) and their knowledge of safe handling practices according to validated surveys, as these measures did not improve in the course of the project. Developing other evidence-based strategies for improving these forms of nursing knowledge and self-efficacy are especially important because the findings for these outcomes deviated from previously published research (Borges et al., 2015; Callahan et al., 2016; Oncology Nursing Society, 2019).

The meso-level, has implications for other facilities. The project findings indicated that implementing toolkits for safe medication handling may not necessarily achieve all the intended results, including improving the staff knowledge and self-efficacy for skills involved in safe medication handling. At the same time, however, the changes between the pre- and post-intervention environmental contamination and medication safety data underscores the importance of evidence-based strategies to promote safe medication handling in various practice settings that handle HDs. Additionally, consistent with the findings of Colvin et al. (2016), the need to measure the outcomes of safe medication handling interventions not only with self-report measures but with objective measures like staff observations and environmental contamination sampling.

The macro-level has implications that affect organizations that offer oncology care directly or have clinical staff working in external healthcare facilities that provide chemotherapy services to patients. The findings from this project, along with sample characteristics, indicate that greater inter-provider communication and coordination are essential to promote medication safety at healthcare facilities. This collaboration could even encompass nursing professional

organizations that provide certification in oncology as well as other disciplines where the administration of potentially hazardous medications occurs frequently.

Recommendations

The significant findings provided a basis for stakeholder recommendations. The safe medication handling intervention using an ONS toolkit was not associated with statistically significant increases in participating outpatient infusion unit nurses' knowledge about chemotherapy exposure, PPE usage self-efficacy, perceived barriers to safety practices, perceived risks of unsafe medication handling, or conflicts of interest in improving safe medication handling. Significant increases in nurses' self-reported interpersonal influence in promoting safety and their perspectives of workplace safety improved after the intervention compared to before it. Moreover, the intervention was associated with significantly higher post-intervention adherence to safe medication administration, medication disposal, and excreta handling practices compared to pre-intervention, and with significant site-specific decreases in environmental contamination from oxaliplatin and 5-fluorouracil at post-intervention compared to pre-intervention.

The recommendations for nursing leaders included the development of improved toolkits for safe medication handling that allow for imparting knowledge about the risks of inadvertent exposure to chemotherapy medications and the effective use of PPE. Nursing directors and other policymakers at health care provider organizations that provide chemotherapy in healthcare facilities should mandate regular training and refresher courses in safe medication handling for all nursing staff who administer potentially hazardous medications. Both staff nurses and nursing leaders that work with HDs should support the implementation of regular observations of staff

medication handling practices and environmental contamination sampling as data collection methods to support quality improvement in safe medication handling.

This project could also inform future nursing research. The discrepancies between nurses' self-reported knowledge and self-efficacy related to safe medication handling and their actual medication handling behaviors would be one key area to examine. The prevalence of this phenomenon, the reasons for it, and ways to address the discrepancies would each serve as essential areas to study. Studies that determine which toolkit content and training delivery factors can best promote improvements not only in medication handling behaviors and contamination reduction outcomes but also in nurses' knowledge, self-efficacy and risk perceptions related to this topic could be essential in developing improved evidence-based interventions to promote hazardous medication handling safety, as well.

Discussion

This project yielded many surprising findings. The improvements in staff medication handling behaviors despite the intervention, participants reporting no improvements in relevant knowledge or self-efficacy was unexpected. However, this issue may be related less to the quality of the interventions and more to the delivery of the intervention, or even the relevance of the Chemotherapy Handling Questionnaire to the intervention contents. The significant pre- to post-intervention reductions in environmental contamination at specific sites, despite the lack of overall observed reductions, was also unexpected. On the other hand, the changes in detected contamination may not have been optimally tested by t-tests, and perhaps a different data transformation method before the t-test could have promoted more accurate analytical findings in the future. While the findings may not be generalized to other settings, there are significant

implications for practice and yielded viable stakeholder recommendations for clinicians and researchers.

There were notable strengths and weaknesses in the process of this paper. The strengths included the inclusion of all 27 nursing staff members in the sample, instead of limiting the intervention participation and data collection to the 15 outpatient oncology staff members; the use of both self-report and objective assessments in the data collection; and the use of an evidence-based toolkit in the intervention. Because the project was only delivered at a single site and limited sample size, however, there may have lacked enough generalizability to other settings. The findings may have also been stronger had a different research design been used, such as a randomized controlled trial**.**

Plans for Dissemination

The results will be disseminated to several stakeholder groups in distinct ways. The outpatient infusion unit nursing staff who participated in the project intervention, along with the unit nurse and non-nursing leaders at the cancer committee, patient care service oversight steering committee, and our medication management committee. The results will be delivered through an audiovisual PowerPoint presentation that includes time for questions and discussions of the findings and implications. A more detailed presentation poster may also be created to submit to regional and national nursing professional organizations, particularly the Oncology Nursing Society and the National DNP Conference so that the findings can be disseminated to other nurses and nurse leaders working with potentially hazardous medications in their own practice settings.

Conclusions and Contributions to the Profession of Nursing

The project introduced an evidence-based safety toolkit at an outpatient infusion unit in order to assess whether providing nursing staff training for safe medication handling and providing safety equipment and additional resources would be associated with improved staff knowledge, safety practices, and reducing environmental contamination related to safe handling of chemotherapy medications. These findings contradicted previous research that found similar interventions improved nursing knowledge and self-efficacy related to medication safety (Borges et al., 2015; Callahan et al., 2016; Pfeiffer et al., 2018).

However, the differences between pre- and post-intervention self-report measures related to safe medication handling and observed medication handling behaviors were consistent with the findings from a prior study by Colvin et al. (2016). This project contributed to the understanding of interventions to improve nurses' safe medication handling actions and outcomes. It could be helpful for nurse leaders, staff nurses, and nurse researchers working in outpatient infusion units, as well as in other practice settings where staff members handle and administer medications that may be unsafe if people are inadvertently exposed to them.

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Appendices, Tables, and Figures

Appendix A

Summary of Primary Research Evidence

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
Boiano, J. M., Steege, A. L., & Sweeney, M. H. (2014). Adherence to safe handling guidelines by health care workers who administer antineoplastic drugs. Journal of Occupational & Environmental Hygiene, 11(11), 728–740. doi:10.1080/15459624.2014.916809	Which types of protective practices do clinicians use when administering chemotherapy drugs, and what are the barriers to implementing protective practices?	None	Descriptive research survey using the NIOSH Health and Safety Practices Survey, administered online to 2069 health care clinicians working with potentially hazardous drugs.	98% of respondents were nurses. Exposure risks were primarily due to not wearing proper protective equipment, IV tubes that were primed with chemotherapy drugs by pharmacies or clinicians, lack of training, and failure to wear proper gloves during handling. Lack of exposure in the past was the main reason cited for not following proper safety protocols.	Even though safety guidelines are often well-known by clinicians, they are not necessarily followed. Training and safety equipment availability would help promote better adherence to safety guidelines.	Level II-descriptive study.
Borges, G. G., Silvino, Z. R., Dos Santos, & Galvao, S. (2015). Proposal for best practice guidelines on chemical exposure risk for nurses of a chemotherapy unit. *Revista De Pesquisa: Cuidado é Fundamental Online*, *7*(4), 3506. doi:10.9789/2175-5361.2015.v7i4.3506-3515	What was the impact of implementing a best practice guidelines approach on handling hazardous drugs among chemotherapy nurse?	Health belief model	Intervention study using pre-test post-test comparisons and the Beliefs, Attitudes, and Practices survey. The sample included 25 nurses working in a chemotherapy department.	There was a significant change in the nurses who considered themselves vulnerable to exposure following the completion of the training module ($p<0.05$), representing an increase from 53.8% to 76.9% at the pre- and post-intervention time points. Adherence to safety standards also significantly ($p<0.05$) increased after the intervention was administered, with a compliance rate of 96.2% among participants.	Staff training interventions based on the health belief model delivered to chemotherapy unit nurses is an effective way of improving knowledge about exposure risks to hazardous drugs and the use of safety precautions to prevent exposure.	Level II – retrospective data review study
Callahan, A., Ames, N. J., Manning, M. L., Touchton-Leonard, K., Yang, L., & Wallen, R.	Which factors were associated with safe handling of potentially	Factors Predicting Use of Hazardous Drug Safe-	Cross-sectional descriptive study involving the Hazardous Drug Handling Questionnaire delivered to a	Among the survey respondents, knowledge of exposure risk was generally high, as was the ratings of personal self-efficacy toward	Nurses were aware of exposure risk, were knowledgeable about the need to prevent exposure,	Level II-descriptive study.

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
(2016). Factors influencing nurses' use of hazardous drug safe-handling precautions. *Oncology Nursing Forum, 43*(3), 342–349. doi:10.1188/16.ONF.43-03AP	hazardous drugs among nurses in an oncology unit?	handling Precautions Model	sample of 102 nurses working at a single major oncology facility in the United States.	preventing exposure to hazardous drugs. However, perceived risk was also rated high, as were interpersonal influences on safety behaviors and workplace safety climate content. The staff respondents also stated that moderate conflicts of interest and barriers existed that prevented the use of safe handling behaviors in all cases. Precautions were most likely to be used during drug administration and least likely when disposing of waste with hazardous drug content in them.	and had safety equipment available, the nurses did not always use protective strategies and practices, which may be due to conflicts of interest and perceived barriers to use during specific steps in the use of hazardous drugs.	
Colvin, C. M., Karius, D., & Albert, N. M. (2016). Nurse adherence to safe-handling practices: Observation versus self-assessment. *Clinical Journal of Oncology Nursing, 20*(6), 617-622. doi:10.1188/16.CJON.617-622	How do nurses' perceptions of their own safe handling behavior for hazardous drugs differ from their actual handling practices?	Factors Predicting Use of Hazardous Drug Safe-handling Precautions Model	Observational and survey study involving a sample of 33 oncology nurses, and there were investigator-developed 15 item checklists for observations based on NIOSH guidelines as well as a 33 nine-point Likert-type survey instrument that were used by the observers and nurses respectively.	According to 22 observational periods, there were 100% completion rates for three safety behaviors, including glove disposal, chemotherapy equipment disposal, and washing hands after administering chemotherapy drugs. The comparisons of observations and surveys revealed that nurses used double gloving and proper gowning significantly ($p<0.05$) more often than they perceived, and protected work surfaces significantly ($p<0.05$) less often than they perceived.	Although compliance with certain safe handling behaviors was high among the nurses in the study, there were notable discrepancies between observed and self-reported safety behaviors, meaning that safety behaviors should be assessed by observations in intervention research, rather than by self-report, at least ideally.	Level II-descriptive study.
Connor, T. H., DeBord, D. G., Pretty, J. R., Oliver, M. S., Roth, T. S., Lees, P. S., & Clark, J. C. (2014). Evaluation of antineoplastic drug exposure of health care workers at three university-based U.S.	What was the rate of exposure for hazardous drugs among nursing staff at three health care centers?	None	Cross-sectional study involving a sample of 68 clinicians exposed to hazardous drugs and 53 clinicians who had not been exposed to these compounds. A researcher developed diary was used to track 10,000 potential exposure events.	In six weeks, 118 staff members handled potentially hazardous drugs 10,000 times. Exposure occurred in 60% of wipe samples and more than 50%of employees, but only three urine samples tested positive. No genetic damage was detected in any exposed staff members.	Hazardous drug exposure is a common and serious problem even among oncology staff who were trained and had access to protective equipment.	Level II-descriptive study.

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
cancer centers. *Journal of Occupational and Environmental Medicine, 52*(10), 1019-1027.			Wipe samples were used to examine compounds for exposure, as were blood and urine samples from clinicians.			
Eisenberg, S. (2016). A call to action for hazardous drug safety: where we have been and where we are now. *Clinical Journal of Oncology Nursing, 20*(4): A1-A8.	Which types of protective practices do clinicians use when administering chemotherapy drugs, and what are the barriers to implementing protective practices?	None	Descriptive research survey using the NIOSH Health and Safety Practices Survey, administered online to 2069 health care clinicians working with potentially hazardous drugs.	98% of respondents were nurses. Exposure risks were primarily due to not wearing proper protective equipment, IV tubes that were primed with chemotherapy drugs by pharmacies or clinicians, lack of training, and failure to wear proper gloves during handling. Lack of exposure in the past was the main reason cited for not following proper safety protocols.	Even though safety guidelines are often well-known by clinicians, they are not necessarily followed. Training and safety equipment availability would help promote better adherence to safety guidelines.	Level II-descriptive study.
Finnell, D. S. & Crickman, R. (2017). Chemotherapy Safe Handling. *Clinical Journal of Oncology Nursing, 21*(1).	What was the impact of implementing a best practice guidelines approach on handling hazardous drugs among chemotherapy nurse?	Health belief model	Intervention study using pre-test post-test comparisons and the Beliefs, Attitudes, and Practices survey. The sample included 25 nurses working in a chemotherapy department.	There was a significant change in the nurses who considered themselves vulnerable to exposure following the completion of the training module ($p<0.05$), representing an increase from 53.8% to 76.9% at the pre- and post-intervention time points. Adherence to safety standards also significantly ($p<0.05$) increased after the intervention was administered, with a compliance rate of 96.2% among participants.	Staff training interventions based on the health belief model delivered to chemotherapy unit nurses is an effective way of improving knowledge about exposure risks to hazardous drugs and the use of safety precautions to prevent exposure.	Level II-descriptive study.
Graeve, C. U., McGovern, P. M. & Alexander, B. (2016). Occupational exposure to antineoplastic agents: An analysis of healthcare workers and their environments. *Workplace*	Which factors were associated with safe handling of potentially hazardous drugs among nurses in an oncology unit?	Factors Predicting Use of Hazardous Drug Safe-handling Precautions Model	Cross-sectional descriptive study involving the Hazardous Drug Handling Questionnaire delivered to a sample of 102 nurses working at a single major oncology facility in the United States.	Among the survey respondents, knowledge of exposure risk was generally high, as was the ratings of personal self-efficacy toward preventing exposure to hazardous drugs. However, perceived risk was also rated high, as were interpersonal	Nurses were aware of exposure risk, were knowledgeable about the need to prevent exposure, and had safety equipment available, the nurses did not always use protective strategies and practices,	Level II-descriptive study.

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
Health & Safety, *65*(1): 9-20. doi:10.1177/2165079916662660				influences on safety behaviors and workplace safety climate content. The staff respondents also stated that moderate conflicts of interest and barriers existed that prevented the use of safe handling behaviors in all cases. Precautions were most likely to be used during drug administration and least likely when disposing of waste with hazardous drug content in them.	which may be due to conflicts of interest and perceived barriers to use during specific steps in the use of hazardous drugs.	
He, B., Mendelsohn-Victor, K., McCullagh, M. C., & Friese, C. R. (2017). Personal protective equipment use and hazardous drug spills among ambulatory oncology nurses. *Oncology Nursing Forum*, *44*, 60–65. doi:10.1188/17.ONF.60-65	How do nurses' perceptions of their own safe handling behavior for hazardous drugs differ from their actual handling practices?	Factors Predicting Use of Hazardous Drug Safe-handling Precautions Model	Observational and survey study involving a sample of 33 oncology nurses, and there were investigator-developed 15 item checklists for observations based on NIOSH guidelines as well as a 33 nine-point Likert-type survey instrument that were used by the observers and nurses respectively.	According to 22 observational periods, there were 100% completion rates for three safety behaviors, including glove disposal, chemotherapy equipment disposal, and washing hands after administering chemotherapy drugs. The comparisons of observations and surveys revealed that nurses used double gloving and proper gowning significantly ($p<0.05$) more often than they perceived, and protected work surfaces significantly ($p<0.05$) less often than they perceived.	Although compliance with certain safe handling behaviors was high among the nurses in the study, there were notable discrepancies between observed and self-reported safety behaviors, meaning that safety behaviors should be assessed by observations in intervention research, rather than by self-report, at least ideally.	Level II – retrospective data review study
Kavanagh, C. (2017). Medication governance: Preventing errors and promoting patient safety. *British Journal Of Nursing*, *26*(3), 159-165.	What was the rate of exposure for hazardous drugs among nursing staff at three health care centers?	None	Cross-sectional study involving a sample of 68 clinicians exposed to hazardous drugs and 53 clinicians who had not been exposed to these compounds. A researcher developed diary was used to track 10,000 potential exposure events. Wipe samples were used to examine compounds for exposure, as were blood and	In six weeks, 118 staff members handled potentially hazardous drugs 10,000 times. Exposure occurred in 60% of wipe samples and more than 50%of employees, but only three urine samples tested positive. No genetic damage was detected in any exposed staff members.	Hazardous drug exposure is a common and serious problem even among oncology staff who were trained and had access to protective equipment.	Level II – retrospective data review study

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
			urine samples from clinicians.			
Meade, E., Simons, A., & Toland, S. The need for national mandatory guidance on CSTDs. *British Journal of Nursing, 26*(Sup16b), S5-S14.	Which types of protective practices do clinicians use when administering chemotherapy drugs, and what are the barriers to implementing protective practices?	None	Descriptive research survey using the NIOSH Health and Safety Practices Survey, administered online to 2069 health care clinicians working with potentially hazardous drugs.	98% of respondents were nurses. Exposure risks were primarily due to not wearing proper protective equipment, IV tubes that were primed with chemotherapy drugs by pharmacies or clinicians, lack of training, and failure to wear proper gloves during handling. Lack of exposure in the past was the main reason cited for not following proper safety protocols.	Even though safety guidelines are often well-known by clinicians, they are not necessarily followed. Training and safety equipment availability would help promote better adherence to safety guidelines.	Level II-descriptive study.
Pfeiffer, Y., Gut, S. S., & Schwappach, D. L. B. (2018). Medication safety in oncology care: Mapping checking procedures from prescription to administration of chemotherapy. *Journal of Oncology Practice*, *14*(4), e201–e210. doi:10.1200/JOP.2017.026427	What was the impact of implementing a best practice guidelines approach on handling hazardous drugs among chemotherapy nurse?	Health belief model	Intervention study using pre-test post-test comparisons and the Beliefs, Attitudes, and Practices survey. The sample included 25 nurses working in a chemotherapy department.	There was a significant change in the nurses who considered themselves vulnerable to exposure following the completion of the training module ($p<0.05$), representing an increase from 53.8% to 76.9% at the pre- and post-intervention time points. Adherence to safety standards also significantly ($p<0.05$) increased after the intervention was administered, with a compliance rate of 96.2% among participants.	Staff training interventions based on the health belief model delivered to chemotherapy unit nurses is an effective way of improving knowledge about exposure risks to hazardous drugs and the use of safety precautions to prevent exposure.	Level II-descriptive study.
Randolph, S. A. (2018). Hazardous drugs: handling in health care settings. *Workplace Health and Safety, 66*(5): 264. doi:10.11.1177/2165079918763940	Which factors were associated with safe handling of potentially hazardous drugs among nurses in an oncology unit?	Factors Predicting Use of Hazardous Drug Safe-handling Precautions Model	Cross-sectional descriptive study involving the Hazardous Drug Handling Questionnaire delivered to a sample of 102 nurses working at a single major oncology facility in the United States.	Among the survey respondents, knowledge of exposure risk was generally high, as was the ratings of personal self-efficacy toward preventing exposure to hazardous drugs. However, perceived risk was also rated high, as were interpersonal influences on safety behaviors and workplace safety climate content. The staff respondents	Nurses were aware of exposure risk, were knowledgeable about the need to prevent exposure, and had safety equipment available, the nurses did not always use protective strategies and practices, which may be due to conflicts of interest and perceived barriers to use	Level II-descriptive study.

Citation	Question or Hypothesis	Theoretical Foundation	Research Design (include tools) and Sample Size	Key Findings	Recommendations/ Implications	Level of Evidence
				also stated that moderate conflicts of interest and barriers existed that prevented the use of safe handling behaviors in all cases. Precautions were most likely to be used during drug administration and least likely when disposing of waste with hazardous drug content in them.	during specific steps in the use of hazardous drugs.	
Sheldon, L. K. (2019). The importance of PPE use. *American Journal of Nursing, 119*(4): 10. doi:10.1097/01.NAJ.0000554528.24998.76	How do nurses' perceptions of their own safe handling behavior for hazardous drugs differ from their actual handling practices?	Factors Predicting Use of Hazardous Drug Safe-handling Precautions Model	Observational and survey study involving a sample of 33 oncology nurses, and there were investigator-developed 15 item checklists for observations based on NIOSH guidelines as well as a 33 nine-point Likert-type survey instrument that were used by the observers and nurses respectively.	According to 22 observational periods, there were 100% completion rates for three safety behaviors, including glove disposal, chemotherapy equipment disposal, and washing hands after administering chemotherapy drugs. The comparisons of observations and surveys revealed that nurses used double gloving and proper gowning significantly ($p<0.05$) more often than they perceived, and protected work surfaces significantly ($p<0.05$) less often than they perceived.	Although compliance with certain safe handling behaviors was high among the nurses in the study, there were notable discrepancies between observed and self-reported safety behaviors, meaning that safety behaviors should be assessed by observations in intervention research, rather than by self-report, at least ideally.	Level II-descriptive study.

Appendix B

Summary of Systematic Reviews (SR)

Citation	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Recommendation/ Implications	Level of Evidence
Batras, D., Duff, C. & Smith, B. J. (2014). Organizational change theory: Implications for health promotion practice. *Health Promotion International*, *31*(1): 231-241. https://doi.org/10.1093/heapro/dau098	What influences on health care practice result from the selection of different organizational change theories in health promotion?	Multiple online databases of published peer-reviewed research in health care journals	Inclusion: English-language articles in peer-reviewed journals from 1994-2014 that dealt with theoretical organizational change theory usage in primary studies of health promotion research. Exclusion: Articles that dealt with health promotion research but did not include organizational change theory content.	Articles were reviewed and analyzed for themes by all three authors independently and triangulated afterward to determine whether there was agreement on inclusion and the themes that emerged.	Several theoretical implications for health promotion arose based on which theory was selected. These implications included whether the theory could be adjusted to fit practice setting contexts, the amount of time that practitioners had to invest to create change, whether short-term successes could be integrated into long-term change plans, whether group experiences should be shared to promote change, and whether external factors should be considered during the change process.	Receptive practice setting contexts for change must be created prior to initiating change, change should not be initiated too early, and unsuccessful changes should be studied carefully to determine which lessons they hold for selecting a change theory approach.	Level II – systematic review of level II studies or level I studies where results were heterogeneous.
Bernabeu-Martínez, M. A., Merino, M. R., Gago, J. M. S., Sabucedo, L. M. A., Wanden-Berghe, & Sanz-Valero, J. (2018). Guidelines for safe handling of hazardous drugs: A systematic review. *PLOS ONE*. doi:org/10.1371/journal.pone.0197172	What is the current consensus in the peer-reviewed literature on the best practices for safe handling of hazardous drugs?	Search of multiple online health care databases, including MEDLINE, the Cochrane Library, Scopus, CINAHL, the Web of Science, and LILACS. Reference lists were also searched.	Inclusion: Articles published in English or Spanish as full text in peer-reviewed journals between September 2004 and January 2017 containing the MeSH terms “antineoplastic agents,” “cytostatic sgents,” and “hazardous substances.”	Descriptive cross-sectional study using systematic critical review techniques. Two authors selected articles for inclusion independently and assessed for concordance with a Kappa index score of>80%. Double tables were used to detect errors. Variables were used	61 articles from 1100 results were selected for inclusion. Only 23.3% of these included all stages of risk from exposure to hazardous substances. A single guide included all stages of handling for drugs with and without exposure risk. Drug preparation, staff management, patient education, and drug administration were the	Most guidelines were limited in their recommendations to exposure risk steps in handling, but the existing guides could still be effective for protecting stakeholders during drug preparation and administration and staff and patient education.	Level I – systematic review of level I studies

Citation	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Recommendation/ Implications	Level of Evidence
			Exclusion: Grey literature or articles citing grey literature, and articles not available in full text in English or Spanish.	to extract data, and the Burton-Kebler and Price indexes were calculated as well.	most commonly included elements for guidelines. No standardized system was used between any studies that facilitated risk minimization, tracing, and quality management for hazardous drugs.		
Brent, N.J. (2016). Workplace safety a must for nurses. *Nurse.com*. Retrieved from https://www.nurse.com/blog/2016/11/16/what-nurses-need-to-know-about-workplace-safety/.	What steps does the 2016 Occupational Safety and Health Administration memo establish for handling potentially dangerous drugs?	Consultation of the 2016 OSHA memo and online search of resources based on the references cited by OSHA.	Inclusion: Full-text, English language sources cited by the OSHA memo. Exclusion: Sources not available in full-text or that had to do with the same topic that were not cited as references by OSHA.	Thematic review of the content by a single author including a listing of the main points made by OSHA.	Nurses and other health care staff have responsibilities that go beyond OSHA requirements in order to maintain safety, but that also include OSHA requirements. These include the use of "universal precautions," wearing safety equipment, adhering to policy when delivering injections, and following other safety steps like the cleaning of spills to avoid slip and fall accidents.	The OSHA requirements can provide a general basis for reducing accidents with hazardous drugs, but additional steps that are specific to drug handling and to the practice settings are also necessary to adhere to.	Level II – systematic review of level II studies or level I studies where results were heterogeneous.
Celano, P., Fausel, C. A., Kennedy, E. B., Miller, T, M., Oliver, T. K. & Page, R. (2019). Safe Handling of Hazardous Drugs: ASCO Standards. *Journal of Clinical Oncology*, *37*(7): 598-608. doi:10.1200/JCO.18.01616	What are the elements of the ASCO standards for safely handling hazardous drugs?	Online search of guidelines from ASCO and multiple database search of articles used to support the ASCO guidelines and develop them.	Inclusion: ASCO guidelines and full-text articles from studies used to develop the guidelines. Exclusion: Guidelines for handling hazardous drugs that were not related to ASCO standards.	Thematic review and assessment of the guidelines were undertaken by a panel of health care professionals belonging to the ASCO, including nurses, along with an evaluation of differences between the guidelines.	The ASCO standards represent not only practices that are aligned with existing safety studies but are also able to reflect recent research evidence as well.	ASCO guidelines. represent an appropriate and evidence-based approach to handling hazardous drugs in oncology settings.	Level I – systematic review of level I RCTs where study results were homogeneous.

Citation	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Recommendation/ Implications	Level of Evidence
Cummings, S., Bridgman, T. & Brown, K. G. (2015). Unfreezing change as three steps: rethinking Kurt Lewin's legacy for change management. *Human Relations*, *69*(1): 33-60. https://doi.org/10.1177/0018726715577707	How did the three-step change model developed by Kurt Lewin become created overtime?	Online search of multiple databases	Inclusion: Articles and publications by Lewin during his lifetime, and articles about Lewin's chang eprocess that were published after his death Exclusion: Collected works of Lewin published after his death and works about Lewin's change model published during his life.	Thematic review and assessment of variables from published research, using two researchers to correlate findings. A larger group of researchers was used to resolve discrepancies.	Lewin's model constitutes a grand foundation from which individual change theories can be developed, including the three-step theory that is commonly associated with Lewin.	Lewin's change model is effective as he originally developed it, but the three-step model is a creation of other theorists.	Level II – systematic review of level II studies or level I studies where results were heterogeneous.
Department of Health and Human Services. (2019). Social and behavioral theories. Retrieved from https://obssr.od.nih.gov/wp-content/uploads/2016/05/Social-and-Behavioral-Theories.pdf	What considerations need to be made when selecting a theoretical model to guide health care interventions?	Online search of resources available through the National Institutes of Health library.	Inclusion: Full-text, English-language sources found in NIH library databases. Exclusion: Sources available only as an abstract or that were not found through the NIH databases.	Thematic review and assessment of variables from published research, using two researchers to correlate findings. A larger group of researchers was used to resolve discrepancies.	Interventions are more likely to succeed when they have as their basis an appropriate social or behavioral model. However, the specific model should be chosen based on considerations of the practice setting, the population the intervention will target, and the parameters of the intervention itself.	Interventions should be developed around a specific theoretical model that are suitable for the intervention being employed.	Level II – systematic review of level II studies or level I studies where results were heterogeneous.
ONS Voice. (2019). ONS safe handling guidelines are consistent with national recommendations. *ONSVoice.com.* Retrieved from https://voice.ons.org/news-and-views/ons-safe-handling-guidelines-are-consistent-with-	In what ways do the American Society of Clinical Oncologists and the Oncology Nursing Society recommendations for handling chemotherapy drugs align?	Online search of guidelines from ASCO and ONS.	Inclusion: Only the ASCO and ONS guidelines were included in the search, along with the peer-reviewed research studies that were used to develop the recommendations. Exclusion: Topically relevant studies and guidelines that did not specifically pertain to	Thematic review and assessment of the guidelines were undertaken by a panel of ONS researchers, along with an evaluation of differences between the guidelines.	ONS and ASCO guidelines are not fully consistent with one another. However, the ONS guidelines do align with the requirements of the U.S. Pharmacopoeia, National Institutes of Occupational Safety and Health, and other national standards organizations.	Although the ASCO and ONS guidelines are not aligned with one another, the ONS guidelines are an appropriate basis for developing practice setting standards for handling hazardous drugs.	Level I – systematic review of level I RCTs where study results were homogeneous.

Citation	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Recommendation/ Implications	Level of Evidence
national-recommendations			the comparison of the guidelines.				
Batras, D., Duff, C. & Smith, B. J. (2014). Organizational change theory: Implications for health promotion practice. *Health Promotion International*, *31*(1): 231-241. https://doi.org/10.1093/heapro/dau098	What influences on health care practice result from the selection of different organizational change theories in health promotion?	Multiple online databases of published peer-reviewed research in health care journals	Inclusion: English-language articles in peer-reviewed journals from 1994-2014 that dealt with theoretical organizational change theory usage in primary studies of health promotion research. Exclusion: Articles that dealt with health promotion research but did not include organizational change theory content.	Articles were reviewed and analyzed for themes by all three authors independently and triangulated afterward to determine whether there was agreement on inclusion and the themes that emerged.	Several theoretical implications for health promotion arose based on which theory was selected. These implications included whether the theory could be adjusted to fit practice setting contexts, the amount of time that practitioners had to invest to create change, whether short-term successes could be integrated into long-term change plans, whether group experiences should be shared to promote change, and whether external factors should be considered during the change process.	Receptive practice setting contexts for change must be created prior to initiating change, change should not be initiated too early, and unsuccessful changes should be studied carefully to determine which lessons they hold for selecting a change theory approach.	Level II – systematic review of level II studies or level I studies where results were heterogeneous.

Appendix C

Exposure Side Effects Related to Hazardous Drugs Exposure

- Anorexia
- Nausea and vomiting
- Diarrhea
- Headache
- Dizziness
- Rash
- Throat irritation
- Alopecia
- Nail hyperpigmentation
- Infertility
- Miscarriages
- Stillbirths
- Menstrual cycle changes
- Ectopic pregnancies
- Spontaneous abortions
- Infants with low birth weights
- Congenital anomalies
- Learning disabilities in children of exposed mothers
- Pre-term birth

Source: Eisenberg (2016).

Appendix D

Frequencies of Personal Protective Equipment Use Among Personnel in Different Job Tasks

Table 4. Frequencies of Personal Protective Equipment Use Among Personnel in Different Job Tasks

Equipment	Always	51%-99%	1%-50%	Never
Preparation (pharmacy)				
Biological safety cabinet ($n = 10$)	90%	10%	0	0
Closed system transfer device ($n = 10$)	20%	10%	20%	50%
Chemotherapy gloves ($n = 9$)	100%	0	0	0
Other gloves ($n = 9$)	33.3%	0	0	66.7%
Chemotherapy gown ($n = 10$)	100%	0	0	0
Other gown ($n = 10$)	100%	0	0	0
Eye protection ($n = 9$)	33.3%	0	0	66.7%
Respirator/mask ($n = 9$)	11.1%	0	22.2%	66.7%
Administration				
Closed system transfer device ($n = 85$)	60%	7.1%	3.6%	29.4%
Chemotherapy gloves ($n = 82$)	83%	4%	2%	11%
Other gloves ($n = 76$)	10.7%	6.7%	2.7%	80.3%
Double gloves ($n = 77$)	33.8%	11.7%	13%	41.6%
Chemotherapy gown ($n = 82$)	81.7%	15.8%	1.2%	1.2%
Other gown (e.g., isolation; $n = 77$)	2.6%	1.3%	5.2%	90.9%
Reused disposable gowns ($n = 77$)	2.6%	16.9%	7.9%	72.7%
Eye protection ($n = 79$)	27.8%	11.4%	17.7%	43%
Respirator ($n = 77$)	11.8%	7.9%	15.6%	64.9%
Disposal				
Chemotherapy gloves ($n = 94$)	79.8%	7.5%	2.1%	10.6%
Other gloves ($n = 76$)	11%	5%	4%	80%
Double gloves ($n = 79$)	32.9%	7.6%	10.1%	49.4%
Chemotherapy gown ($n = 81$)	55.6%	19.7%	11.2%	13.6%
Other gown (e.g., isolation; $n = 75$)	2.6%	0	5.3%	92.1%
Reused disposable gowns ($n = 76$)	4%	7.9%	10.5%	77.6%
Eye protection ($n = 77$)	22.1%	6.5%	14.3%	57.1%
Respirator ($n = 77$)	9.1%	5.2%	14.3%	71.4%
Handling excreta				
Chemotherapy gloves ($n = 91$)	70.3%	7.7%	2.2%	19.8%
Other gloves ($n = 74$)	17.8%	2.7%	8.2%	71.6%
Double gloves ($n = 76$)	9.2%	7.9%	14.5%	68.4%
Chemotherapy gown ($n = 77$)	20.8%	20.8%	13%	36.4%
Other gown (e.g., isolation; $n = 76$)	9.2%	15.8%	14.4%	60.5%
Reused disposable gowns ($n = 74$)	0	9.5%	9.5%	81.1%
Eye protection ($n = 75$)	14.7%	2.6%	25.3%	57.3%
Respirator ($n = 74$)	5.4%	4.1%	19%	71.6%

Source: Graeve et al. (2016).

Appendix E

Organizational Factors and Personal Protective Equipment Use*

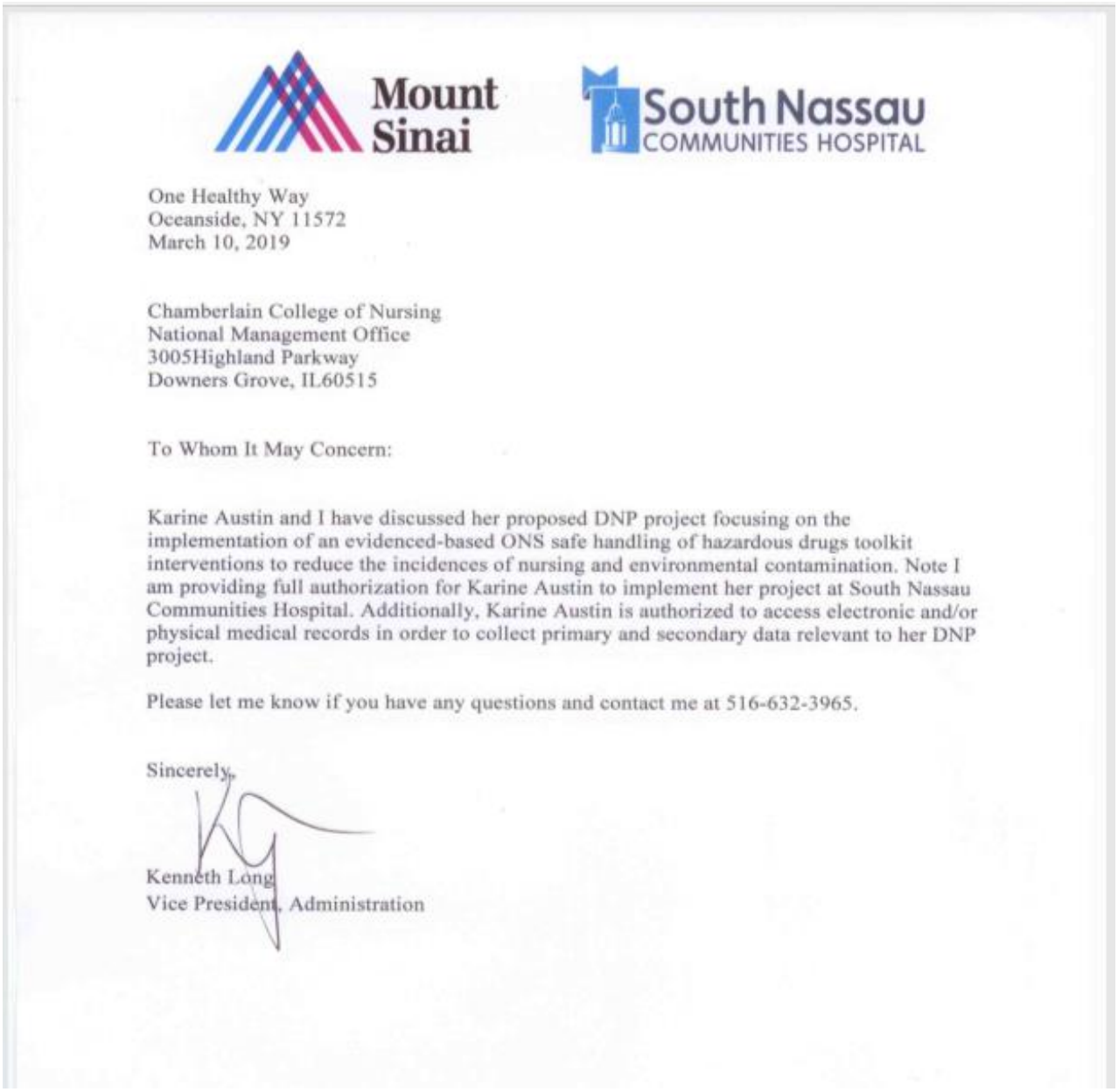
	Parameter Estimate	**(95 % CI)**	***p* value**
Nurse participation in hospital affairs	0.25	0.10 to 0.41	.001
Collegial nurse-physician relations	−0.19	−0.35 to −0.03	.02
Barriers to protective equipment use**	0.65	0.36 to 0.93	<.001
Nursing workloads	0.03	0.01 to 0.04	<.01
Non-private practice ownership	0.37	0.10 to 0.64	<.01

*Multivariable linear regression analysis using generalized estimating equations to account for clustering of nurses within practices.
**Barriers to Protective Equipment Use scale is reverse scored (higher score reflects fewer barriers).

Source: He et al. (2017).

Appendix F

Letter of Support



Mount Sinai

South Nassau COMMUNITIES HOSPITAL

One Healthy Way
Oceanside, NY 11572
March 10, 2019

Chamberlain College of Nursing
National Management Office
3005Highland Parkway
Downers Grove, IL60515

To Whom It May Concern:

Karine Austin and I have discussed her proposed DNP project focusing on the implementation of an evidenced-based ONS safe handling of hazardous drugs toolkit interventions to reduce the incidences of nursing and environmental contamination. Note I am providing full authorization for Karine Austin to implement her project at South Nassau Communities Hospital. Additionally, Karine Austin is authorized to access electronic and/or physical medical records in order to collect primary and secondary data relevant to her DNP project.

Please let me know if you have any questions and contact me at 516-632-3965.

Sincerely,

Kenneth Long
Vice President, Administration

Appendix G

Project Implementation Timeline

DNP Project Implementation Timeline	Duration	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Approval from Chamberlain University IRB Committee	0 weeks										
Chemotherapy handling pre-questionnaire	1 week										
CHEMOALERT surface pre-testing	1 week										
Purchase of new equipment	1 week										
Presentation of safe handling practice education to nurses	1 week										
Implementation & Go Live with 1. Equipment 2. Clinical observation at least 2-3 days weekly of proposed interventions and formative evaluation using structured-debriefing at the end of the clinical day.	8 weeks										
Chemotherapy handling post-questionnaire	1 week										
CHEMOALERT surface post-testing	1 week										
Data collection	1week										
Data analysis	1 week										
Data results	1 week										

Appendix H

Chemotherapy Handling Questionnaire (Developed by Dr. Martha Polovich, 2010 used with written permission)

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 workplace:
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	☐	☐	☐	☐	☐

	SA	A	N	D	SD
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 workplace:			

Is there anything else you would like to tell us about safe handling in your work place?

Thank you for participating in this study!

Appendix I

From: Martha Polovich <mpolovich2@gsu.edu>
Sent: Tuesday, March 12, 2019 8:21 AM
To: Austin, Karine O. <Karine.Austin@snch.org>
Subject: RE: Permission to use instruments

Karine,

You are welcome to use the instruments for your project. I am sending the questionnaire and the scoring guide as attachments to this message. You have my permission to use or adapt the questionnaire as needed. I ask that if you publish any results, that you reference me as the author of the original questionnaire.

Good luck with your project.

Sincerely,

Martha Polovich, PhD, RN, AOCN
Assistant Professor
Byrdine F. Lewis College of Nursing and Health Professions
P.O. Box 4019
Atlanta, GA 30302-4019
mpolovich2@gsu.edu
404-413-1171

Georgia State University | BYRDINE F. LEWIS COLLEGE OF NURSING AND HEALTH PROFESSIONS

From: Austin, Karine O. <Karine.Austin@snch.org>
Sent: Monday, March 11, 2019 3:13 PM
To: Martha Polovich <mpolovich2@gsu.edu>
Subject: Permission to use instruments

Good afternoon Mrs. Polovich,
I am currently pursuing my doctorate in nursing practice and my project is on reducing the incidences on chemotherapy and other hazardous drug contamination in the outpatient setting. I would like to know if I can request a copy and use your instrument for my project. Thanks

Karine Austin, MSN, RN, NEA-BC, CENP
Service Line Administrator, Oncology & Infusion Therapy
South Nassau Communities Hospital
One Healthy Way, Oceanside, NY 11572
516-632-3482

Appendix J

Plan for Educational Offering

OBJECTIVES	CONTENT (Topics)	TEACHING METHODS	TIMEFRAME	EVALUATION METHOD
To identify the risk of hazardous drug exposure	Hazardous Drugs	Lecture, PowerPoint slide presentation, handouts, question & answer	8 minutes	Chemotherapy handling questionnaire section 1
Ability to differentiate the various hierarchy of controls in the clinical setting	Hierarchy of Controls	Lecture, PowerPoint slide presentation, handouts, question & answer	8 minutes	Chemotherapy handling questionnaire section 1 to 13
Determine the personal protective equipment required in different medication administration situations	Personal Protective Equipment	Lecture, PowerPoint slide presentation, handouts, question & answer	10 minutes	Chemotherapy handling questionnaire section 3
Identify the personal protective equipment donning and doffing procedures Compare organizational policies to the safe handling practices recommendations by ONS, NIOSH	Safety Precautions	Lecture, PowerPoint slide presentation, handouts, question & answer	10 minutes	Chemotherapy handling questionnaire sections 2, 3 and 13

Select the route of disposal for hazardous drugs and trace contaminated materials	Waste Disposal/Routine Cleaning	Lecture, PowerPoint slide presentation, handouts, question & answer	8 minutes	Chemotherapy handling questionnaire section 6
Describe the actions to take following acute exposure to hazardous drugs	Acute Exposure	Lecture, PowerPoint slide presentation, handouts, question & answer	8 minutes	Chemotherapy handling questionnaire section 7
Identify the sequence of steps in hazardous drugs spill management process	Spill Management	Lecture, PowerPoint slide presentation, handouts, question & answer	8 minutes	Chemotherapy handling questionnaire section 8

Tables

Table 1

Budget

EXPENSES				
Direct Costs	**Unit Cost**	**Quantity**	**Cost**	**2020 Projection****
Office Supplies:				
Paper (Pre & Post-questionnaire)	$0.05	280 1	$14.00	NA
Toner	$10.00		$10.00	
Supplies:				
CHEMOALERT® surface wipe test	$230.00	20	$4600.00	NA
Decontamination agent	$10.16	9	$91.44	$213.36
Chemotherapy glove	$0.10	584*	$58.40	$657.60
Chemotherapy gown	$0.65	584*	$379.60	$4,274.40
N95 masks	$1.35	59	$60.35	$886.95
Equipment:				
Leur lock adaptor	$0.55	584*	$321.20	$3,616.80
Syringe adaptor	$1.95	59	$115.05	$1,281.15
Total Expense			**$5.650.04**	**$10,930.26**

*Based on a 3-month average (April/May/June 2019) of chemotherapy preparation volume

**Estimated >6,000 chemotherapy administrations

Table 2

Demographics

	Frequency	%
Gender		
Male	2	7.4
Female	25	92.6
Race or Ethnic Identity		
Asian	6	22.2
Black/African American	3	11.1
White	17	63.0
Two or more	1	3.7
Highest Education Level		
Associate degree	3	11.1
Bachelor's degree	22	81.5
Master's degree	2	7.4
Oncology Nursing Society member		
Yes	19	76.0
No	6	24.0
Certified in nursing		
Not certified	11	40.7
Oncology certified	11	40.7
Other certification	5	18.6
Chemotherapy setting		
Inpatient	11	40.7
Outpatient	14	51.9
Both	2	7.4
Facility Type		
Community non-teaching hospital	4	14.8
Community teaching hospital	17	63.0
Private physician office	2	7.4
Public/Government hospital	2	7.4
Other	2	7.4

Table 3

Sample Characteristics

	M	SD
Age (years)	43.96	11.95
Experience (years)		
Nursing	12.19	9.68
Oncology	6.93	6.48
Handling chemotherapy (years)	6.68	6.65
Treatment volume		
Patients per nurse per day	2.73	2.86
Patients per day at work	11.78	13.00

Table 4

Descriptive Statistics and t-test Results for CHEMOALERT™ Surface Sample Testing

	Pre-surface sampling		Post-surface sampling		95% Confidence Interval of the difference				
Variable	M	SD	M	SD	Lower	Upper	t	df	Sig. (2-tailed)
Oxaliplatin	7.47	4.08	5.00	0.00	-0.44	5.38	1.91	9	0.08
5-Fluorouracil	950.92	2951.30	5.00	0.00	-1.76	1.76	0.00	9	1.00

Table 5

Descriptive Statistics and t-test Results for Chemotherapy Handling Questionnaire Domains

	Pre-Questionnaire		Post-Questionnaire		95% Confidence Interval of the difference				
	M	SD	M	SD	Lower	Upper	t	df	Sig. (2-tailed)
Chemotherapy exposure knowledge	7.62	1.13	7.66	0.92	-0.562	0.479	-0.166	23	0.870
Self-efficacy for using PPE	9.57	2.23	8.14	2.52	0.036	2.821	2.140	20	0.045
Perceived barriers	22.81	6.41	19.40	5.92	-0.222	0.639	1.000	23	0.328
Perceived risks	2.20	0.31	2.22	0.21	-0.171	0.135	-0.241	23	0.812
Administration	11.76	7.93	19.47	5.41	-12.907	-2.50	-3.14	16	0.006
Disposal	10.63	9.44	19.15	5.33	-14.171	-2.881	-3.17	18	0.005
Handling Excreta	6.16	4.26	18.66	5.82	-18.464	-63.536	-5.38	5	0.003
Interpersonal influence	1.81	0.63	2.77	0.65	-1.379	-0.534	-4.696	22	0.000
Conflict of interest	11.50	3.98	10.00	3.12	-0.591	3.591	1.484	23	0.151
Workplace safety	76.79	12.49	86.37	9.31	-15.480	-3.686	-3.36	23	0.003