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**THE ROLE OF THE HEALTHCARE PROVIDER
IN FACILITATING RISK SURVEILLANCE
OF OCCUPATIONAL EXPOSURE TO
ANTINEOPLASTIC AGENTS**

Being

An Evidence Based Practice Project Presented to the Graduate Faculty
of Mississippi University for Women in
Partial Fulfillment of the Requirements for
the Degree of Master of Science in Nursing

by

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DEDICATION

I wish to dedicate my research to my children Sarah, Jasmine, David, and Amy.

They have been and will continue to be my life's inspiration.

**EVIDENCE-BASED PRACTICE CONSIDERATIONS IN
FACILITATING THE RISK SURVEILLANCE OF
OCCUPATIONAL EXPOSURE TO
ANTINEOPLASTIC AGENTS**

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Abstract

According to Martin and Larson (2003), healthcare professionals involved with handling antineoplastic drugs may be exposed inadvertently to these agents, placing them at potential risk for acute and long-term adverse effects. For example, cyclophosphamide one of the most frequently used antineoplastic agents in clinical treatment facilities, is a known human carcinogen (Larson, Khazaeli, & Dillon, 2003). While the health risks associated with cytotoxic use have been well established, there is little information available about how people perceive these risks, particularly among those most affected by it-chemotherapy nurses. Therefore, the purpose of this Evidence Based Practice (EBP) project was to develop a nurse practitioner knowledgebase regarding the impact of risk perception on the cytotoxic agent safety behaviors of oncology nurses. The research questions asked: (a) what is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents? (b) according to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards? and (c) according to the literature, how can healthcare providers

contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents? A Boolean computer search of nursing and medical literature for theory-based, data-based, randomized controlled trials for citations utilizing CINAHL, MEDLINE, and the Cochrane Library was conducted for this systematic review.

Becker's Health Belief Model (1974) served as the theoretical foundation for this clinical project and guided the systematic review through data collection of the healthcare literature. Literature reviewed totaled 8 manuscripts, which represented reviews of another 122 references. Studies of healthcare workers have shown that occupational exposure to antineoplastic agents has caused acute adverse effects such as nausea, headache and dizziness (Valanis, Vollmer, Labuhn, & Glass, 1997). Exposure risk and its relationship to healthcare professionals' compliance to established protocols for the safe handling and administration of chemotherapy agents continues to be a concern for health care institutions (Ritchie, McAdams, & Fritz, 2000). The literature reviewed for this study recommends compliance with established safety guidelines to ensure adequate protection to those involved in the handling, administration, and care of patients receiving antineoplastic agents. Yet despite the adoption of these guidelines in healthcare institutions, the current literature also suggests that many workers do not follow the standards established by their employers and current OSHA guidelines, putting themselves at risk for exposure to potential mutagenicity, alterations in fertility and long-term effects from chemotherapy agents (Valanis, Vollmer, Labuhn, & Glass, 1997).

Using an Evidence Based Medicine (EBM) approach, based on that of Sackett, Straus, Richardson, Rosenberg, and Haynes (2000), a knowledgebase was developed

according to methods described by Davidson (2003) in which key findings from the systematic review of randomized control trials, data-based and theory-based literature were compared with current practice guidelines, resulting in a number of safe practice recommendations. These recommendations emphasize that safe levels of exposure to antineoplastic agents have not been determined therefore; it is essential to minimize exposure.

The need for further attention to risk surveillance of occupational exposure to antineoplastics in advanced practice nursing literature is critical. Evidence-based practice modalities that will utilize current guidelines in the risk surveillance of occupational exposure to antineoplastic agents are essential for nurse practitioner application in oncology settings. Implications for nursing theory, nursing research, advanced nursing practice, nurse practitioner education, and health policy are provided as they emerge from the concepts explored.

ACKNOWLEDGEMENTS

I would also like to express my most sincere thanks to Dr. Janice Unruh Davidson, my Supervising Professor and Major Advisor, who guided and mentored me throughout my thesis. She is truly a student advocate, putting in countless extra hours and placing student needs above her own on numerous occasions just to help them get the most out of their educational endeavors. This research project would not have been possible without her help and guidance.

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CHAPTER I

Dimensions of the Problem

Occupational exposure to harmful agents has been identified as a problem of increasing health concern (Martin & Larson, 2003). Agencies such as the Oncology Nursing Society, the Occupational Safety and Health Administration, and the American Society of Health-Systems Pharmacists have developed guidelines for the safe handling of hazardous drugs because of the potential dangers they present. According to Martin and Larson, compliance with established safety guidelines is increasing as compared to previous chemotherapy-handling studies. However, many health professionals continue to disregard these guidelines in their everyday practice.

The administration of chemotherapeutic agents is an integral part of nurses' role in the provision of care. Cytostatic drugs possess toxic properties and may cause mutagenic, carcinogenic and teratogenic effects. Therefore, nurses handling these drugs in the course of their profession may face serious health risks. The occupational exposure risk of cytotoxic agents was first documented in healthcare personnel by Falck et al. (1979), who reported an elevated frequency of mutagenesis in spot urines after continuous low-level exposure within a group of oncology nurses. Proper handling of these drugs combined with the use of personal protective equipment can drastically reduce this threat.

Problem Statement

While the health risks associated with cytotoxic use have been well established, there is little information available about how people perceive these risks, particularly among those most affected by it-chemotherapy nurses. Chemotherapy is a treatment

method of choice for many cancers. The preparation and administration of chemotherapeutic agents is often a primary responsibility of the oncology nurse.

According to Martin and Larson (2003), healthcare professionals involved with handling antineoplastic drugs may be exposed inadvertently to these agents, placing them at potential risk for acute and long-term adverse effects. For example, cyclophosphamide is one of the most frequently used antineoplastic agents in clinical treatment facilities, and is a known human carcinogen (Larson, Khazaeli, & Dillon, 2003).

Generally, the occupational activities that pose the greatest risk of exposure are the preparation and administration of antineoplastic agents, cleaning of chemotherapy spills, and handling of patient excreta (Martin & Larson, 2003). Agencies such as the Oncology Nursing Society have developed guidelines for the safe handling of hazardous drugs because of the potential dangers they present. These guidelines are recommendations that are intended to improve the routine involved with the preparation and administration of chemotherapy. Thus, the problem statement that was generated for the scope of this investigation concerns the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents.

Statement of Purpose

Exposure risk and its relationship to healthcare professionals' compliance to established protocols for the safe handling and administration of chemotherapy agents continues to be a concern for healthcare institutions (Ritchie, McAdams, & Fritz, 2000). Studies of healthcare workers have shown that chemotherapy drugs have caused acute adverse effects such as nausea, headache and dizziness (Valanis, Vollmer, Labuhn, & Glass, 1997). Other potential long-term adverse reactions documented in the literature

related to occupational exposure to antineoplastics include chromosomal aberrations and adverse reproductive outcomes. Currently, there does not exist sufficient research to explain why some healthcare workers do not follow recommended precautions (Ritchie et al., 2000). Future nursing research should focus on assessing and identifying ways to increase awareness and encourage compliance.

Significance of the Study

The current level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents is limited. A computer search utilizing CINAHL, MEDLINE, and Cochrane Library, revealed only several articles on this subject. Terms utilized in the search included the following:

Table 1

Summary of Literature Searches

Search Terms	Number of Citations	Database
nurs* and risk surveillance	1	CINAHL
	2	MEDLINE
	31	COCHRANE
nurs* and occupational exposure	1002	CINAHL
	1202	MEDLINE
	35	COCHRANE
nurs* and chemotherapy agents	29	CINAHL
	30	MEDLINE

	34	COCHRANE
nurs* and antineoplastic agents	930	CINAHL
	1639	MEDLINE
	7	COCHRANE
risk surveillance and occupational exposure	0	CINAHL
	1	MEDLINE
	6	COCHRANE
nurse practitioner and Becker	0	CINAHL
	6	MEDLINE
	11	COCHRANE
risk surveillance and Becker	0	CINAHL
	0	MEDLINE
	7	COCHRANE
occupational exposure and Becker	0	CINAHL
	41	MEDLINE
	4	COCHRANE

Note. CINAHL = Cumulative Index to Nursing and Allied Health Literature, MEDLINE = Medical Literature Online, COCHRANE = Cochrane Library (Cochrane Database of Systematic Review, Cochrane Database of Abstracts of Reviews of Evidence, and Cochrane Clinical Trials Register).

Clinical significance regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents is focused on the need for cost-effective, high-quality care. In spite of the medical benefits resulting from the

use of these drugs, they may be potentially harmful to workers handling them. Adverse health effects from both acute and chronic exposures have been demonstrated in healthcare personnel. In 1979, the British journal, *Lancet*, published a report suggesting that healthcare personnel handling antineoplastic agents may be at risk. This study by Falck et al. (1979) showed mutagenic activity in the urine of nurses working in an oncology unit, and proposed that the cause was related to exposure to antineoplastic agents. This was the first look at the carcinogenic risk of antineoplastics from an occupational standpoint. The clinical significance regarding the occupational exposure risks associated with antineoplastic use is tremendous.

Theoretical Foundation

The Health Belief Model (HBM) and its extended form, the Protection Motivation Theory (PMT) state that the adoption of a behavior appropriate to the prevention or control of some disease depends on the individual's perception of a threat to personal health and a conviction that the recommended action will reduce this threat (Floyd, Prentice-Dunn, & Rogers, 2000). The Protection Motivation Theory has been used in many studies that attempt to explain why behavioral choices are made, thus is an appropriate theoretical framework for this study. The perception of a health threat is determined by the strength of two underlying beliefs: personal susceptibility to a given disease and the potential severity of its impact on the individual's life. These perceptions can be awakened or strengthened through a striking event. The perceived efficacy of the recommended preventive action depends on a personal assessment of the perceived benefits of the proposed behavior and real or perceived barriers to initiation or continuation of the suggested behavior. The Protection Motivation Theory assumes that

anticipation of a negative health outcome and the desire to avoid this outcome or reduce its impact creates motivation for self-protection (Rogers, 1983). And that intent to change behavior is generated only when the benefits outweigh the costs associated with making the change.

According to the PMT, a maladaptive response like not using protective equipment is facilitated by certain rewards. For example, nurses' can quickly prepare and administer the chemo without having to adorn all sorts of protective equipment. This translates into less time patients have to wait. The maladaptive response is also inhibited by the perceived severity of exposure risk and nurses' perceived vulnerability to it. In the PMT, anxiety has no direct relation with behavioral intention or behavior, but is mediated by perceived vulnerability, which is seen as a cognitive representation of anxiety (Floyd, Prentice-Dunn, & Rogers, 2000). Adaptive responses, such using personal protective equipment is, according to the model, facilitated by response efficacy and self-efficacy. In this context, response efficacy refers to the belief that using protective equipment reduces the risks of exposure. Self-efficacy refers to the perceived ability to perform these behaviors consistently. While it cannot predict the amount of behavior change that will occur following an intervention, Protection Motivation Theory can predict whether some groups more than others will benefit from interventions based on the theory (Rogers, 1983). The Protection Motivation Theory has been used in many studies that attempt to explain why behavioral choices are made, thus is an appropriate theoretical framework for this study.

Definition of Terms

For the purposes of this study, the following terms are defined:

Risk Surveillance

Theoretical. Life is a risky business and deciding which risks are worth taking and which should be avoided has important implications for an individual's lifestyle. The benefits gained from taking a risk need to be weighed against the possible disadvantages. Different people have a different level of preference for taking risks. Some people go bungee-jumping in their free time while others prefer to read. Demographic variables have a large effect on risk propensity. For example, males have a higher risk inclination than females; older people have a lower risk inclination than younger people; different cultures endorse different risk-taking values; and person with more dependents will tend to take fewer risks (Lipshitz, Klein, Orasanu, & Salas, 2001).

Risk perception also depends on experience. An inexperienced decision-maker will perceive lower risk, and as a result, might often take greater risks than desirable. Also, because his or her decision is based on only a small sample of past decisions and outcomes, it is likely that an additional piece of information might cause him or her to change the decision (Lipshitz et al., 2001). A moderately experienced decision-maker sees all the risks involved and is not as likely to be affected by additional information, since he or she has more to experience to base the decision on. Just like the moderately experienced decision-maker, the expert knows about all the risks; however, because of his or her past experience, the expert might be overconfident and again perceive the risks as lower than they actually are, potentially leading to overconfidence. Lastly, risk perception is affected by perceived responsibility for the outcome: people will regard as more risky situations that they have full responsibility. Therefore, many people try to

limit their personal responsibility for risky outcomes by discussing the decision with their superiors or their team.

Operational. Research shows that people tend to overestimate the probability of unfamiliar, catastrophic and well-publicized events and to underestimate the probability of unspectacular or familiar events (Lipshitz et al., 2001). Misperception of risk can lead to unreasonable concern about a hazard. Given a chance, people would rather not have to confront the risks inherent in life's activities. Psychological research shows that whenever possible, people attempt to reduce the anxiety generated in the face of uncertainty by denying that uncertainties, thus making the risk seem either so small that it can safely be ignored or so large that it clearly should be avoided. They are uncomfortable when given statements of probability rather than fact; they want to know exactly what will happen. The general public's perceptions of risk are often highly inaccurate, but by underestimating common risks while exaggerating exotic ones, we may end up protecting ourselves against the unlikely perils while failing to take precautions against those that are far more dangerous.

Occupational Exposure

Theoretical. Occupational exposure is the reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially hazardous materials that may result from the performance of an employee's duties. Occupational exposure to hazardous drugs and the resulting potential health risk to healthcare workers first became a recognized safety concern in the 1970s. Traditional assumptions about safe drug handling were challenged by a study published in a recent edition of the American Journal of Health-System Pharmacy. This study confirmed that, despite existing

protective measures, there persists widespread surface contamination with antineoplastic drugs in the workplace and employee exposure to carcinogenic or mutagenic particulates and vapors.

The inadvertent introduction of hazardous drugs into an environment can occur in various ways. Drug containers may become damaged in the shipping process. A broken, cracked, or otherwise damaged container may result in leakage of the hazardous materials onto other containers. If not properly inspected upon receipt, the shipping container can be opened in the receiving area, exposing receiving personnel to the hazardous agent. In addition, contamination of the surrounding drug storage areas may occur. The manipulation required to prepare hazardous drugs for administration may also lead to environmental contamination. Leaks, spills, and the creation of aerosols of liquid drugs can occur during dose preparation. The process of priming IV tubing may lead to inadvertent environmental contamination if the priming process is not performed appropriately. In addition, during drug administration, tubing and injection port connections that are not properly secured may lead to leakage of the prepared agent. Inappropriate disposal of hazardous drugs, either from the clean-up of spills or leaks, or from waste created during drug preparation and administration, can also lead to environmental contamination.

Operational. Mutagenic changes in the urine and evidence of chromosome damage in healthcare personnel who have prepared or administered antineoplastic drugs led to the conclusion that handling such drugs poses a genuine health risk to the individuals involved. Because these measures were indirect, and a direct cause-and-effect relationship could not be determined, more direct methods of determining exposure have

been developed. These methods include urinalysis to determine the presence of metabolites of dangerous drugs handled by healthcare workers, and environmental air and surface sampling techniques

Antineoplastic Agents

Theoretical. These agents are chemotherapy drugs that modify the growth and reproduction of cancer cells through alteration of the genetic material thereby destroying them. Despite the medical benefits of these drugs, they may be potentially harmful to workers handling them. Many chemotherapeutic drugs are known human carcinogens, for which there is no safe level of exposure. Falck et al. (1979) were the first to note evidence of mutagenicity in the urine of nurses who handled cytotoxic drugs. Researchers have also studied pharmacy personnel who handled antineoplastic drugs. The researchers showed increasingly mutagenic urine over the period of exposure; when they stopped handling the drugs, activity fell within 2 days to the level of unexposed controls (Nguyen, Theiss, & Matney, 1982). The researchers also found mutagenicity in workers using horizontal laminar flow hoods that decreased to control levels with the use of vertical flow containment hoods.

Operational. Generally, the occupational activities that pose the greatest risk of exposure are the preparation and administration of antineoplastic agents, cleaning of chemotherapy spills, and handling of patient excreta (Martin & Larson, 2003). The Occupational Safety & Health Administration has created guidelines to control occupational exposure to hazardous drugs like the cytotoxic agents used in cancer treatment facilities. Safe levels of exposure have not been determined therefore; it is essential to minimize exposure to these agents.

The guidelines recommends that chemotherapy preparation be performed in a restricted, preferably, centralized area (OSHA, 1999). Signs restricting the access of unauthorized personnel are to be prominently displayed. Eating, drinking, smoking, chewing gum, applying cosmetics, and storing food in the preparation area should be prohibited. OSHA also recommends that procedures for spills and emergencies, such as skin or eye contact be posted in this area. The use of class II or III Biological Safety Cabinets should minimize exposure during preparation. Decontamination of the hood should be performed routinely and serviced by a qualified technician at least every six months.

Research indicates that the thickness of the gloves used in handling antineoplastics is more important than the type of material, since all materials tested have been found to be permeable to some agents (Singleton & Connor, 1999). Because all gloves are permeable to some extent and their permeability increases with time, they should be changed regularly (hourly) or immediately if they are torn, punctured, or contaminated with a spill (OSHA, 1999).

A protective disposable gown made of lint-free, low-permeability fabric with a closed front, long sleeves, and elastic or knit closed cuffs should be worn (OSHA, 1999). The cuffs should be tucked under the gloves. Eye and face protective equipment should be worn whenever splashes, sprays, or aerosols of chemo may be generated. All gowns, gloves, and disposable materials used in preparation should be disposed of according to the hospital's hazardous drug waste procedures and as described under this review's section on waste disposal. Goggles, face shields and respirators may be cleaned with mild detergent and water for reuse.

Findings from existing research indicate that compliance with established safety guidelines offers adequate protection to those healthcare workers involved in the handling, administration, and care of patients receiving chemotherapy agents (Ritchie, McAdams, & Fritz, 2000). Despite the adoption of these guidelines in healthcare institutions, reports in the current literature suggest that some workers do not follow the standards established by their employers and current OSHA guidelines, putting themselves at risk for exposure to potential mutagenicity, alterations in fertility and long-term effects from chemotherapy agents (Valanis, Vollmer, Labuhn, & Glass, 1997). Valanis, McNeil, and Driscoll (1991) found like results among staff members' adherence to facility protocol regarding the handling of cytotoxic agents. Ben-Ami, Shaham, Rabin, and Ribak (2001) showed that notwithstanding the rules and regulations pertaining to cytotoxic drugs, nurses in the study did not comply to them fully. The safety behavior of exposed nurses and the relative usage of safety equipment were related to their appraisal of their susceptibility to becoming ill.

Nurses have given a number of reasons for not wearing protective equipment when handling cytotoxic drugs (Valanis, McNeil, & Driscoll, 1991). Barriers to using the protective equipment include that it is inconvenient to wear, time-consuming and awkward to apply, and not readily available (Mahon, Casperson, Yackzan, Goodner, Hasse, Hawkins et al., 1994). Other barriers include a lack of awareness of the health risks of handling cytotoxic drugs, disbelief that a danger actually exists despite being informed, and a concern that wearing the protective equipment may upset the patient (Mahon et al., 1994).

Research Questions

For the purposes of this study, the following research questions were generated:

1. What is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents?
2. According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards?
3. According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents?

Delimitations

Literature was delimited, for the purpose of this integrative literature review, to the following:

1. Literature that pertains to the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents.
2. Literature that is available in the English language or translated into English abstracts.
3. Literature available through CINAHL, MEDLINE, and Cochrane Libraries.
4. Literature that is available through the Mississippi University for Women Library and Interlibrary loan program.

Limitations

For the purpose of this investigation a particular limitation identified is that the information obtained cannot be generalized beyond the scope of the research reviewed. The generalizability of the findings is further impacted by the lack of nursing research related to the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents.

Summary

The oncogenic and teratogenic effects of antineoplastic agents are well established. However, the long term effects of continued exposure to small amounts of one or more of such drugs remain undetermined. For example, it is known that long-term use of potent immunosuppressive agents may result in the development of lymphoma. It is not known, however, at what drug level or over what period of time this may occur and how this correlates with possible drug levels achieved through occupational exposure during preparation and administration of hundreds or thousands of injectable and oral doses of these agents.

The danger to healthcare personnel from handling hazardous drugs stems from a combination of its inherent toxicity and the extent to which workers are exposed to the drug in the course of carrying out their duties. This exposure may be through inadvertent ingestion of the drug on foodstuffs (e.g., workers' lunches), inhalation of drug dusts or droplets, or direct skin contact. *Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Healthcare Settings* was recently published by NIOSH (DHHS Publication Number 2004-165). The purpose of this release was to increase awareness among healthcare workers and their employers about the health risks posed by

working with hazardous drugs and to provide them with measures to protect their health. To date, the research provides primary evidence that healthcare workers exposed to hazardous drugs during the course of their work are absorbing these drugs and are at risk for adverse outcomes.

Additional research in this area is needed, but awareness of the problem has led to overall reduction of exposures, either by improved drug handling techniques or through the implementation of safety programs and thus fewer exposed healthcare workers are available for study. Definitive knowledge of the occupational dangers of handling hazardous drugs may someday be available through epidemiologic studies of healthcare workers.

In theory, correct and perfect preparation and handling techniques will prevent drug particles or droplets from escaping from their containers while they are being manipulated. Near-perfect technique is uncommon; therefore, contamination of the workplace is likely and worker exposure may increase without protective equipment and other safety measures. This is particularly true in the absence of any structured training and quality-assurance programs covering the proper handling of hazardous drugs.

CHAPTER II

Review of Literature

This investigation is an integrative literature review which summarizes research on a topic of interest by placing the research problem in context and identifying gaps and weaknesses in prior studies to justify new investigations (Polit & Beck, 2004). For the purpose of this investigation, data-based and theory-based manuscripts were reviewed and critiqued using a knowledgebase template concerning occupational exposure to antineoplastic agents (see Appendix A). Literature reviewed totaled six data-based manuscripts and three theory-based manuscripts, which represented reviews of another one-hundred thirty references. In this chapter, an overview of the study variables is presented as it has emerged from the developing knowledgebase.

An Overview of the Healthcare Literature Related to Risk Surveillance of Occupational Exposure to Antineoplastic Agents

According to a study by Brown (2000), that was indexed in MEDLINE, a number of pertinent conclusions were made concerning antineoplastic agents and occupational exposure. The data-based method was that of a descriptive design with a sample ($N=126$). A strength of the study was that the researchers employed genetic testing to validate chromosomal deviations resultant to occupational exposure to antineoplastic agent use among oncology nurses in a selected cancer clinic on the East coast. A weakness of the research was that generalizability of findings was limited due to the homogenous sample of convenience. The research does provide a foundation for further study in this area; however, the convenience sampling used in the study may impact external validity. Results suggest that exposure to antineoplastic is a potential health

hazard. Findings suggest that exposure be kept to a minimum and the use protective measures are essential when handling antineoplastics.

In a study by Burgaz et al., 2002), that was conducted in Turkey and indexed in MEDLINE, conclusions concerning antineoplastic drugs, chromosomal aberrations, and nurse occupational exposure were reported. The data-based method was that of a descriptive design with a large sample ($N=738$). The study showed that increased genetic damage was directly a result of occupational exposure to antineoplastic agents. A weakness of the design was that only one antineoplastic agent, cyclophosphamide, was reviewed in relationship to occupational exposure. The study reveals a need to research the concept and domains with other antineoplastic agents. In addition, lengthy written questionnaires can be source of error as subjects tire of questions and completes survey too quickly. However, the large sample does provide a foundation for future research in this area. Of concern was the fact that a questionnaire was used to assess previous personnel exposure to cyclophosphamide. Accuracy of such data collection remains unclear, relying heavily on recollection. Analyses of CP in urine demonstrated compound absorption. Also, higher CP excretion rates were observed among nurses handling CP, suggesting a direct relation between handling CP and occupational exposure to CP. Increased frequency of structural CA in peripheral lymphocytes is associated with an increased overall risk for cancer. This warrants chromosomal changes to be regarded as potentially serious effects. Exposure to these genotoxic chemicals should be limited. This study also showed that increased genetic damage was evident in nurses at the population level due to occupational exposure to antineoplastics. Results suggest that exposure be kept to a minimum and protective measures are essential when handling antineoplastics.

Also emphasized was the importance of the establishment and implementation of national regulations for handling these substances.

In a literature review by Gribben (2002), indexed in CINAHL, the concepts of antineoplastic agents, occupational exposure, and protective equipment were explored. The data-based manuscript followed the pattern of a systematic literature review. A strength of the study was that it examined factors influencing use of personal protective equipment and the development of acute adverse health effects. A weakness of the findings was that terms were not well-defined, which may obfuscate the author's intended meaning. The systematic review provides the foundation for further research. The lack of clarity in literature selection may be a source of potential bias influencing the findings. This article examined the use of personal protective equipment and adverse health effects associated with antineoplastic use. Findings indicate that the use of gloves, mask, and goggles have a significant effect on reducing the likelihood of adverse health outcomes associated with antineoplastic use. In addition, diligent preparation of the drugs under a biological safety cabinet greatly reduces the potential for adverse health effects. Results suggest that exposure be kept to a minimum and protective measures are essential when handling antineoplastics. Also emphasized was the importance of the establishment and implementation of national regulations for handling these substances.

In a research study conducted by Larson and Khazeli (2003), indexed in MEDLINE, conclusion were reported regarding research of antineoplastics and air monitoring methods. The data-based method was that of a descriptive design. Strengths of the research is that it explored a variety of filter monitoring methods for antineoplastics. Data collection and analysis were done concurrently thereby reducing the

risk of miscoding or other analysis errors. A weakness of the study is that preparation of standards were obtained but could not always be verified by the analysis of blank or spiked samples. The conclusions of the study provide a foundation for further research in this area. A threat to the study was that the potential for cyclophosphamide to sublime off filter material may account for potential skewed findings. This study addressed the issue of overall effectiveness of current monitoring media for antineoplastics. In addition, the study also looked at solid sorbent medias as a method of choice. Indications from the study include the finding that filter methods are not acceptable for air monitoring of cyclophosphamide and possibly other antineoplastic agents. This information also supports the observation that the HEPA filter is not an acceptable control for biological safety cabinets that return filtered air to the work room.

In a study by Rodgers (2000), that was indexed in MEDLINE, variables concerning pharmacy personnel, antineoplastic agents, and occupational exposure were explored. The data-based method was that of a descriptive design in a considerable sample ($N=348$). A strength of the research was the extensive descriptive survey of personnel exposure to antineoplastics and use of personal protective equipment. However, a weakness of the design was that lengthy, written questionnaires can be source of error as subjects tire of questions and completes survey too quickly. Moreover, nurses who fear their answer would exemplify them as ignorant or indifferent may not have answered truthfully. The research provides a foundation for further study exploring these variables. A threat to the study was the potential for skewed findings since risk is subjective in nature. Moreover, the subject may not reveal true feelings to avoid being labeled as indifferent or uncaring which could alter the validity of the findings. This

study looked at nurse perception of risk associated with antineoplastic use and examined the nurse's demographics in relation to the use of personal; protective equipment. The study revealed that the use of personal protection was statistically significant in regards to the demographic variables which were defined for the study.

In a research study conducted by Sardas, Gok and Karakaya (2003), that was conducted in Turkey and indexed in MEDLINE, variables explored included: antineoplastic drugs, chromosome damage, and occupational exposure. The data-based method was that of a quasi-experimental design ($n=23$ nurses; $n=50$ control). A strength of the research was that this study examined a group of 23 oncology nurses working in different university hospitals in Turkey with a control group of 50 unexposed individuals. However, the lack of standardized microscope slide preparation could potentially skew test results. Even so, the research provides the foundation for future exploration of these variables. A threat to the study was that several slides did not demonstrate any relationship between occupational exposure to antineoplastics and increased sister chromatid exchanges. This article examines the increase in sister chromatid exchanges in circulating lymphocytes among nurses handling antineoplastic agents. This work has also shown that cigarette smoking causes a significant increase in SCE's. Overall, this study supports the existence of an association between professional exposure to antineoplastic drugs and an increase in SCE's in lymphocytes and that smoking contributes to elevated SCE rates.

In a study by Thompson (2004), that was indexed in MEDLINE, the variables of hazardous chemicals, antineoplastic agents, and occupational exposure were explored. The data-based method was that of a descriptive design in a large sample ($N=421$). A

strength of the study was that the authors stressed the fact that antineoplastic use is appropriate and beneficial to patients experiencing a terminal disease such as cancer. However, there is significant risk for adverse health effects from occupational exposure. A weakness of the design was that the sample size was limited to members of Oncology Nursing Society. This study validated previous research that workplace exposure to antineoplastics is potential health risk. Adverse outcomes are associated highly with the extent of exposure as well as the toxicity of the drugs. However, the homogenous sample of convenience limits the ability to generalize the findings to other nurses without membership in ONS. This study looked at personnel exposure to antineoplastic agents in the workplace. Findings indicate the potential exists for adverse health effects with the use of these drugs. Further research should involve the deliberate sampling of diverse populations as well as the use of personal protective equipment to decrease the chances of risk.

In a research study conducted by Valanis, Vollmer, Labuhn, and Glass (2001), that was indexed in MEDLINE, the variables of antineoplastic agents, absorption, and toxicity were explored. The data-based method used was that of a descriptive design in a large sample ($N=800$). A strength of the study was that the setting included large medical centers where data was easily accessible. A weakness of the study was the lack of clarity in method may mask internal threats to validity and reliability of findings. Results of the study provide foundation for future research regarding acute adverse effects. A threat to the study was the volunteer-based sample and moderate participation rates are clear limitations-sample essentially protected group. This study looked at the relationship between occupational exposure to antineoplastic drugs and the presence of acute

symptoms of exposure. Handling of these drugs was associated with a significant increase in the number of symptoms compared with controls. Skin contact was the most predominant predictor of symptoms. The number of doses and extent of protection were significantly associated with the number of symptoms as well.

Summary

In reviewing the literature, it was determined that a consensus among the researchers exists regarding the fact that the drugs are cytotoxic and have the potential for causing adverse health effects, both short-term and long-term. Research supported the notion that three variables have emerged as being best predictors of adverse effects. These variables include: duration of exposure, toxicity of the drug, and use of personal protective gear. An area of disagreement among the researchers was found regarding the degree to which personal protective equipment was found to be effective. Moreover, current research regarding antineoplastic monitoring methods was found to be less effective than originally expected. An interesting finding of the literature review was the notion that complacency in working with such drugs, can kill. For healthcare providers, the importance of screening for occupational exposure is critical. Moreover, in occupational health environments, the importance of a pre-employment screening and regular screenings thereafter is essential.

CHAPTER III

Design and Methodology

This chapter will present the parameters used for this research investigation. The approach that was used was that of an evidence-based systematic review. According to Sackett, Straus, Richardson, Rosenberg, and Haynes (2000) evidence-based practice attempts to integrate best research evidence with clinical expertise and patient values. The literature selection procedure and literature analysis procedure is detailed in this chapter.

Approach

An integrated literature review, which is a review of research that amasses comprehensive information on a topic, weighs pieces of evidence, and integrates information to draw conclusions about the state of knowledge, will be used for this study. This investigation is an evidence-based practice systematic review. While an integrative literature review summarizes research on a topic of interest, by placing the research problem in context and identifying gaps and weaknesses in prior studies to justify the new investigation (Polit & Beck, 2004), evidence-based practice seeks to integrate best research evidence with clinical expertise and patient values (Sackett, Straus, Richardson, Rosenberg, & Haynes, 2000). A summary of the current literature regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents is provided.

Literature Selection Procedure

A systematic search of CINAHL, MEDLINE, and the Cochrane Library was conducted for the relevant literature concerning the role of the healthcare provider in

facilitating risk surveillance of occupational exposure to antineoplastic agents. The reference list accompanying each article was then manually reviewed for further articles pertaining to the subject. Articles were selected based on inclusion of at least one of the relevant concepts, whether as the focus of the article or as part of a broader topic. Other informative articles were also included to further explore the knowledgebase.

The systematic review of the literature began with CINAHL to find relevant nursing literature on the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. Next, MEDLINE and then the Cochrane Library were evaluated for further relevant literature. Journal articles were obtained through the Mississippi University for Women library, via Internet databases and interlibrary loan. The review incorporated data beyond nursing literature to expand the knowledgebase for a thorough review, thus providing a multi-disciplinary approach.

References utilized were relevant and applicable to this investigation. The references were obtained from reputable and respected scholarly journals in the healthcare fields. The evidence-based practice procedure (Sackett, et al., 2000) for the systematic review comprises the following steps:

1. convert the need for information (about prevention, diagnosis, prognosis, therapy, causation, etc.) into research questions.
2. track down the best evidence with which to answer the questions using a variety of database strategies.
3. critically appraise the evidence for its validity (closeness to the truth), impact (size of the effect), and applicability (usefulness in our clinical practice addressing both sensitivity and specificity).

4. integrate the critical appraisal with clinical expertise and the patient's unique biology, values and circumstances (p. 3-4).

Literature Analysis Procedure

For the purpose of this study, a knowledgebase of literature critiques will be used to organize the literature by source and date, variables of interest, literature type and research tools, research design and sample size, theoretical foundation, references, and key findings. Data (provided in Appendix A) is analyzed in terms of relevancy of findings and then summarized utilizing a chart format to assist in application of findings to the clinical problem. The findings document the current state of knowledge available that is discussed in Chapter Four according to the research questions regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents.

Summary

This chapter detailed the parameters for this research investigation. This evidence-based practice systematic review of the literature will be conducted utilizing the literature selection procedure and literature analysis procedure highlighted above. Through this process, the research questions regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. will be answered.

CHAPTER IV

Knowledgebase Findings and Practice-Based Application

The purpose of this section is to expound the findings of the knowledgebase derived from this evidenced-based systemic literature review. Tables showing pertinent findings from of this knowledgebase are provided with practice-based applications from current clinical practice guidelines.

Knowledgebase Findings

In order to obtain the knowledgebase findings, a systematic literature search of CINAHL, MEDLINE, and the Cochrane Library was conducted by this author. The literature reviewed totaled 8 citations, which represented another 122 references. Findings from the literature reviewed are addressed in this section in terms of each research question generated for the scope of this study.

Research Question One

Research question one asks: What is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents? The results of this literature review reflect the growing knowledge of the risks associated with exposure to antineoplastic drugs, as well as the development and application of policies aimed at preventing occupational exposure of nurses to these drugs. Healthcare professionals think of antineoplastic drugs in terms of their therapeutic value to cancer patients. However, there's a risk of serious health problems for healthcare workers who are occupationally exposed to such agents.

Table 2***Characteristics of Citations Reviewed***

Citation	Type	Database
Brown, 2000	Data-based (descriptive)	MEDLINE
Burgaz et al., 2002	Data-based (descriptive)	MEDLINE
Gribben, 2002	Data-based (systematic literature review)	CINAHL
Larson & Khazeli, 2003	Data-based (descriptive)	MEDLINE
Rodgers, 2000	Data-based (descriptive)	MEDLINE
Sardas, Gok & Karakaya, 2003	Data-based (quasi-experimental)	MEDLINE
Thompson, 2004	Data-based (descriptive)	MEDLINE
Valanis, Vollmer, Labuhn, & Glass, 2001	Data-based (descriptive)	MEDLINE

Note. Total number of citations reviewed = 8.

Research Question Two

Research question two asks: According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards? Studies have demonstrated widespread environmental contamination by hazardous drugs in preparation and administration areas, as well as human uptake. Healthcare providers can facilitate the delivery of high-quality healthcare to oncology patients by complying with current standards and recommendations set forth by agencies such as OSHA. Research suggests the use of personal protective equipment

and diligent drug preparation reduce the likelihood of an occupational hazard. Nonetheless, workplace exposures should be immediately reported, the events meticulously documented, and any injuries treated without delay.

Research Question Three

Research question three asks: According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents? Hazardous drugs are drugs that pose a potential health risk to healthcare workers who may be exposed during preparation or administration. Such drugs require special handling because of their inherent toxicities. The health and safety of workers who handle hazardous drugs should be a high priority. Medical monitoring and risk surveillance programs enhance the safety and overall wellbeing of the healthcare providers.

Practice-Based Application

In order to obtain the practice-based findings, a search for clinical practice guidelines housed in the world wide web (WWW) was conducted by this author. The web revealed a number of sites with clinical practice guideline holdings including the Centers for Disease Control and the Agency for Healthcare Research and Quality. Clinical practice guideline findings from the web holdings are addressed in this section in terms of each research question generated for the scope of this study.

Research Question One

Research question one asks: What is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents? The clinical practice guidelines concerning

occupational exposure to antineoplastic agents according to NIOSH (CDC, 2004), acknowledges some important practices. The carcinogenicity of several antineoplastic drugs has been well established. A number of studies indicate that antineoplastic drugs may cause increased genotoxic effects in pharmacists and nurses exposed in the workplace (Falck et al., 1979; Valanis, Vollmer, Labuhn, & Glass, 2001). Several studies that have not linked genotoxic effects with worker exposures may be explained by technical confounders and a lack of accurate blood and urine sampling in exposed workers. The weight of evidence associates hazardous drug exposures at work with increased genotoxicity. Currently no recommended exposure limits have been established. Recommended guidelines and standards have been created to keep exposure and risk at a minimum.

Table 3

Summary of Clinical Practice Guidelines Reviewed

Source of Guidelines	Website URL
Agency for Healthcare Research and Quality	www.ahrq.gov
Centers for Disease Control and Prevention	www.cdc.gov/niosh/docs/2004-165/
Occupational Safety and Health Administration	www.osha.gov
Oncology Nursing Society	www.ons.org

Note. Total number of guidelines reviewed = 3.

Research Question Two

Research question two asks: According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards? High-quality, cost-effective care for the oncology patient is

important. Employee medical surveillance is an additional strategy for optimizing the health status of persons who work in settings where hazards exist. Medical risk surveillance involves a careful search for unexpected outcomes that might herald new or uncontrolled hazards in the workplace. It most often refers to the systematic collection, analysis and dissemination of health information on groups of workers. For risk surveillance to be an effective warning mechanism, it must be connected to preventive safety and health actions. Healthcare providers overseeing the surveillance effort must take the lead in ensuring that quality issues relating to medical screening and surveillance are adequately addressed. This step is important because when otherwise healthy persons are screened, end points of significance are usually more subtle than they are in overtly symptomatic persons. Adhering to available guidelines also facilitates epidemiologic review because of the quality and integrity of the data obtained.

Research Question Three

Research question three asks: According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents? Occupational exposure to anticancer drugs has been shown to be associated with both increased incidence of malignancy in male and female healthcare workers, as well as fetal developmental effects in their offspring (Valanis et al., 2001). It is therefore essential for oncology nurses to be aware of the potential effects of cytotoxic agents, and diligent in taking the steps needed to minimize exposure. Several studies have documented the surface contamination that can occur throughout the healthcare setting. Examination of work practices is important to reduce exposure. Data indicate that exposure is lower than in the past, but also that cleaning techniques remain

inefficient, that ineffective surface cleaning can result in spreading contamination, and that surface contamination can and does result in worker contamination.

Summary

The purpose of this investigation was to explore the literature regarding the current level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. The results of this investigation suggest that occupational exposure to cytotoxic substances continues to be a hazard in the healthcare setting; however, the literature did not provide consistent significant findings to prove a relationship between occupational exposure and mutagenesis. The three major variables in determining severity of exposure include duration of exposure, toxicity of the drug, and the use of personal protective equipment. It is essential for oncology nurses to understand the risk of hazardous drug exposure in all areas of the healthcare setting, and to ensure careful and proper work practices—such as using appropriate BSC techniques, changing gloves frequently, swabbing final products, and using appropriate drug cleaning and inactivation agents—to reduce the risk of exposure for themselves and their colleagues.

CHAPTER V

Evidence-Based Conclusions, Implications, and Recommendations

The potential adverse health risks from occupational exposure to hazardous drugs are based on the inherent toxicities of the drugs. The same health effects that occur in patients who receive therapeutic doses of the drugs are possible if employees are exposed. Hazardous drugs are genotoxic, carcinogenic, teratogenic or cause developmental toxicity. Many result in adverse reproductive outcomes and cause organ toxicity at low doses.

Evidence for continued risk of occupational exposure to antineoplastic agents is abundant; however, nurses' use of the recommended precautions is not universal. This may be related to a lack of information or to a lack of serious concern for the potential hazards. There was little interest or concern among health care workers. Information about health effects from low levels of occupational exposure is sparse in recent literature. Many reports of adverse effects were published before the implementation of safe handling precautions. This has contributed to the lack of concern among nurses regarding hazardous drug handling. Hazardous drug handling is potentially risky work. Many nurses have the potential to be exposed to hazardous drugs in the workplace.

OSHA, ASHP, ONS, and NIOSH all provide guidelines for the safe handling of hazardous drugs. While not providing complete protection, it is believed that adherence to current recommendations will reduce health care workers' exposure. By reducing exposure, the negative health effects should be reduced. It is time for nurses to take their own occupational safety as seriously as the safety of the patients under their care.

Summary of the Investigation

This literature review was undertaken with the focus of exploring the available literature regarding the current level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. A review of the literature revealed the need to further the level of knowledge regarding this issue. This chapter provides a summary of the literature review, including interpretation of the findings and the conclusions drawn from the findings, as well as limitations of the study and recommendations for further research.

Interpretation of Findings with Conclusions

According to the literature analysis, the findings from this investigation demonstrate a consensus in the literature regarding the current level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. An examination of the literature revealed that this area requires further investigation. Conclusions drawn from the findings reveal that healthcare providers are often well aware of the drug's potential toxicity; however they disregard recommended national guidelines set forth. In this section, the interpretation of the findings will be presented in response to each research question.

Research Question One

The first research question asked, "What is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents?" The results of the research indicate the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents is limited. Much has

been written about securing caregivers' compliance with practice guidelines and other best practice recommendations. However, it appears that defining ideal practices may be easier than getting clinicians to change their long-established habits. Caregivers seem to resist change even when it's the right thing to do. For example, in a study of how well oncology nurses comply with OSHA guidelines for handling cytotoxic drugs, researchers found that some of the nurses used some protective equipment when preparing and administering cytotoxic drugs, but the type of equipment and its frequency of use did not specifically meet OSHA guidelines (Gribben, 2002).

Research Question Two

The second research question asked, "According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards?" The results of the research indicate that cost-effective, high-quality care is enhanced by facilitating risk surveillance of occupational hazards. Moreover, facilitating risk surveillance of occupational hazards was addressed in the knowledgebase in that authors agreed that risk surveillance was important, but not necessarily conducted from the perspective of occupational hazard exposure. Conversely, facilitating risk surveillance of occupational hazards was addressed in the clinical guidelines reviewed in that guidelines posted by various agencies stressed the importance and method, but differed dramatically in content and process. The consensus was that healthcare providers should implement surveillance efforts and take the lead in ensuring that quality issues relating to risk surveillance are adequately addressed.

Research Question Three

Research question three asks: According to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents? The results of the research indicate that cost-effective, high-quality care is enhanced by facilitating risk surveillance of exposure to antineoplastic agents. Moreover, facilitating risk surveillance of exposure to antineoplastic agents was addressed in the knowledgebase in that authors agreed that risk surveillance was important, but not necessarily conducted from the perspective of antineoplastic agent exposure. Conversely, facilitating risk surveillance of exposure to antineoplastic agents was addressed in the clinical guidelines reviewed in that guidelines posted by various agencies stressed the importance and method, but differed dramatically in content and process. The consensus was that healthcare providers should implement surveillance efforts and take the lead in ensuring that quality issues relating to risk surveillance are adequately addressed.

Limitations

There were limitations identified in this study. Some information obtained cannot be generalized beyond the scope of the research that was reviewed. Also, lengthy written questionnaires can be source of error as subjects' tire of questions and completes survey too quickly. Most of the research was limited to specific populations and locations, therefore findings may not prove reliable when tested in other locations or with other populations.

Implications and Recommendations

The review of the literature revealed limited documentation regarding the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents. There was agreement that duration of exposure, toxicity of drug, and use of personal protective equipment directly affect exposure risk. Gribben (2002) showed that use and availability of personal protective equipment when handling chemotherapy have increased, but medical monitoring of exposed employees still is neither widely practiced nor consistent with OSHA guidelines.

Safety concerns and potential adverse health effects associated with the occupational handling of chemotherapeutic agents have been reported. Historically, nurses' adherence to chemotherapy-handling guidelines has been poor. Results suggest that adherence is increasing. The investigation of the literature has resulted in implications and recommendations focused on nursing theory, nursing research, advanced nursing practice, nurse practitioner education, and health policy. Each of these areas will be considered in this section.

Nursing Theory

The theoretical foundation for this study was Becker's Protection Motivation Theory. Although primarily not a nursing theory, it has been used in many studies that attempt to explain why behavioral choices are made, thus is an appropriate theoretical framework for this study.

Nursing Research

The level of healthcare knowledge regarding risk surveillance of occupational exposure to antineoplastic agents is very scant. Safety concerns and potential adverse health effects associated with the occupational handling of chemotherapeutic agents have been reported. Historically, nurses' adherence to chemotherapy-handling guidelines has been poor. Results suggest that adherence is increasing; however, research is lacking regarding nurses' level of knowledge of and specific barriers to safe handling of chemotherapy. Although adherence to recommended guidelines is increasing, further research regarding specific barriers to safe handling of chemotherapy is needed. Research empowers practice and enhances the status of nursing as a profession by expanding nursing's scientific knowledgebase. Research findings not only improve patient care but also affect the healthcare system (Polit & Beck, 2004).

Advanced Nursing Practice

Oncology nurses are key professionals in the delivery of skilled care to people with cancer. These nurses are challenged with the responsibility of coordinating quality patient care and administering chemotherapy. The administration of chemotherapeutic agents is an integral part of nurses' role in the provision of care. Cytostatic drugs possess toxic properties and may cause mutagenic, carcinogenic and teratogenic effects. Therefore, nurses handling these drugs in the course of their profession may face serious health risks. The occupational exposure risk of cytotoxic agents was first documented in health care personnel by Falck et al. (1979) who reported an elevated frequency of mutagenesis in spot urines after continuous low-level exposure within a group of

oncology nurses. Proper handling of these drugs combined with the use of personal protective equipment can drastically reduce this threat.

Nurse Practitioner Education

In nursing, there is an emphasis on providing competent, safe nursing care to enhance patient safety. However, intertwined in the promotion of safe patient care is the critical issue of nurse safety. Nurse Practitioners are renowned for their superb communication and educating ability. As a result, they should promote healthcare provider safety in relation to antineoplastic handling as well.

Health Policy

As a result of the recent trend toward managed care, it has become essential for healthcare providers to consider cost-effective, high-quality strategies in providing care for oncology patients. The oncology Nurse Practitioner must assume a leadership role in promoting risk surveillance programs through education, legislation, and social policy change.

Summary

According to Martin and Larson (2003), healthcare professionals involved with handling antineoplastic drugs may be exposed inadvertently to these agents, placing them at potential risk for acute and long-term adverse effects. For example, cyclophosphamide one of the most frequently used antineoplastic agents in clinical treatment facilities, is a known human carcinogen (Larson, Khazaeli, & Dillon, 2003). While the health risks associated with cytotoxic use have been well established, there is little information available about how people perceive these risks, particularly among those most affected by it-chemotherapy nurses. Therefore, the purpose of this Evidence Based Practice (EBP)

project was to develop a nurse practitioner knowledgebase regarding the impact of risk perception on the cytotoxic agent safety behaviors of oncology nurses. The research questions asked: (a) what is the level of healthcare knowledge regarding the role of the healthcare provider in facilitating risk surveillance of occupational exposure to antineoplastic agents? (b) according to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of occupational hazards? and (c) according to the literature, how can healthcare providers contribute to cost-effective, high-quality care by facilitating risk surveillance of exposure to antineoplastic agents? A Boolean computer search of nursing and medical literature for theory-based, data-based, randomized controlled trials for citations utilizing CINAHL, MEDLINE, and the Cochrane Library was conducted for this systematic review.

Becker's Health Belief Model (1974) served as the theoretical foundation for this clinical project and guided the systematic review through data collection of the healthcare literature. Literature reviewed totaled 21 manuscripts, which represented reviews of another 419 references. Studies of healthcare workers have shown that occupational exposure to antineoplastic agents has caused acute adverse effects such as nausea, headache and dizziness (Valanis, Vollmer, Labuhn, and Glass, 1997). Exposure risk and its relationship to healthcare professionals' compliance to established protocols for the safe handling and administration of chemotherapy agents continues to be a concern for health care institutions (Ritchie, McAdams, and Fritz, 2000). The literature reviewed for this study recommends compliance with established safety guidelines to ensure adequate protection to those involved in the handling, administration, and care of patients receiving

antineoplastic agents. Yet despite the adoption of these guidelines in healthcare institutions, the current literature also suggests that many workers do not follow the standards established by their employers and current OSHA guidelines, putting themselves at risk for exposure to potential mutagenicity, alterations in fertility and long-term effects from chemotherapy agents (Valanis, Vollmer, Labuhn, and Glass, 1997).

Using an Evidence Based Medicine (EBM) approach, based on that of Sackett, Straus, Richardson, Rosenberg, and Haynes (2000), a knowledgebase was developed according to methods described by Davidson (2003) in which key findings from the systematic review of randomized control trials, data-based and theory-based literature were compared with current practice guidelines, resulting in a number of safe practice recommendations. These recommendations emphasize that safe levels of exposure to antineoplastic agents have not been determined therefore; it is essential to minimize exposure.

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APPENDIX

Knowledgebase Regarding Risk Surveillance of Occupational Exposure to Antineoplastic Agents

Knowledgebase regarding risk surveillance of occupational exposure to antineoplastic agents.

Source & Database	Variables of Interest (Keywords)	Literature Type & Research Tools	Research Design & Sample Size	Theoretical Foundation	# References & SWOT Critique	Key Findings
(Brown, 2000), US, MEDLINE	-antineoplastic agents -occupational exposure	data-based	descriptive N=126	none	#=12 S: Study employed genetic testing to validate chromosomal deviations resultant to occupational exposure to antineoplastic agent use amongst oncology nurses in a selected cancer clinic on the East coast. W: Generalizability of findings is limited due to homogenous sample of convenience. O: Provides foundation for further research. T: Convenience sampling may impact external validity.	Results suggest that exposure to antineoplastic is a potential health hazard. Findings suggest that exposure be kept to a minimum and the use of protective measures are essential when handling antineoplastics.
(Burgaz et al., 2002), Turkey, MEDLINE	-antineoplastic drugs -chromosomal aberrations -nurse -occupational exposure	data-based	descriptive N=738	none	#=20 S: Study showed that increased genetic damage was directly a result of occupational exposure to antineoplastic agents. W: Only one antineoplastic agent, cyclophosphamide,	Analyses of CP in urine demonstrated compound absorption. Also, higher CP excretion rates were observed among nurses handling CP, suggesting a direct relation between handling CP and occupational exposure to CP. Increased

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					<p>was reviewed in relationship to occupational exposure. Need to research the concept and domains with other antineoplastic agents. Lengthy written questionnaires can be source of error as subjects tire of questions and completes survey too quickly.</p> <p>O: Provides a foundation for future research.</p> <p>T: A questionnaire was used to assess previous personnel exposure to cyclophosphamide. Accuracy of such data collection remains unclear, relying heavily on recollection.</p>	<p>frequency of structural CA in peripheral lymphocytes is associated with an increased overall risk for cancer. This warrants chromosomal changes to be regarded as potentially serious effects. Exposure to these genotoxic chemicals should be limited. This study also showed that increased genetic damage was evident in nurses at the population level due to occupational exposure to antineoplastics. Results suggest that exposure be kept to a minimum and protective measures are essential when handling antineoplastics. Also emphasized was the importance of the establishment and implementation of national regulations for handling these substances.</p>
(Gribben, 2002),	-antineoplastic agents	data-based	Systematic	none	#=12	This article examined

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US, CINAHL	-occupational exposure -protective equipment	literature review	<p>S: Examined factors influencing use of personal protective equipment and the development of acute adverse health effects.</p> <p>W: Lengthy written questionnaires can be source of error as subjects tire of questions and completes survey too quickly.</p> <p>O: Provides the foundation for further research.</p> <p>T: The lack of clarity in method may be a source of potential bias influencing the findings.</p>	<p>the use of personal protective equipment and adverse health effects associated with antineoplastic use.</p> <p>Findings indicate that the use of gloves, mask, and goggles have a significant effect on reducing the likelihood of adverse health outcomes associated with antineoplastic use.</p> <p>In addition, diligent preparation of the drugs under a biological safety cabinet greatly reduces the potential for adverse health effects. Results suggest that exposure be kept to a minimum and protective measures are essential when handling antineoplastics. Also emphasized was the importance of the establishment and implementation of national regulations for handling these substances.</p>	This study addressed the issue of overall
(Larson & Khazeli, 2003), US,	-antineoplastics -air monitoring	descriptive	None	#=15	S: Explored a variety

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<p>MEDLINE</p>	<p>methods</p>				<p>of filter monitoring methods for antineoplastics. Data collection and analysis were done concurrently thereby reducing the risk of miscoding or other analysis errors. W: Preparation of standards were obtained but could not always be verified by the analysis of blank or spiked samples. O: Provides a foundation for further research. T: The potential for cyclophosphamide to sublimate off filter material may account for potential skewed findings.</p>	<p>effectiveness of current monitoring media for antineoplastics. In addition, the study also looked at solid sorbent medias as a method of choice. Indications from the study include the finding that filter methods are not acceptable for air monitoring of cyclophosphamide and possibly other antineoplastic agents. This information also supports the observation that the HEPA filter is not an acceptable control for biological safety cabinets that return filtered air to the work room.</p>
<p>(Rogers, 2000), US, MEDLINE</p>	<p>-pharmacy personnel -antineoplastic agents -occupational exposure</p>	<p>Data-based</p>	<p>descriptive N =348</p>	<p>none</p>	<p>#=17 S: Extensive descriptive survey of personnel exposure to antineoplastics and use of personal protective equipment. W: Lengthy written questionnaires can be</p>	<p>This study looked at nurse perception of risk associated with antineoplastic use and examined the nurse's demographics in relation to the use of personal; protective equipment. The study</p>

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<p>(Sardas, Gok & Karakaya, 2003) TURKEY, MEDLINE</p>	<p>-antineoplastic drugs -Chromosome damage -Occupational exposure</p>	<p>data-based</p>	<p>quasi-experimental (n=23 nurses; n=50 control)</p>	<p>none</p>	<p>source of error as subjects tire of questions and completes survey too quickly. Moreover, nurses who fear their answer would exemplify them as ignorant or indifferent may not have answered truthfully. O: Provides foundation for further research. T: Potential for skewed findings since risk is subjective in nature. Moreover, the subject may not reveal true feelings to avoid being labeled as indifferent or uncaring which could alter the validity of the findings. #=12 S: This study examined a group of 23 oncology nurses working in different university hospitals in Turkey and a control group of 50 unexposed individuals. W: The lack of</p>	<p>revealed that the use of personal protection was statistically significant in regards to the demographic variables which were defined for the study.</p>
					<p>This article examines the increase in sister chromatid exchanges in circulating lymphocytes among nurses handling antineoplastic agents. This work has also shown that cigarette smoking causes a significant increase in</p>	

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					<p>standardized microscope slide preparation could potentially skew test results.</p> <p>O: Provides the foundation for future research.</p> <p>T: Several slides did not demonstrate any relationship between occupational exposure to antineoplastics and increased sister chromatid exchanges.</p> <p>#=14</p> <p>S: The authors stressed the fact that antineoplastic use is appropriate and beneficial to patients experiencing a terminal disease such as cancer. However, there is significant risk for adverse health effects from occupational exposure.</p> <p>W: Sample size was limited to members of Oncology Nursing Society.</p> <p>O: This study validated</p>	<p>SCE's. Overall, this study supports the existence of an association between professional exposure to antineoplastic drugs and an increase in SCE's in lymphocytes and that smoking contributes to elevated SCE rates.</p>
(Thompson, 2004), US, MEDLINE	-hazardous chemicals -antineoplastic agents -occupational exposure	data-based	descriptive N=421	none	<p>This study looked at personnel exposure to antineoplastic agents in the workplace. Findings indicate the potential exists for adverse health effects with the use of these drugs. Further research should involve the deliberate sampling of diverse populations as well as the use of personal protective equipment to decrease the chances of risk.</p>	

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<p>(Valanis, Vollmer, Labuhn, & Glass, 2001), US, MEDLINE</p>	<p>-antineoplastic agents -absorption -data collection -toxicity</p>	<p>data-based</p>	<p>descriptive N=800</p>	<p>none</p>	<p>previous research that workplace exposure to antineoplastics is potential health risk. Adverse outcomes are associated highly with the extent of exposure as well as the potency/toxicity of the drugs. T: Homogenous sample of convenience limits the ability to generalize the findings to other nurses without membership in ONS.</p>	<p>This study looked at the relationship between occupational exposure to antineoplastic drugs and the presence of acute symptoms of exposure. Handling of these drugs was associated with a significant increase in the number of symptoms compared with controls. Skin contact was the most predominant predictor of symptoms. The number of doses and</p>
					<p>#=30 S: The setting was large medical centers where data was easily accessible. W: Lack of clarity in method may mask internal threats to validity and reliability of findings. O: Results of the study provide foundation for future research regarding acute adverse effects. T: Volunteer-based sample and moderate</p>	

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							participation rates are clear limitations- sample essentially protected group.	extent of protection were significantly associated with the number of symptoms as well.
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Note. Manuscripts reviewed totaled 8, representing the reviews of an additional 122 citations.

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