Nursing students' knowledge, observation of environmental risk factors and compliance with recommended precautions for the prevention of transmission of infectious diseases by needlestick injury

Cynthia Ann Logan
Louisiana State University and Agricultural and Mechanical College

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NURSING STUDENTS’ KNOWLEDGE, OBSERVATION OF ENVIRONMENTAL RISK FACTORS, AND COMPLIANCE WITH RECOMMENDED PRECAUTIONS FOR THE PREVENTION OF TRANSMISSION OF INFECTIOUS DISEASES BY NEEDLESTICK INJURY

A Dissertation
Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in

The School of Human Resource Education and Workforce Development

by

Cynthia Ann Logan
B.S., University of Southwestern Louisiana, 1967
M.S., Texas Woman’s University, 1972
August, 2002
To my children,

Renée, Joel, and Aaron
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ABSTRACT

The primary purpose of this study was to determine the relationships between selected institutional and personal demographic factors, knowledge, observation of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

A four part, 89 item questionnaire was administered to students enrolled in clinical courses at three associate degree and four baccalaureate nursing programs in order to measure knowledge, compliance, environmental risk factors, and demographics. Useable data was collected from 710 nursing students enrolled in clinical courses. The typical respondent was female, between the ages of 20 and 29, and in the upper level of the curriculum. Most students (>90%) received instruction either before or during the first clinical course.

Mean scores on Section I of the questionnaire, knowledge survey, for students from baccalaureate and associate degree programs did not differ, \( t(708) = -.153, p > .05 \), but scores for both groups were lower than might be expected for mastery level achievement. Baccalaureate nursing students scored significantly higher on Section II of the questionnaire, compliance actions, than associate degree students, \( t(617) = 7.62, p = .000, d = .31 \). Mean scores of baccalaureate students did not differ significantly from those of associate degree students on Section III, observations of environmental risk factors. Students identified lecture as the most frequently used teaching method, followed by videotaped presentations but indicated that demonstration was the most
helpful method of teaching this content. Students followed recommended needle safety precautions more often when modeling the actions of admired teachers than when modeling the actions of admired hospital staff nurses. In addition, students reported that staff nurses followed needle safety precautions less often than teachers. Based on the results of multiple linear regression analysis, $F(7,570) = 21.13, p < .000$, seven variables explain 20.6% of the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

The findings of this study suggest that nurse educators reconsider current curriculum design, course content, and teaching strategies concerning nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.
CHAPTER I: INTRODUCTION

Occupational safety in the health care workplace is a serious concern today. Among the potential sources of injury is the risk of exposure to infectious disease through the ordinary actions involved in the care of patients. The Occupational Safety and Health Administration (OSHA) estimates that 5.6 million health care workers (HCWs) who handle sharp devices are at risk of occupational exposure to human immunodeficiency virus (HIV), hepatitis B virus, hepatitis C virus, and other bloodborne pathogens (Occupational Safety and Health Administration, 2002). Sharp devices, or sharps, are capable of penetrating the skin and include needles, surgical instruments, lancets, and glass (Hersey & Martin, 1994). Although disease transmission can occur by inoculation from other sources, penetrating sharps’ injury, such as needlestick injury, sustained from an infected person, carries the greatest threat of disease transmission (Marcus et al., 1988). Non-intact skin, as well as parenteral and mucous membrane routes, have been implicated in transmission of infectious disease in the workplace (OSHA, 1996). The National Institute for Occupational Safety and Health (NIOSH, 1999) reported that nursing staff and doctors sustain a large percentage of the estimated 800,000 needlestick injuries that occur annually in hospitals.

while the more common risk of hepatitis B is 6 to 30 percent (Gerberding, 1994). The risk of hepatitis C virus transmission is 2.7 (Kiyosawa et al., 1991) to 10 percent (Mitsui et al., 1992). Though the risk may be statistically small, the transmitted virus could have a lethal outcome which causes fear in health care providers. Occupational risk may be greater than the statistics reveal, since underreporting of injuries is common. In a study sample of five hospitals Roy and Robillard (1995) reported that a distressing 69.9 % of sharps’ injuries went unreported. Underreporting of sharps’ injuries has been noted by other investigators (Burke & Madan, 1997; deVries & Cossart, 1994; & Gordon, 1999). In addition to underreporting, other considerations must be taken into account when examining available statistics. A telephone interview with S. Critchley, a Technical Information Specialist at CDC and a registered nurse, revealed that statistics on transmission of infectious diseases in the workplace are accumulated from several sources by the Centers for Disease Control and Prevention (CDC), a state by state breakdown is not available, and data are not complete due to many factors, including lack of mandatory reporting and underreporting,(personal communication, October 26, 1999). As a result of the type of data reported and the lack of consistency in reporting, statistics generated must be examined critically.

The possibility of becoming infected with a bloodborne pathogen or transmitting the disease to others is not the only risk involved. Although the risk to patients who are cared for by HIV infected HCWs is considered negligible, practice restrictions could be imposed by the courts on an individual basis (Gostin & Webber, 1998). According to the ethical guidelines in the American Nurses’ Association’s Code
for Nurses, “the nurse’s primary commitment is to the health, welfare, and safety of the client” (American Nurses’ Association, 1985, p. 6). Nurses are also responsible for questioning inappropriate practice and are accountable for individual actions. Presently, avoidance of occupational exposure is the only effective prevention strategy (Gerberding, 1995).

One of the central safety issues involving risk is compliance with the mandatory precautions and regulations designed to prevent occupational exposure. Schwartz, Jacobs, and Juda (1992) compared HCWs compliance rates before and after attending a one hour educational session. Compliance was defined by the frequency of OSHA recommended glove and/or goggle use. Observations were recorded before and after the session. The authors found that the educational session had little effect on glove and goggle use in potential situations involving exposure to bloodborne pathogens (BBP). Though the study was limited by the use of a specialized sample of aeromedical workers, it does present findings on the most common method of encouraging compliance with preventive measures.

The occurrence of sharps’ injuries is higher in physicians, but more sharps’ injuries are reported by nurses. When compared to physicians, twice as many nurses have acquired HIV infection through occupational exposure (Robert & Bell, 1994). One reason that may account for the increased vulnerability of nurses is the greater amount of time nurses spend in direct patient contact (Gerberding, 1991). In addition to perception of barriers and workplace setting, nurses’ awareness of their own noncompliance may further interfere with full use of precautions. Henry, Campbell,
Collier, and Williams (1994) studied emergency department personnel by direct observation and self reporting, finding that individual HCWs interpreted universal precautions differently. In addition to interpretation differences the actual basis of decision making in nursing is varied and complex, taking into account such factors as conflict, change, and ambiguity (Lewis, 1997). Yet another factor may be HCW’s belief that touching is related to healing and personal protective equipment may interfere with patient relationships (Linn & Kahn, 1989).

Since infected patients could not be identified by readily observable or identifiable demographic characteristics (Marcus et al., 1993), universal precautions were recommended for use with all patients. The risk of infection from repeated cutaneous exposure was greater than that of one cutaneous exposure. Consistent use of gloves reduces risk of transmission by repeated exposure.

**Compliance Issues**

Health care workers’ behavior may vary according to their perception of risk, in spite of similar training. Some of the reasons to which HCW’s attribute lack of compliance with universal precautions are habit, lack of time, interference with carrying out procedures, discomfort with protective equipment, lack of supplies, carelessness, concern for costs, unexpected body fluid contact, and the possibility of causing increased fear in patients (Kelen et al., 1990; Bauer, 1991). In addition, the perception of the exposure as not significant, inadequate knowledge of the reporting process, and issues related to confidentiality and job discrimination were cited as reasons for underreporting (Mangione, Gerberding, & Cummings, 1991). Ramsey,
McConnell, Palmer and Glenn (1996) examined compliance issues in 1991 and again in 1993 following the 1992 implementation of mandatory Occupational Safety and Health Act (OSHA) regulations which defined standard and transmission-based precautions. The authors found that in spite of reported decreased barriers to compliance, noncompliance continued to be problematic. Barriers that continued to interfere with full compliance with mandatory regulations were needle recapping, inadequate staffing, glove interference with performance, discomfort with protective equipment, lack of glove use by physicians, dependence on signs to warn of need for protective equipment use, and concerns regarding offending patients. Furthermore, the authors concluded that nurses knew when and how to protect themselves from injury but continued to adjust compliance according to the known HIV or hepatitis B virus status of the patient.

Lack of compliance among nurses may also vary according to the setting of the workplace, rural or urban. Nurses working in rural settings were 2.7 times more likely to be exposed to body fluids than their counterparts in urban settings (Glenn & Ramsey, 1995), even when no differences in knowledge, compliance, or practice barriers were found. The findings suggested a gap between rural nurses’ knowledge of appropriate practice and their application of knowledge to compliance with universal precautions. The authors also conclude that rural nurses may not perceive potential patient risk in the same manner as nurses practicing in an urban area. Increasingly, patient care is being delivered in the home. A home setting may further complicate
compliance issues for nurses, since there is less control over the environment than in an inpatient setting (Backinger & Koustenis, 1994).

Nurses have expressed concern about risks of occupational exposure, according to Gordon (1999). A self administered survey of 172 RNs in a metropolitan Midwest area, Gordon reported current practice behaviors. At least one needlestick injury from a hollow bore needle between 1993 and 1997 was reported by 34.5% of RNs, most of which occurred on the day shift (61%) and in the presence of another person (46%). Medical-surgical units and emergency room had the highest incidence of 10 needlestick injuries; however, one category combined long-term care facilities, home health care, and public health settings for a total of 16. Although 86% expressed satisfaction with the post exposure inquiry, 14% were dissatisfied with the present policies or protocols, the lack of policies, or stated that they did not report the incident but saw a private physician. When asked to rank their concerns, the RNs listed employment loss, unlicensed personnel, AIDS, hepatitis B virus, and hepatitis C virus, respectively.

Factors related to sharps’ injuries can be categorized as engineering, organizational, or behavioral (Hanrahan & Reutter, 1997). Since 1981, efforts to prevent injury have focused on changing behavior, using protective barriers, developing safer devices, decreasing unnecessary invasive procedures, and initiation of administrative controls (McCormick & Maki, 1981). Resultant changes in the workplace environment, such as convenient placement of needle disposal boxes, decreased the number of recapped needles but did not eradicate the problem entirely.
(Makofsky & Cone, 1993). Despite the mandated guidelines and available institutional protocols for safe practice, compliance with guidelines is still not universal.

**Statement of the Problem**

The health care industry employed more than seven million workers in 1990, a number that increased to more than eleven million by 2000 (United States Bureau of Labor Statistics, 2002). HCWs are frequently exposed to numerous occupational hazards. Registered nurses constitute the largest professional group of HCWs and work primarily with hollow bore needles which carry the greatest amount of blood. Furthermore, many currently employed registered nurses are women of childbearing age which extends risk, potentially, to another being. Many needlestick injuries are preventable with the current level of knowledge and technology, but risk related to noncompliance still exists. Despite the significance of the risk and the lack of effective post injury treatment, full compliance with universal precautions has not yet been achieved. Little research exists on the education process in schools of nursing used to instruct nursing students about needle safety, occupational exposure in situations involving bloodborne pathogens, and the transmission of infectious diseases, such as HIV, hepatitis B virus, or hepatitis C virus. The effectiveness of teaching strategies used with the subject of compliance with OSHA recommendations has not yet been fully explored. Additional knowledge about the factors which affect compliance may enable nurses to design more effective strategies to increase compliance.
Purpose

The primary purpose of this study was to determine the relationships between selected institutional and personal demographic factors, knowledge, observation of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

Objectives

The objectives of this study were to:

1. Describe the nursing students in Louisiana on selected demographic characteristics.

2. Describe and compare nursing students’ knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety by degree program.

3. Describe the curriculum content placement used for needlestick injury and needle safety in selected associate degree and baccalaureate nursing programs.

4. Describe and compare the nursing students’ observations of environmental risk factors concerning disease transmission by needlestick injury by degree program and course level.

5. Describe and compare the nursing students’ compliance with standard and transmission-based precautions concerning needlestick injury and needle safety by degree program and course level.
6. Describe and compare the strategies used by baccalaureate and associate degree nursing programs to teach content related to needlestick injury, recommended practices of needle safety, and prevention of disease transmission by needlestick injury.

7. Determine if a relationship existed between nursing students’ knowledge of disease transmission and needlestick injury and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

8. Determine if a relationship existed between nursing students’ observation of environmental factors and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

9. Examine the efficacy of the Learning/Action/Beliefs (LAB) Model, a researcher developed needle safety compliance model, that utilizes knowledge and environmental factors to explain the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens (See Figure 1).
Hypotheses

The following hypotheses were investigated in this study:

1. The emphasis given concerning recommended precautions for the prevention of occupational exposure to bloodborne pathogens in a program of study at the time of initial instruction is positively related to the extent of compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens by nursing students.

2. The teaching strategies used in nursing students’ initial instructions for the prevention of occupational exposure to bloodborne pathogens are positively related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

3. Nursing students’ perceived support of compliance with standard and transmission-based precautions by faculty and clinical staff is positively related to nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

Significance of the Study

Exposure to bloodborne pathogens is a serious occupational safety issue. Although the risk of transmission of infectious disease is statistically small, it can have devastating effects. Mandatory compliance with standard and transmission-based precautions is designed to prevent the transmission of infectious disease, regardless of the patient’s known or suspected diagnosis. Nurses have the highest rate of documented needlestick injuries, yet do not always comply with mandated guidelines.
Students are expected to meet the standards of the profession of nursing when caring for patients as part of the program of study. They must meet the same standards for compliance required of other HCWs, yet they are inexperienced clinicians. Preclinical nursing students often are prepared for the clinical area with the use of simulations in a learning or skills laboratory before caring for patients. In these settings students practice procedures, learning to apply the principles of asepsis or other common techniques outside of the clinical area. Since nurses are responsible for venipunctures, intravenous fluid administration, intramuscular injections, and other procedures which require the use of needles, these techniques are often performed first in a laboratory setting. No research has yet been conducted to determine how influential the teaching techniques, learning laboratory settings, and clinical practice are on students’ compliance with Centers for Disease Control and Prevention guidelines. Since nurses have been identified as the group with the highest rate of reported needlestick injuries, studying the education process related to occupational exposure and workplace hazards may shed light on compliance behaviors of nurses. This study will be conducted to determine the relationships between selected institutional, personal demographic, knowledge, observation of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.
Definition of Terms

The following definitions were used in this study. A citation follows definitions that were taken from other works. Definitions which are not cited were developed for the purpose of this study.

**Acquired Immunodeficiency Syndrome (AIDS):** “The combination of specific clinical conditions and CD4+ T lymphocyte counts designated by the Centers for Disease Control and Prevention as the final stage of infection by the human immunodeficiency virus” (Thomas, 1997, p. 53).

**Centers for Disease Control and Prevention (CDC):** “A division of the United States Public Health Service in Atlanta, Georgia, that investigates and controls various diseases,...also responsible for national programs to improve laboratory conditions and encourage health and safety in the workplace” (Thomas, 1997, p. 345).

**Compliance Actions:** adherence to the desired protective behaviors for prevention of transmission of infectious diseases, defined in this study as the score on Section II of the questionnaire, Compliance Actions.

**Health Care Workers (HCWs):** persons who work in a health care setting in direct contact with blood and/or body fluids, including nursing students.

**Hepatitis B:** “An inflammation of the liver...that tends to cause a severe acute infection and may progress to chronic infection and permanent liver damage” (Thomas, pp. 884-885).
**Hepatitis C:** “An inflammation of the liver...caused by an RNA virus...similar in many ways to hepatitis B. (Thomas, p. 915).

**Human Immunodeficiency Virus (HIV):** “A retrovirus of the subfamily lentivirus that causes acquired immunodeficiency syndrome” (Thomas, p. 915).

**Needlestick:** Injury penetration of the skin by needle or other sharp object resulting in a cut or other entry (Burke & Madan, 1997).

**Standard Precautions:** official OSHA terminology which indicated mandatory precautions which apply to blood, all body fluids except sweat, nonintact skin, and mucous membranes and are to be used in the care of all hospitalized patients, regardless of diagnosis or infection status (Garner, 1996).

**Transmission Based Precautions:** official OSHA terminology which indicated mandatory precautions to be used when infection is suspected or known, consisting of airborne, droplet, and contact precautions (Garner, 1996).

**Universal Precautions:** common terminology for the desired protective behaviors for prevention of transmission of infectious diseases, based on the modification of isolation precautions to include universal application to all patients, regardless of diagnosis or infection status (Garner, 1996).
CHAPTER II: REVIEW OF RELATED LITERATURE

Introduction
This literature review has been designed to explore the issues surrounding the concept of compliance with measures designed to prevent the transmission of infectious disease to HCWs. Occupational exposure to infectious disease is a hazard faced by the health care industry. The review will include related literature in the following areas: historical perspective, risk from exposure, knowledge and compliance, decision making factors, and variables affecting compliance. This study was conducted to determine the relationships between selected institutional and personal demographic factors, knowledge, observation of environmental risk factors and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

Historical Perspective
Guidelines for isolation precautions in the United States evolved in response to the need to prevent transmission of infections in hospitals. Nightingale (1859) addressed the value of cleanliness, hygiene, and ventilation and the nurse’s role in prevention of disease in her mid-nineteenth century writing. As early as 1877 (Lynch, 1949), separation of infectious disease patients from others was recommended. Eventually, patients were segregated according to specific diseases and aseptic procedures were instituted to further decrease disease transmission. Since that time, discoveries in the health field have multiplied. At the same time the United States
experienced a decline in mortality from infectious disease in the years 1900 through 1980. Seven hundred ninety-seven deaths per 100,000 were attributed to infectious disease in 1900. Thirty-six deaths per 100,000 due to infectious disease occurred in 1980. Pneumonia, influenza, and tuberculosis were major sources of disease and mortality in this century. Mortality in the 1980's and 1990's has been attributed to the spread of AIDS and an increase in deaths in the over 65 population due to influenza and pneumonia (Armstrong, Conn, & Pinner, 1999). A drop in infectious disease mortality to 59 per 100,000 again occurred in 1996, the first such drop since 1980. AIDS mortality decreased for the first time from 1995 to 1996.

The 1989 CDC Guideline for Isolation Precautions in Hospitals was revised in 1991. The approach differed from earlier recommendations by advocating the application of precautions to all patients, regardless of their infection status. By doing so, the recommendations acknowledged that many bloodborne diseases go unrecognized. Two tiers of precautions were recommended in the final rule: Standard Precautions and Transmission-Based Precautions. Standard Precautions which are to be applied in every hospital situation became the primary method for preventing nosocomial infections transmitted via blood; body fluids, secretions, and excretions except sweat; nonintact skin; and mucous membranes. Transmission-Based Precautions are instituted when “…patients are known or suspected to be infected by epidemiologically important pathogens spread by airborne or droplet transmission or by contact with dry skin or contaminated surfaces” (Garner, 1996, p. 64). The recommendations can be modified if “…the principles of epidemiology and disease
transmission are maintained, and ... precautions are included to interrupt spread of infection by all routes that are likely to be encountered in the hospital” (Garner, 1996, p. 54).

**Social Learning Theory**

Social Learning Theory has been offered as one way of explaining why individuals behave in the manner they do (Bandura, 1971). Generally, people have attempted to exert control over their lives. Predicting behavioral responses was complex, because the causes of behavior within relationships were themselves complex and lacked predictability. Effective instructive modeling was the first step in the development of competencies. Learning that took place through observation of modeled behaviors permitted individuals to mentally review the combination and sequencing of components in order to perform the behavior. Thus, observation served as a guide for development of behaviors (Bandura, 1971). Furthermore, learning vicariously through the observation of behavior could be achieved before performance occurred, because factors other than reinforcement mediated the learner’s response. Reinforcement facilitated learning, but was not always essential to the process. Moreover, the use of verbal and visual symbols, such as might be seen when competencies are broken down into component parts, permitted individuals to preserve experiences which guided later behavior.

Observation of models produced three main effects: modeling effects, inhibitory and disinhibitory effects, and eliciting effects (Bandura & Walters, 1967). Each type of effect was reflected in changes in the responses of the observers. Through
modeling effects, observers could take on new, previously unknown behaviors which were identical to the models. In addition, the observer could strengthen or weaken an already present behavior with inhibitory or disinhibitory effects, which may not be identical to the model’s behaviors. Finally, the observer could be prompted to respond with matching previously learned behaviors, which was designated eliciting effects.

Behavioral competence alone does not assure that skills will be performed as desired. In later work on social learning theory, Bandura (1977) claimed that expectancies and incentives determined behavior. Expectancies were further separated into three types: expectancies about environmental clues, expectancies about consequences of personal actions, and expectancies about one’s performance competence. The term outcome expectation was used to characterize expectancies about consequences of personal actions, while expectancies about one’s performance competence was labeled self-efficacy. Figure 1 depicts a modification of Sirisook’s (1988) model of the relationships between efficacy and outcome expectancies. Incentives or reinforcements, defined as the significance of a particular outcome to the individual, served to regulate behavior through the individual’s interpretation and understanding of the consequences of behavior (Becker & Rosenstock, 1987). Clark (1987) explained that
Figure 1. Learning/Action/Beliefs (LAB) Needle Safety Compliance Model
Bandura’s social learning theory which focused on explaining learned behaviors, was educationally useful in designing interventions which evoked new behaviors.

Belief in one’s ability has been found to influence goal attainment. “Perceived self-efficacy refers to beliefs in one’s capabilities to mobilize the motivation, cognitive resources, and courses of action needed to meet given situational demands” (Bandura, 1991). The choices that people make, the effort expended on specific activities, and the length of time individuals persevere were based in part on one’s perceptions of self-efficacy (Bandura, 1977). Bandura identified four methods of altering perceived self-efficacy: mastery experiences, modeling, social persuasion, and physiological state. Through cognitive processing individuals considered the significance of information employed to judge self-efficacy. Mastery experiences strengthened self-efficacy through the success that achievement of competencies prompts. On the other hand failure, particularly early failure, undermined self-efficacy. Modeling involved comparison of one’s performance with the performance of others. Observation of other’s successes or failures enhanced beliefs about one’s own abilities. In addition, modeling taught competencies and informed observers about specific strategies which could be used in difficult situations. Social persuasion involved the use of verbalization to support individuals’ belief in their abilities, possibly leading to the expenditure of greater effort in the achievement of competencies. The perception of physiological state indicators, such as fatigue, stress, or pain, influenced people’s judgment of their capabilities. This perception could be modified by facilitating the skills needed to interpret inferences from their physiological states.
Social learning theory has a history of application in the area of patient health behavior change, particularly with smokers, cardiac patients, and diabetics; however, fewer studies have been done in the area of HCW health behavior change. Since compliance with safe needle handling techniques is also a health related behavior, one could reason that social learning theory could be similarly applied to HCWs behavior. Applying social learning theory to HCWs compliance with safe needle handling techniques, presupposes that HCWs would be inclined to change risky behaviors if they perceived that current behaviors posed a threat, that changes in behavior would decrease the threat, and that they are capable of changing their behavior. Specifically, one could say that for a HCW to cease using unsafe needle handling practices, the HCW must perceive that current needle handling behaviors are a health threat, believe that cessation would be beneficial to the HCW, and that the use of another method of needle handling is within the HCW’s control. HCWs who do not perceive their behaviors to be risky or a health threat may not change. Likewise, HCWs who perceive the risk but for some reason do not believe that they can change their behavior, also may not change.

Inaccuracy in judging one’s ability to perceive risk or change behavior could result in either overestimation or underestimation of capability, affecting one’s decisions and functioning. The consequences of misjudgement could lead to undertaking tasks well beyond one’s ability or unnecessarily limiting the tasks one attempts (Bandura, 1991). The relevance of information is determined through cognitive processing whereby information from various sources is weighed and
accepted or rejected according to the individual’s ability to integrate the information into already formed self-conceptions.

Bandura’s social learning theory suggested that learning of preventive practices could be facilitated through early teaching, so that proficiency in the practices was achieved early in the learning process (Jeffe et al., 1998). Changing one’s practice later may prove more difficult. The learning experience created by factors, such as class size, teaching strategies, and faculty/student interaction, influences the outcome of teaching but teaching does not always result in learning (Saunders & Werner, 2002). Nurse educators frequently utilize demonstration, observed practice, and role modeling to teach competency skills, such as those requiring needle use. In some instances learning through demonstration and imitation may foster inappropriate practice, if the student mimics the actions of role models rather than following the appropriate precautionary guidelines. By concentrating on the theory’s potential for explaining the rationale for given learned behaviors, educational interventions may be designed to assist learners to change behavior in desirable ways (Clark, 1987).

**Risk from Exposure**

Exposure to blood-borne pathogens in the workplace constitutes a serious risk to employees. Historically, health care providers had not emphasized concern with transmission of disease from patient to worker; however, the threat of transmission of AIDS, as well as hepatitis B virus, hepatitis C virus, and other infectious diseases, resulted in serious consideration of occupational exposure of workers to disease transmission. Through 1999 fifty-six HCWs were known to have become infected with
HIV through occupational exposure. Another 136 HIV seroconversions occurred in HCWs with a history of occupational exposure but without a documented seroconversion following a specific occupational exposure. Nurses had the highest incidence of occupational transmission at 42%. Of the group with possible occupational transmission, 25% were nurses. The next highest group in both categories was clinical laboratory technicians, consisting of 16% (CDC, 1999a).

HIV transmission was not the only occupational hazard facing HCWs. The CDC calculates that annually in the United States approximately 8,700 hepatitis B virus infections occur in HCWs with occupational exposure to blood and other infectious substances. In addition to causing 200 deaths per year, 2100 cases of clinical acute hepatitis and 400 to 440 hospitalizations were estimated to stem from hepatitis B virus (OSHA, 1991). The use of personal protective equipment, along with hepatitis B vaccination, better engineering, and work practice controls, should prevent almost all occupationally acquired hepatitis.

Mangione, Gerberding, and Cummings (1991) noted that certain common activities involving needle use, such as needle disposal, recapping, and intravenous stylet use, led to more frequent injury. Furthermore, the authors also observed that 22% of the needlestick injuries would have been avoided if CDC guidelines had been followed. Not all accidents in the workplace can be prevented, but it is estimated that 85% of needlestick injuries were preventable which could be interpreted to mean that needlestick injuries should not exceed 15%. More than half of all needlestick injuries occur with unnecessary use of needles (Doan-Johnson, 1992). Needles have been
essential to puncture the skin but often have been used in situations that did not require needles. Repeatedly, needles have been used to connect tubing or other devices, such as the attachment of an intermittent intravenous medication delivery tubing to a primary intravenous tubing set. A safer, needleless or protected needle device could accomplish the same end without the risk.

Recapping of needles has been the source of many needlestick injuries but the practice of recapping has not been eliminated. Becker et al. (1990) examined the contents of needle disposal boxes of 12 hospital units and found that recapped needles comprised more than 25% of the discarded needles and in four cases exceeded 50% of all discarded needles. The authors explained the risky behaviors by inadequate knowledge and suggested that too little attention has been directed toward overcoming specific risky behaviors in inservice education about prevention of occupational exposure to infectious disease. Inservice education has generally taken a broad approach to risk which did not prioritize or attach risk to specific behaviors.

Other factors that influence risk have also been investigated. To determine the effect of needle size, needle penetration depth, and single or double gloving Bennett and Howard (1994) conducted a study assessing the quantity of blood inoculum on various suture and phlebotomy needles. The authors found that two gloves removed more blood from suture needles than one glove but did not significantly decrease the amount of blood transferred by phlebotomy needles which are hollow and capable of holding a quantity of blood, varying according to the diameter of the needle. In other relevant research Cardo et al. (1997) conducted a case-control study, using one group of 33
HCWs who had seroconverted after sustaining an occupational, percutaneous exposure to HIV and a control group of 679 HCWs who had not seroconverted following exposure. In both groups 91% of the injuries sustained were from needlesticks. All needlesticks in the case patient group involved hollow bore needles, while 594 of 620 needlesticks in the control group involved hollow bore needles. The authors concluded that risk of HIV infection following exposure was likely influenced by the volume of blood and the titer of HIV in the source patient’s blood. A logistic regression analysis revealed that the following factors were significant for seroconversion: deep injury, injury with a visibly contaminated device, arterial or venous needle placement, and death of the source patient due to AIDS within two months of the injury.

Further complicating the picture were the unreported incidents which may have resulted in disease transmission (S. Critchley, personal communication, October 26, 1999). Underreporting of needlestick injury has been documented for some time. The rate of underreporting of needlestick injuries in the literature varied widely from 70% (Mangione, Gerberding, & Cummings, 1991) to 18.5% (Henry & Campbell, 1995). A recent study by Jochimsen et al. (1998) reported the continued problem with unreported needlesticks, finding that only 97 of 245 (40%) needlestick injuries to home health HCWs were reported. Knowledge of underreporting was important, because of the resultant underestimation of the risk of acquiring HIV and other bloodborne disease. In addition, unreported exposures do not permit post-exposure treatment or follow-up of universal precautions and may reinforce the improper use of personal protective equipment. (Haiduven, Simpkins, Phillips, & Stevens, 1999; Mangione, Gerberding, &
Mangione et al. (1991) examined the rate of hepatitis B virus infection among physicians in the pre-vaccine era and studied the frequency of occupational exposures. The high rate of hepatitis B virus infection supported the lack of reporting of accidental occupational exposure.

Additional effects of underreporting included underestimation of nosocomial exposure and inadequate post-exposure medical care. In a survey of infection control practitioners conducted by Henry and Campbell (1995) an underreporting rate of 18.5% was reported. One hundred United States hospitals were randomly selected from the 1988 American Hospital Association’s Guide. Infection control practitioners were sent a 56 item survey requesting demographic information, information about sharps’ injuries, and an estimate of nonreported sharps’ injuries, including needlesticks. Sixty-five percent of the hospitals responded and 45 submitted a precise or estimated number of sharps’ injuries. Respondents estimated that 18.5% of all sharps’ injuries went unreported and 1.4% of these involved an HIV infected source. The total number of sharps’ injuries was found to be an indicator of the risk to which HCWs were exposed in the workplace. Currently, the only strategy which can effectively prevent occupational infection is avoidance of exposure; however, a comprehensive approach should also include immunization and appropriate post-exposure prophylaxis (Gerberding, 1995).

Underreporting of blood contact incidents was well documented (Roy & Robillard, 1995; deVries & Cossart, 1994; & Gordon, 1999), though the reasons for underreporting were not always clearly identified. Nurses often gave logistical reasons
for not reporting or for delayed reporting of needlestick injuries, such as difficulty finding supervisors or the need to continue seeing home health patients away from the office (Gordon, 1999). Detection of underreporting was important, because it could result in underestimation of the risk of acquiring infection from occupational exposure to bloodborne pathogens and the subsequent delay in postexposure treatment.

Mangione, Gerberding, & Cummings (1991) conducted one of the earlier studies to determine the extent of underreporting and reasons for not reporting. Interns and residents at three California hospitals where 10 to 20% of patients admitted to internal medicine were infected with HIV. Because a clearly defined procedure for reporting was not in place at the time, the investigators accepted a broad definition of reporting. Seeking treatment or advice from a personal physician, an emergency room physician, or the employee health service, as well as participating in a study designed to follow universal precautions HCWs with occupational exposure were all considered reporting. Haiduven et al. (1999) reported similar underreporting and concluded that the reasons given for not reporting needlestick injuries supported targeting specific groups for further education.

A later study by Burke & Madan (1997) surveyed United Kingdom doctors’ and midwives’ reasons for not reporting contamination incidents. Questionnaires were sent to 482 doctors and 380 midwives seeking information about participation in invasive procedures and contamination injuries, such as needlesticks, blood splashes on broken skin or mucous membranes, or human bites or scratches, during the previous six months. Response rates were 80 percent for doctors and 77 percent for midwives. Two
hundred doctors (71%) disclosed having sustained a contamination injury but only 24 (9%) doctors reported the incidents. Of 63 midwives who disclosed having sustained a contamination injury 29 (46%) reported the incident. Reasons given for not reporting included lack of knowledge of reporting procedure, thinking that nothing could be done, confidentiality issues, embarrassment, time, effect on career, belief that no risk existed, and completing a complicated form. In addition thirty five doctors and six midwives reported other reasons. Lack of protocol or lack of knowledge of the institution’s protocol was also reported by Gordon (1999), as a reason RNs gave for not reporting or delayed reporting. The continuing underreporting was supported by Haiduven et al. (1999) who reported the results of a confidential survey conducted at a public teaching hospital. Of 549 respondents, 83% were nurses and 45% of nurse respondents had not reported all needlesticks in the last five years. Reasons given for lack of reporting included the perception that the needle was sterile or clean, not a risk, that they were too busy, and that they were dissatisfied with the follow-up. The occurrence of blood contact by emergency department workers, as well as the effectiveness of gloves in preventing contact with blood, and the risk of HIV infection due to blood contact by emergency department workers was investigated by Marcus et al. (1993). Three pairs of urban and suburban hospitals with high numbers of AIDS patients were used in the study. Trained observers monitored 9,793 procedures with potential blood contact and recorded glove use, type of blood contact, and HIV patient status. Data were also collected on the number of patients seen per shift of various types of staff occupations. The authors estimated one of every 40 full time emergency department physicians or
nurses came into contact with HIV positive blood via the percutaneous route at a facility with high incidence of HIV seroprevalence. At a facility with low HIV seroprevalence the rate was estimated to be one out of 575 physicians or nurses.

Gerberding (1994) conducted a 10 year cohort study for the purpose of evaluating risk following occupational exposure. A variety of health care providers who had frequent contact with HIV infected patients agreed to participate and were tested at intervals following exposure to blood or bloody body fluids from HIV infected patients. In addition to data on the incidence of HIV, hepatitis B virus, hepatitis C virus, and cytomegalovirus, demographic data were obtained from 976 subjects, including nonoccupational risk behavior identified with HIV infection. The results of the study included one HIV infected nurse, no reported cases of acute hepatitis though the risk of seroprevalence increased with age at enrollment, two cytomegalovirus seroconversions, and one hepatitis C virus seroconversion of a nurse working in the emergency department. Gerberding also calculated the average risk of HIV infection following percutaneous exposure on pooled data from this study and 13 others to be 0.25%. Seroconversion for cytomegalovirus occurred with two subjects. The author concluded that in light of the findings and lack of effective postexposure treatment, efforts toward prevention of exposures should be increased.

Parenteral exposure carried the highest risk of disease transmission but cutaneous and mucous membrane exposure also carried documented risk. Fahey, Koziol, Banks, and Henderson (1991) compared self-reported cutaneous exposure frequencies of 559 HCWs before universal precautions training to 269 subjects 12
months following training. Although there was a significant decrease in mean annual blood exposures following training, cutaneous exposure was not eliminated. Training included attendance at a formal instruction session on infection control policies and the distribution of memos, newsletters, and posters. One explanation offered for the self-reported 50% reduction in exposures was that the training increased awareness of the risks HCWs were taking and changes in behavior followed.

**Knowledge and Compliance**

Though the serious consequences of noncompliance with standard precautions have been widely disseminated, noncompliance itself remains a problem. A study conducted by Ramsey et al. (1996) utilized drawn random samples of RNs and licensed practical nurses in 1991 and 1993 to determine if compliance rates had increased as a result of the 1992 enactment of mandatory OSHA regulations. Using a 36 item Risk Assessment Scale with three subscales to measure perceived risk and a 16 item questionnaire to measure attitudinal, behavioral, practice setting, and role modeling factors, the investigators found that the 1993 survey showed improved compliance, particularly with known HIV/hepatitis B virus status, yet optimum rates had not been attained. Generalizability was limited by very low response rates, 30% in 1991 and 24% in 1993. The use of self-reported data also limited the study.

Using a stratified random approach, Hersey and Martin (1994) surveyed 4,417 hospital, emergency room, and inpatient direct care workers for the purpose of developing estimates of worker compliance with established guidelines for the prevention of Hepatitis B virus and HIV occupational transmission. Of 3,094
respondents 2,440 were patient care staff, including registered nurses (RN), licensed practical nurses, aids, phlebotomists, or medical technologists/technicians; 457 were physicians; and 197 were housekeeping staff. The sample was selected from both high and low acquired immunodeficiency syndrome (AIDS) areas. The study focused on three main areas: hepatitis B virus vaccination, use and disposal of needles and sharps, and barrier precautions. Self-reported data were also “collected on the frequency and nature of percutaneous exposures, knowledge and attitudes regarding HIV/AIDS and hepatitis B virus, and training in infection control practices (p. 245).” When given an opportunity for free hepatitis B virus vaccination, only 42% of patient care staff, 45% of physicians, and 13% of housekeeping staff took advantage of the opportunity and completed the series of three injections. The authors reported 96% compliance with the use of sharps’ disposal containers but the rate of compliance with recapping of needles with one or both hands and use of barrier precautions, such as protective equipment and hand washing, had a much lower rate of compliance. When asked to respond to questions about needlestick or sharp injury, 24% of patient care staff, 34% of physicians, and 18% of housekeeping staff reportedly experienced a percutaneous exposure during the past 12 months. Approximately 6% of housekeeping staff reported such contact within the past week. Physicians and patient care staff also reported facial contact with blood or bloody fluids, occurring most often during surgical procedures or suctioning.

Henry, Campbell, Collier, and Williams (1994) were able to compare self-reported data to observations by using seven trained RNs to observe and document
needle disposal, needle recapping, and barrier use for 400 hours in two emergency
departments. Personnel observed were also asked to complete a 50 item written survey
which allowed staff to estimate rates of appropriate barrier use, needle disposal and
recapping practices, reasons for noncompliance, and knowledge of recommended
precautions. The RN observers documented observation of 1822 procedures. Personnel
had access to gloves, gowns, masks, and goggles from more than one location.
Appropriate needle disposal units were also readily available to staff. Response rate of
53% for the self-reported survey was considerably higher than that of Ramsey et al.
(1996). Though self-reported compliance rates were significantly higher than observed
compliance rates, they were still inadequate. Observers noted appropriate glove use
occurred 67.2% of the time. Use of goggles, masks, and gowns occurred 50.7%, 16.0%,
and 15.3% of the time, respectively. Additionally, needles were recapped 34.4% of the
time and most of the time a more risky two handed technique was used. The results of
this study support the lack of overall compliance with universal precautions whether
obtained from self-reported or observer data.

Knowledge level about HIV or other bloodborne pathogens varied among
HCWs. Gellert, Maxwell, Higgins, Barnard, and Page (1994) found that first responders
(paramedics and firefighters) were more knowledgeable about AIDS than about HIV
transmission and that there was a strong association ($p = .0001$) between self-assessed
and actual AIDS knowledge. Bauer’s (1991) assessment of the effectiveness of
permitting discretionary policies pointed out that circulating nurses in the operating
room did not comply appropriately with universal precautions when given the discretion
to do so, in spite of years of experience, age, and the presence of informal leadership modeling on-site. Circumstances with greater risk also did not alter the nurses’ choice of personal protective equipment.

A cross sectional survey of one medical school’s students’ knowledge, attitudes, and intention to comply with universal precautions was conducted by Jeffe et al. (1998). Students’ inexperience in infection control and other clinical procedures were thought to affect performance with sharps, resulting in higher rates of percutaneous exposures to blood borne pathogens. Surveys were distributed to 116 second year students (96% response), 129 third year students (62% response), and 104 (58% response) fourth year students. Nonrespondents did not differ from respondents on age and race, but fourth year respondents differed from nonrespondents on gender with the percentage of male nonrespondents exceeding respondents ($p < .05$). Students were asked seven questions about HCWs risk of occupationally acquired infectious disease when the HCW is not vaccinated against Hepatitis B virus. The authors found that second year students correctly answered questions about HCWs risk of infection following exposure, the efficacy of hepatitis B vaccine, and post exposure prophylaxis more often than third or fourth year students who were already in the clinical area. Although the median score in each group was two, 45% of the second year students, 21% of the third year students, and 22% of the fourth year students scored three or better out of seven points. Chi-square was used to determine whether the differences were significant ($p < 0.01$). The authors concluded that the timing and content of interventions designed to increase compliance with universal precautions may affect compliance.
Jeffe et al. (1998) also reported that second year medical students were more likely to contemplate planning for compliance with universal precautions than were third and fourth year students. All third and fourth year student respondents reported compliance with safe sharps disposal while only 50% of the second year students reported compliance. Readiness to comply, defined as students’ intentions to comply with universal precautions, was conceptualized using Prochaska’s transtheoretical model of behavior change. The authors found that third and fourth year medical students were more likely to report having no plans to double glove, report all exposures rather than only high risk exposures, and wear protective eye gear.

Differences in compliance among various types of HCWs has also been investigated by Hellinger and Gonsoulin (1998) who administered a 15 question survey to a sample of emergency medical service (EMS) personnel in order to assess attitudes toward HIV infected patients, satisfaction with knowledge of HIV, perceived level of risk in the workplace, and compliance with universal precautions. Although 80% of respondents felt that EMS personnel had a greater risk of occupational exposure to HIV than other types of HCWs, one third did not agree that the employer did everything possible to protect the workers from HIV. An earlier study by Matin and Lester (1990) found similar attitudes about employer support among emergency medical service personnel. Twelve percent of EMS personnel surveyed by Hellinger and Gonsoulin admitted not using recommended protective behaviors all of the time. The authors noted that myths about HIV transmission still thrive, despite the current level of knowledge available. One prevalent myth is that HIV infected patients can be identified by means
other than a blood test, which is not available in the field. Furthermore, respondents thought they should be informed of patients’ known HIV status in spite of the recommendations about the consistent use of universal precautions on all patients. This response suggests that behavior would be changed by such knowledge, which supports the authors’ finding that compliance with recommendations does not always occur.

Setting as a potential source of differences among nurses’ knowledge of universal precautions, compliance, and frequency of body fluid exposure was studied by Glenn and Ramsey (1995). They found that nurses in rural settings were exposed more often to body fluids through needlestick and other sharps’ injuries. The authors concluded that nurses practicing in urban and rural settings were knowledgeable about universal precautions but that nurses working in rural settings did not implement this knowledge to the same degree.

In addition to needlestick and sharp injuries many routine procedures carry risk of contact with blood and bloody body fluids. While gloving will not prevent punctures, gloves serve as a barrier to transmission by other means. Following surgical procedures, wound drainage systems may be used to promote wound healing. Zerbe, McArdle, Goldrick, and Francis (1996b) investigated the performance of a closed wound drainage system, comparing its performance, frequency of exposure, and satisfaction to that of a commonly used drainage system which required opening for emptying. Each system was used on 20 adult subjects who had orthopedic surgery over a six month period. Use of the closed system resulted in fewer nursing staff exposures to blood and body fluids. Furthermore, nurses indicated greater satisfaction with protection from exposure
provided by the closed system. Nurses who emptied the commonly used drainage system which required opening, transfer of bloody fluid to another container, and emptying of the second container into a toilet elected to use only gloves 98% of the time and followed with hand washing 67% of the time. Nurses handling the closed drainage system chose to use gloves 43% of the time and followed with hand washing 43% of the time. Exposure risks were also explored by Zerbe, McArdle, and Goldrick (1996b) when 58 registered nurses (RN) volunteered to select appropriate personal protective equipment for use in a simulation with three wound drainage systems, including the two already referred to and one additional system. Although most RNs used gloves to handle each system, additional PPE was rarely used despite observed contamination during the simulation. Henry, Campbell, Collier, and Williams (1994) also noted that personnel were not always aware of incidents of noncompliance.

The increased incidence of patient to HCW and patient to patient transmission of multi-drug resistant tuberculosis has been documented (Wenger, Otten, Breeden, Orfas, Beck-Sague, & Jarvis, 1995). An increase in the number of tuberculin-skin-test conversions among HCWs accompanied an outbreak on an HIV ward. Wenger et al. conducted a follow-universal precautions study of the effect of specific control measures taken to prevent nosocomial transmission. Prior to the institution of control measures, the authors documented both patient and HCW exposure to infectious multidrug resistant tuberculosis. The rate of HCW tuberculin-skin-test conversions declined from 28% to 18% and no further conversions occurred after June, 1992. The authors attributed the decline to stricter use of isolation precautions and the
implementation of stricter control measures. The control measures included criteria for isolation and discontinuance of isolation, expansion of medical treatment, assurance of negative pressure in designated rooms, and other treatment related policies. A change in the type of mask worn by HCWs was also initiated. A submicron surgical mask, rather than a cup-shaped surgical mask was used. The frequency of monitoring of HCWs on the unit was increased in order to identify problems earlier.

Unfortunately, the reporting system itself may present a barrier to disclosure of needlestick injuries. In order to report a needlestick injury the employee may have to leave a unit understaffed, see someone in another building, or wait for a long time in the emergency department. If the HCW is on nights or evenings, the inconvenience may be even greater and the HCW may choose not to bother reporting (Doan-Johnson, 1992).

Several authors (Zerbe et al., 1996b; Gerberding, 1994; Zerbe et al., 1996a) recommend continued work on designing safer needle devices, promotion of hepatitis B virus vaccinations, and effective implementation of infection control precautions. D’Arco and Hargreaves (1995) described the effect of a comprehensive, multidisciplinary approach to reduce needlestick injuries among nurses in one institution. Staff education, discussion, emphasis on the need to report all needlestick injuries, not recapping needles, and installation of appropriate needle disposal containers were the primary foci of the approach. Nurses sustained the greatest number of needlestick injuries, 78%, and recapping needles caused the highest number of needlesticks. After an initial increase in needlestick injury reports which was attributed to previous under reporting, the number of needlestick injuries by nurses decreased
from 163 in 1987 to 104 in 1994. Needlestick injuries were still higher among nurses than other HCWs, which illustrates the difficulty of reducing risk of exposure even with a comprehensive, multidisciplinary approach. In a study on the incidence of needlestick injuries in 89 medical students, Shalom, Ribak, and Froom (1995) pointed out that although 26% of needlestick injuries occurred during recapping another 16% occurred while handling uncapped needles. The authors concluded that because experience decreased the risk for needlesticks, instructional intervention may have its greatest impact when given early in the students’ clinical experience.

**Decision Making Factors**

Planning and decision making are essential to nursing. Decision making, as an integral part of nursing, requires the ability to make judgments and think critically. Nurses who know the consequences of exposure and have knowledge about proper use of personal protective equipment still make decisions which include ignoring both consequences and knowledge. Sulzbach-Hoke (1996) reviewed literature on risk perception and decision making, concluding that nurse manager leadership and clinical nurse specialist expertise and role modeling could add a currently missing factor in the decision to take precautions or ignore risk. To the types of nurses who might have the most impact on improving compliance, Levin (1994) added occupational health nurses who have an opportunity to take a leadership role in workplace safety issues. Levin reviewed literature for the type of research designs used, sample sizes, reliability measures, and other research concerns, finding that too often methodologic problems limited generalization of results.
HCWs often prejudge clinical situations, taking precautions when HIV or other infections are suspected, rather than using precautions universally, despite the fact that many infected patients are asymptomatic, do not fit a stereotypical picture, and may not be aware of their own infected status (Hellinger and Gonsoulin, 1998). Although nursing education considers decision making a major curriculum concept, facilitating the development of this skill in an increasingly complex health care environment has proved difficult. In the initial testing of a decision making model, Lewis (1997) found that the presence of conflict resulted in higher task complexity ratings. Campbell (1988) notes the lack of consensus concerning characteristics that identify a task as complex. He points out that when desirable outcomes conflict, complexity increases. If the demands of quality conflict with the demands of quantity, a negative relationship exists between the outcomes.

A comprehensive approach might also include adding compliance with universal precautions to the performance review which has been suggested by Hersey and Martin (1994). Better enforcement of compliance was a need expressed by nurses, also (Sulzbach-Hoke, 1996). Both views emphasize the organizational component of the approach. Using a social learning theoretical context, Finley (1994) compared knowledge, attitudes, and preventative practices toward AIDS in emergency room nurses and paramedics in an urban area. Finley found that voluntary compliant behavior was more likely, when compliance with precautions was modeled.

Stress, fatigue, and alcohol use have been linked to accident risk. Murphy, DuBois, and Hurrell (1986) cite the combination of hazardous work conditions,
organizational factors, and inadequate training as contributors to accidents. The authors
designed a model of stress and accidents which identifies work and nonwork stressors
resulting in acute reactions, described as anxiety, fatigue, low motivation, and alcohol
use. Decreased capacities leading to unsafe behaviors and accidents or near misses
followed. “For example, anxiety can lead to lower performance accuracy, fatigue to
slower reaction time and inattention, and alcohol use to impaired judgement and
nurses and found that nurses who worked rotating shifts were twice as likely to have an
accident or error related to sleepiness, which included medication errors or near misses.
Corcoran studied the relationships among task complexity, nursing expertise, and
planning. Six expert and five novice nurses chosen from a hospice setting were asked to
development pain management plans for three cases of varying complexity. Expert
nurses were defined as registered nurses with at least 18 months experience in hospice
nursing who were presently in a leadership position. Novice nurses were defined as
staff registered nurses with less than six months hospice experience. The investigator
found that experts developed better final plans than novice nurses. Campbell (1991)
also points out that in the case of complex tasks increased effort does not always
translate into improved performance. Changes in the way one performs might have to
occur before performance can be improved.

Although a number of factors have been found to influence compliance, no
definite common solution to the complex problem of noncompliance has been
identified. Exploring relationships between various factors may result in the improvement of compliance.

**Variables Impacting Compliance**

Several factors have been found to influence compliance with guidelines for the prevention of transmission of infectious diseases. Physical factors, such as the proximity of needle disposal boxes to point of use, have been identified frequently. When needle disposal devices were placed close to the point of use, the hazard of recapping was reduced, but not eliminated (Makofsky & Cone, 1993; D’Arco & Hargreaves, 1995). HCWs have also been known to perceive recapping and not recapping needles as competing hazards, recapping if it was perceived to be less hazardous than not recapping (Jagger, Hunt, Brand-Elnaggar, & Pearson, 1988).

Specific definition of compliance and the use of monitoring were found to result in the overall improvement of usage rates of barrier precautions in a study by Kelen et al. (1991). A change in policy to one that mandated compliance with proper use of barrier precautions was accompanied by an educational session. Unfortunately, the authors found that compliance was greatest with low risk situations. In situations of high risk, such as in the presence of profuse bleeding, HCWs in the emergency room used barrier precautions less frequently.

HCWs perceived that they could identify high risk patients without confirmatory testing (Hellinger & Gonsoulin, 1998). Selection of barrier precautions was based on the HCW’s perception, rather than the use of mandated guidelines. Forgetfulness, being
too busy (Becker et al., 1990), presence of job or nonwork stressors, and increased task complexity (Lewis, 1997) all have been found to influence performance.

Comprehensiveness and a multidisciplinary approach have been found to increase the likelihood of changing behaviors. D’Arco & Hargreaves (1995) reported the outcome of the inclusion of a nurse manager on the quality improvement committee. Since the nurse member had experience with the problem, she was assigned the responsibilities of writing a needlestick injury reduction plan and monitoring needlestick data. Changes which contributed to an overall decline in needlestick injuries consisted of communication of needlestick data to nursing staff, incorporation of needle safety practices in nurse employee orientation programs, distribution of a written needle safety guideline, and implementation of changes in needle disposal boxes and needle locking devices (Kelen, 1991).

Modeling of compliant behaviors has been found to be an effective teaching strategy (Finley, 1994). A three hour training session which included didactic, written instructions, and demonstration and observed practice of venipuncture, intravenous catheter insertion, and proper disposal of sharps was used to prepare 135 medical students for compliance with universal precautions during clinical training (Wurtz, Dolan, O’Neal, & Azarcon, 1994). Instructors demonstrated the techniques in small groups and completed competency checklists on the students. Students were also offered the opportunity for additional practice with a phlebotomist on their own time. Using paired $t$ tests for 103 students who completed both assessments, the researchers
found significant differences between students’ before and after self-assessment scores ($p = .0001$).

The effect of class size on student learning has been studied primarily in elementary through high school education and the evidence favoring reduction in class size is not yet clearly conclusive (Hanushek, 1998; & Pritchard, 1999). Related factors, such as additional teacher training, have also been found to increase student learning. Research findings on the effect of class size on student learning has been divided. Small class size alone may not produce the beneficial effects that intuition suggests. Instead, a combination of factors which allows smaller class size to be effective or a learning environment which utilizes the characteristics generally attributed to small classes may facilitate the outcome of student learning. Pritchard concluded from a synthesis of research findings on class size that the beneficial effects of reduced class size outweighed the disadvantages.

**Summary**

The literature review reinforced the seriousness of compliance with measures that prevent transmission of bloodborne diseases and the risks associated with occupational exposure to bloodborne pathogens. The review also revealed that the issues surrounding compliance with barrier precautions and safer needle technology have not yet been fully explored. Furthermore, the effect of education and training on future compliance by nurses has not been clearly identified. Since compliance with standard precautions and transmission-based precautions are essential to preventing
transmission of bloodborne disease, further exploration of compliance factors is needed.

Social learning theory was used as the theoretical framework for the study.
CHAPTER III: METHODOLOGY

Introduction

A descriptive, correlational study was conducted to determine the relationships between selected institutional and personal demographic factors, knowledge, observation of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

Population and Sample

The population for this study was all nursing students currently enrolled in any university nursing program in the state of Louisiana preparing graduates qualified to become registered nurses. The sample for this study was all nursing students currently enrolled in a clinical nursing course in the state of Louisiana. The most recent data available for this population at the time of the study was the report compiled and published annually by the Louisiana State Board of Nursing on students in clinical nursing courses (Louisiana State Board of Nursing, October, 1999). Out of a population of 4175 Louisiana nursing students, 1447 (34.66%) were enrolled in clinical courses in associate degree programs and 2728 (65.34%) were enrolled in clinical courses in baccalaureate programs. Using Cochran’s sample size formula based on a 3% margin of error, the required minimum sample size when adjusted for population size was determined to be 153 associate degree students and 161 baccalaureate degree students. In order to assure that several schools would be sampled
a random sample of approximately one third of all Louisiana associate and baccalaureate degree nursing programs was drawn. Programs were randomly selected using a sampling with replacement model to assure that programs could be added, if consent to survey students was not forthcoming. In anticipation of potential low response rates, the researcher decided to attempt to collect data from all students who met the criterion of enrollment in a clinical course in one of the selected schools. Student enrollment in clinical courses varied widely from school to school. When necessary, the researcher made several trips to selected campuses in order to invite the participation of every qualified student. The researcher acknowledged the possibility of exceeding the minimum sample size before data was collected at every school and made the decision to continue data collection according to the sampling plan in the event of that occurrence. Consequently, without knowing at the outset of data collection exactly what the response rate would be, a procedure which would favor obtaining an adequate sample of schools and nursing students was designed and maintained, resulting in a sample which surpassed the minimum required.

A total of 710 useable surveys was collected from nursing students enrolled in clinical courses at three associate degree programs and four baccalaureate programs. As long as a substantial part of the survey was useable, the survey was included. Four surveys which had few items completed were excluded from the study. More surveys were collected than were necessary according to the sampling estimate, because all students available at the time of data collection were approached and asked to
complete the survey. The resulting sample size for baccalaureate degree programs was 432 and the sample size for associate degree programs was 278.

**Instrumentation**

No survey instrument was available that would meet the objectives of this study; therefore, the researcher developed an instrument designed to collect responses from the population of nursing students. Questions for the instrument were developed from the literature review and submitted to the researcher’s graduate committee, nurse educators, and infection control nurses. Revisions were made based on feedback from all groups prior to conducting a pilot study.

A four section instrument was used to collect data from students at selected associate and baccalaureate degree nursing programs in Louisiana contained the following sections: (a) students’ knowledge of facts related to needlestick injury and transmission of HIV, hepatitis B virus, and hepatitis C virus; (b) students’ compliance with preventive practices; (c) students’ observations of environmental risk factors; and (d) demographic data, self-reported compliance rates, and data related to the educational program, curriculum content, and strategies used to teach compliance with standard and transmission-based precautions.

**Assessment of Instrument Quality**

**Knowledge Section**

The knowledge section consisted of 30 researcher developed multiple choice items designed to assess the students’ knowledge of transmission of disease through
needlestick injury, including recommended precautions for the prevention of occupational exposure to bloodborne pathogens (See Appendix A for the complete instrument).

**Compliance Actions Section**

The compliance actions section consisted of a likert-type four point scale of 11 questions, items 31 through 41, designed to measure nursing students’ actions concerning the practice of recommended precautions for the prevention of occupational exposure to bloodborne pathogens (See Appendix A for complete instrument).

**Observations of Environmental Risk Factors Section**

The observations of environmental risk factors section consisted of a likert-type four point scale of 12 questions, items 42 through 53, designed to measure particular occupational circumstances noticed by students which are relevant to the practice of recommended precautions for the prevention of occupational exposure to bloodborne pathogens (See Appendix A for complete instrument).

**Demographic and Institutional Data Section**

A researcher designed form (See Appendix A for complete instrument) was used to collect self-reported demographic and institutional data from nursing students in clinical nursing courses which was used to describe the subjects. Demographic data included information related to age, gender, work experience, type of nursing program, and current clinical course enrollment. Institutional data included information about initial instruction about the prevention of occupational exposure to bloodborne
pathogens, characteristics of initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens, curriculum content, teaching strategies, and number of needlestick injuries reported by nursing students.

In order to assess content validity on the knowledge section of the instrument six nurse educators and five infection control nurses with expertise in the subject matter were asked to independently rate the relevance of the items to the objectives and hypotheses, using a four point scale: (1) not relevant, (2) somewhat relevant, (3) quite relevant, or (4) very relevant. Using Martuza’s (1977) Index of Content Validity, the percentage of items which were rated 3 or 4 was calculated to be greater than 99%. The expert reviewers were also asked to comment on whether the items adequately represented the domains addressed in the objectives and hypotheses, such as needle safety and handling practices, recommended precautions for the prevention of occupational exposure to bloodborne pathogens, and environmental factors related to transmission of disease by needlestick injury, and compliance. The reviewers responded positively in answer to the question. On this basis the content validity of the instrument was judged to be acceptable.

The instrument was also distributed to 14 of the most recent graduates of a baccalaureate nursing program. Five graduates returned the completed instrument. An additional five students from a pre-clinical class were asked to complete the instrument in order to compare scores of different levels of students and try out the ability of the students to complete the instrument. Descriptive statistics for the knowledge scale for both groups appear in Table 1. The mean scores for the total group, the preclinical
group, and the graduates were 60.30% (SD = 13.52), 55.80% (SD = 16.48), and 64.80% (SD = 9.42), respectively. Based on the results on an independent samples \( t \) test, the groups were not significantly different, \( t(8) = -1.060, p>.05. \)

Table 1. Comparison of Groups on Knowledge of Transmission of Disease through Needlestick Injury by Nursing Program

<table>
<thead>
<tr>
<th>Nursing Program</th>
<th>( N )</th>
<th>( M )</th>
<th>( SD )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>10</td>
<td>60.30%</td>
<td>13.52</td>
</tr>
<tr>
<td>Preclinical</td>
<td>5</td>
<td>55.80%</td>
<td>16.48</td>
</tr>
<tr>
<td>Graduate</td>
<td>5</td>
<td>64.80%</td>
<td>9.42</td>
</tr>
</tbody>
</table>

Note. No significant difference existed between preclinical and graduate groups, \( t(8) = -1.060, p>.05. \)

Pilot Study

A pilot study was conducted in the Summer of 2000 with the initial version of the instrument for the purpose of establishing reliability of the instrument, determining if the instrument would accomplish the objectives and hypotheses of the study, and estimating response rates. Data were collected from students enrolled in courses at one associate degree and two baccalaureate nursing programs in Mississippi. Forty-four of forty-five (97.80%) nursing students agreed to participate in the pilot study, completing all or part of the instrument.

Deans or Directors of the programs were initially contacted by telephone to determine if the program conducted summer classes, if students were enrolled in clinical courses, and if permission to conduct the study would be considered. A follow-up letter describing the study and a copy of the Institutional Review Board approval, if
requested, was then sent. If the administrator agreed to permit the researcher to conduct the study, a date for data collection was set. The researcher traveled to each site and spoke to each class briefly to explain participants’ rights, the purpose of the study, and direct the students to the cover letter and questionnaire.

The demographic profile of the pilot study subjects is displayed in Table 2. The typical respondent was female, 20 to 29 years old, and enrolled in an intermediate clinical nursing course.

Table 2. Demographic Profile of Pilot Study Respondents

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>8.89</td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>82.22</td>
</tr>
<tr>
<td>No Response</td>
<td>4</td>
<td>8.89</td>
</tr>
<tr>
<td>Type of Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BS</td>
<td>30</td>
<td>66.67</td>
</tr>
<tr>
<td>AD</td>
<td>15</td>
<td>33.33</td>
</tr>
<tr>
<td>Age in Years ($M=25.83, SD=6.54$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>30</td>
<td>66.67</td>
</tr>
<tr>
<td>30-39</td>
<td>7</td>
<td>15.56</td>
</tr>
<tr>
<td>40-49</td>
<td>2</td>
<td>4.44</td>
</tr>
<tr>
<td>50-59</td>
<td>1</td>
<td>2.22</td>
</tr>
<tr>
<td>No Response</td>
<td>5</td>
<td>11.11</td>
</tr>
<tr>
<td>Category</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
<td>----</td>
</tr>
<tr>
<td>Work Experience in health care setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before entering nursing program</td>
<td>21</td>
<td>46.67</td>
</tr>
<tr>
<td>During nursing program</td>
<td>16</td>
<td>35.56</td>
</tr>
<tr>
<td>No Response</td>
<td>8</td>
<td>17.78</td>
</tr>
<tr>
<td>Clinical Course Enrollment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First course</td>
<td>7</td>
<td>15.56</td>
</tr>
<tr>
<td>Intermediate course</td>
<td>34</td>
<td>75.56</td>
</tr>
<tr>
<td>Last course</td>
<td>1</td>
<td>02.22</td>
</tr>
<tr>
<td>No Response</td>
<td>3</td>
<td>06.67</td>
</tr>
</tbody>
</table>

*Note: N = 45.

aBS = Baccalaureate Nursing Program. bAD = Associate Degree Nursing Program.

Review of Section II on observations of environmental risk factors and Section III on compliance actions resulted in retention of all items; however, one item was judged to be more suitable for the section on compliance and was moved to that section. Items were reworded to conform to the format of the rest of the items. No other changes were necessary and the instrument was judged as appropriate for this study.

**Data Collection**

Dillman’s (1978) work on the importance of including the elements of personalization, usefulness of the study, and confidentiality, as well as eliminating potentially biased phrasing guided the development of the cover letter addressed to nursing students. Furthermore, the questionnaire was reproduced in booklet format with the cover letter printed on the first page and with no questions on the first or last
pages of the booklet in order to enhance its importance by its professional appearance and to stimulate the interest of nursing students.

Data collection took place in the Fall, 2000 semester and the Spring, 2001 semester. A letter describing the study (See Appendix B) was sent to the Administrator, Dean, Director, or Department Head, of each undergraduate nursing program requesting permission to survey students enrolled in clinical courses. A copy of the cover letter to nursing students (See Appendix C) was also included and a copy of the Institutional Review Board approval was furnished (See Appendix D), upon request. Once permission had been granted, the researcher arranged a suitable time and date for data collection and traveled to each school to conduct the survey. If no response was forthcoming the researcher followed up with telephone and email contacts. In some instances permission to conduct the study was denied outright or the researcher was unable to reach the administrator after several weeks of persistent attempts. In those instances the next program on the list was identified and the researcher repeated the same procedure. The researcher explained the purpose of the study, verbally and in writing, and answered questions before requesting students’ participation in the study. Students were assured verbally and in writing that their participation was voluntary and would not affect their status in the program or their grade in the course in any way. In addition, confidentiality was maintained by securing the completed instruments in the researcher’s locked file cabinet and by not requesting a name or using an identification code. Furthermore, a written explanation was distributed to the students which included the name, phone number, and email address.
of the researcher in the event of questions at a later date. Completion of the instruments served as consent for participation.

**Data Analysis**

A descriptive, correlational research design was used in this study and employed descriptive and univariate, bivariate, and multivariate statistical techniques. Interpretation of correlation coefficients was based on Cohen’s (1988) effect size measures.

Objective one was to describe the nursing students in Louisiana on selected demographic characteristics. Characteristics included age, gender, type of nursing program, current clinical course enrollment, and work experience. Frequencies, percentages, means, and standard deviations were used to describe the variables which were displayed in tabular form.

Objective two was to describe and compare nursing students’ knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety by degree program. Mean scores and standard deviations on Section I (knowledge) of the questionnaire were calculated for the total group, associate degree students, and baccalaureate students and presented in a table. In addition, an independent samples t test was calculated to compare mean scores of associate degree and baccalaureate students.

Objective three sought to describe the curriculum content placement used for needlestick injury and needle safety in selected associate degree and baccalaureate nursing programs. Curriculum content placement was measured by asking students to
identify where initial instruction in the nursing program occurred. The categories included: before the first clinical course, during the first clinical course, during an intermediate clinical course, during the last clinical course, and have not yet received instruction. Frequencies and percentages were calculated and presented in a table.

Objective four sought to describe and compare the nursing students’ observations of environmental risk factors concerning disease transmission by needlestick injury by degree program and course level. Observations of environmental risk factors were measured by Section III of the questionnaire and were reported by nursing program and clinical course enrollment, as well as total group. Frequencies, means, and standard deviations were reported in tables. An independent *t* test was also calculated comparing mean scores of students in associate degree and baccalaureate programs. In addition, a one-way ANOVA was computed to compare mean scores of students in three levels of clinical courses on Section III, observations of environmental risk factors.

Objective five sought to describe and compare the nursing students’ compliance with standard and transmission-based precautions concerning needlestick injury and needle safety by degree program and course level. Frequencies, mean scores and standard deviations for Section II of the questionnaire, compliance actions, were reported for associate degree and baccalaureate students, as well as the total group. In addition, an independent samples *t* test was used to compare mean scores of students in each type of program. A one-way ANOVA was also computed to compare mean scores of students in three levels of clinical courses on Section II, compliance actions.
Objective six sought to describe and compare the strategies used by baccalaureate and associate degree nursing programs to teach content related to needlestick injury, recommended practices of needle safety, and prevention of disease transmission by needlestick injury. Teaching strategies were measured by asking students to identify the main method, the second most often used method, and the most helpful method employed in their initial instruction in the nursing program from among the following categories: lecture, videotaped presentations, group discussion, demonstration, and other. Students were also asked to indicate the size of the group in which they first learned about protecting themselves from occupational exposure to bloodborne pathogens, which included the following categories: 25 or fewer, 26 to 50, 51 to 75, 76 to 100, and 101 or more. In addition, students were queried about the frequency of interaction between faculty and student during initial instruction in the nursing program, using the following categories: many times, several times, few times, and not at all. Finally, students were asked two questions about teacher and hospital staff nurse actions and two questions about following the actions of teachers and hospital staff nurses. Tables of frequencies and percentages were used for all teaching strategies and, where appropriate, means and standard deviations were reported. Frequencies and percentages for all categories of faculty/student interaction were reported. An independent samples t test was also calculated on the mean faculty/student interactions during initial instruction in the nursing program of associate and baccalaureate degree nursing students.
Objective seven was to determine if a relationship existed between nursing students’ knowledge of disease transmission and needlestick injury and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Pearson’s Product Moment Correlation was calculated between respondents’ mean scores on Section I of the instrument, knowledge, and Section II, compliance.

Objective eight sought to determine if a relationship existed between nursing students’ observations of environmental risk factors and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Pearson’s Product Moment Correlation was calculated between respondents’ mean scores on Section II of the questionnaire, compliance, and Section II, observations.

Objective nine examined the efficacy of the LAB Model that utilizes knowledge and environmental factors to explain the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. The following independent variables were entered using the stepwise method: age, current course, gender, working at a hospital in a paid job, working in a non-hospital health care setting at a paid job, having work experience in a health care setting before enrollment, instruction emphasis on prevention of transmission of bloodborne pathogens by NSI, initial instruction in or outside of the nursing program, score on observation of environmental risk section of questionnaire, perceived support of compliance by faculty and clinical staff, initial instruction emphasis on aspects of needlestick injury, size of class receiving initial instruction in the nursing program,
score on knowledge section of questionnaire, and unreported NSI. Multiple linear regression analysis was used to determine if a significant proportion of the variance in the dependent variable, compliance, could be explained by the independent variables.

Hypothesis one stated that the emphasis given concerning recommended precautions for the prevention of occupational exposure to bloodborne pathogens in a program of study at the time of initial instruction was positively related to the extent of compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens by nursing students. Characteristics of initial instruction were measured by asking students to estimate the level of emphasis given to selected components in the initial instruction, items 65 through 69 of the questionnaire (See Appendix A for complete instrument). Spearman’s rho correlation was calculated between the summed emphasis scores (items 65 through 69) and compliance action scores (Section II of the instrument).

Hypothesis two stated that the teaching strategies used in nursing students’ initial instructions for the prevention of occupational exposure to bloodborne pathogens are positively related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Spearman’s rho correlation was calculated between the size of the group in which respondents’ received initial instruction and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Additional Spearman’s rho correlations were calculated between the level of emphasis in instructional components and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Pearson’s Product
Moment Correlation was calculated between the frequency of interaction between faculty and student and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

Hypothesis three stated that nursing students’ perceived support of compliance with standard and transmission-based precautions by faculty and clinical staff is positively related to nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Pearson’s Product Moment Correlation was calculated between the respondents’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and perceived support of compliance by faculty and clinical staff.
CHAPTER IV: FINDINGS

This chapter presents the results of the study that was designed to determine the relationships between selected institutional and personal demographic factors, knowledge, observation of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

Demographic Profile

The first objective was to describe the nursing students in Louisiana on selected demographic characteristics. The demographic profile of the subjects is displayed in Table 3. The typical respondent was female, 20 to 29 years of age, and in the upper level of the program. The data in Table 4 show that most respondents received initial instruction about the prevention of occupational exposure to bloodborne pathogens in a classroom setting.

Table 3. Demographic Profile of Respondents

<table>
<thead>
<tr>
<th>Category</th>
<th>AD^a N</th>
<th>AD</th>
<th>BS^b N</th>
<th>BS</th>
<th>Total N</th>
<th>Total P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>37</td>
<td>13.3</td>
<td>62</td>
<td>14.35</td>
<td>99</td>
<td>13.94</td>
</tr>
<tr>
<td>Female</td>
<td>240</td>
<td>86.3</td>
<td>363</td>
<td>84.03</td>
<td>603</td>
<td>84.93</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>.4</td>
<td>7</td>
<td>1.62</td>
<td>8</td>
<td>1.13</td>
</tr>
<tr>
<td>Age in years^c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>10</td>
<td>3.60</td>
<td>2</td>
<td>0.46</td>
<td>12</td>
<td>1.70</td>
</tr>
<tr>
<td>20 - 29</td>
<td>188</td>
<td>67.63</td>
<td>347</td>
<td>80.32</td>
<td>536</td>
<td>75.49</td>
</tr>
</tbody>
</table>

(table continued)
<table>
<thead>
<tr>
<th>Category</th>
<th>AD&lt;sup&gt;a&lt;/sup&gt;</th>
<th>AD</th>
<th>BS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>BS</th>
<th>Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>30 - 39</td>
<td>52</td>
<td>18.71</td>
<td>57</td>
<td>13.19</td>
<td>109</td>
<td>15.35</td>
</tr>
<tr>
<td>40 - 49</td>
<td>18</td>
<td>6.47</td>
<td>17</td>
<td>3.94</td>
<td>35</td>
<td>4.93</td>
</tr>
<tr>
<td>$50</td>
<td>3</td>
<td>1.08</td>
<td>1</td>
<td>0.23</td>
<td>4</td>
<td>0.56</td>
</tr>
<tr>
<td>No Response</td>
<td>7</td>
<td>2.52</td>
<td>8</td>
<td>1.85</td>
<td>14</td>
<td>1.97</td>
</tr>
</tbody>
</table>

**Work Experience in Health Care Setting<sup>d</sup>**

| Before entering nursing program | 150 | 54.00 | 175 | 40.51 | 325 | 45.77 |
| No Response                     | 1   | 0.36  | 7   | 1.62  | 8   | 1.13  |

| During nursing program          |     |       |     |       |     |       |
| Hospital                        | 87  | 31.29 | 152 | 35.19 | 239 | 33.66 |
| No Response                     | 1   | 0.36  | 8   | 1.85  | 9   | 1.27  |
| Other health care setting       | 44  | 15.83 | 61  | 14.12 | 105 | 14.79 |
| No Response                     | 2   | 0.72  | 7   | 1.62  | 9   | 1.27  |

**Work Experience as:<sup>e</sup>**

| Nurse Technician               | 74  | 26.62 | 141 | 32.64 | 215 | 30.28 |
| Licensed Practical Nurse       | 26  | 9.35  | 14  | 3.24  | 40  | 5.63  |
| Registered Nurse               | 1   | 0.36  | 0   | 0     | 1   | 0.14  |
| No Response                    | 2   | 0.72  | 7   | 1.62  | 454 | 63.95 |

**Clinical Course Enrollment:**

| First course                  | 46  | 16.55 | 118 | 27.31 | 164 | 23.10 |
| Intermediate course           | 116 | 41.73 | 201 | 46.53 | 317 | 44.65 |
| Last course                   | 113 | 40.65 | 107 | 24.77 | 220 | 30.99 |
| No Response                   | 3   | 1.08  | 6   | 1.39  | 9   | 1.27  |

*Note: N = 710 for total students. n = 278 for AD students. n = 432 for BS students. AD = Associate Degree Nursing Program. BS = Baccalaureate Nursing Program. M 25.87, SD 6.47 for age of total student group, M 26.96, SD 7.00 for AD students; M 25.18, SD 6.02 for BS students. “No” responses excluded from table. “None of the above” responses excluded from table.*

Students were asked five questions in which they rated the degree of emphasis placed on particular components of the initial instruction about the prevention of occupational exposure to bloodborne pathogens. The questions addressed the level of
emphasis on the following components: (a) the need for reporting needlestick injuries, (b) the ideal time frame for reporting needlestick injuries, (c) follow-up care for needlestick injuries, (d) the need for preventive medical treatment following needlestick injuries, and (e) the nursing program’s exposure control plan. Ratings were assigned to the responses by the researcher, as follows: (a) four for “greater than given any other area,” (b) three for “greater than given most other areas,” (c) two for “less than given most other areas,” or (d) one for “less than given any other area.” The number and percentage of students reporting each rating for level of emphasis on the components are displayed in Table 5 along with means and standard deviations for the total group and each type of program. With one exception the level of emphasis selected most often by both baccalaureate and associate degree students was “greater than given most other areas.” Associate degree students selected “greater than any other area” most often when rating the level of emphasis given “the nursing program’s exposure control plan.” For every instructional component a majority (>75%) of students indicated that components received either “greater emphasis than given any other area” or “greater emphasis than most other areas.”
Table 4. Setting of Initial Instruction about Prevention of Occupational Exposure to Bloodborne Pathogens

<table>
<thead>
<tr>
<th>Setting</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>511</td>
<td>71.97</td>
</tr>
<tr>
<td>Competency Lab</td>
<td>81</td>
<td>11.41</td>
</tr>
<tr>
<td>Clinical Lab</td>
<td>24</td>
<td>3.38</td>
</tr>
<tr>
<td>Other</td>
<td>85</td>
<td>11.97</td>
</tr>
<tr>
<td>No Response</td>
<td>9</td>
<td>1.27</td>
</tr>
</tbody>
</table>

\[ N = 710 \]
Table 5. Level of Emphasis on Selected Components of Initial Instruction Related to Prevention of Needle Stick Injuries

<table>
<thead>
<tr>
<th>Instructional Component</th>
<th>Levels of Emphasis</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Need for Reporting Needlestick Injuries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totala</td>
<td></td>
<td>260</td>
<td>366</td>
<td>56</td>
<td>12</td>
<td>3.26</td>
<td>0.68</td>
</tr>
<tr>
<td>(N = 693)</td>
<td></td>
<td>(36.62%)</td>
<td>(51.55%)</td>
<td>(7.89%)</td>
<td>(1.69%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td></td>
<td>151</td>
<td>230</td>
<td>31</td>
<td>8</td>
<td>3.24</td>
<td>0.67</td>
</tr>
<tr>
<td>(n = 420)</td>
<td></td>
<td>(34.95%)</td>
<td>(53.24%)</td>
<td>(7.18%)</td>
<td>(1.85%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td></td>
<td>109</td>
<td>136</td>
<td>25</td>
<td>4</td>
<td>3.28</td>
<td>0.69</td>
</tr>
<tr>
<td>(n = 274)</td>
<td></td>
<td>(39.21%)</td>
<td>(48.92%)</td>
<td>(8.99%)</td>
<td>(1.44%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ideal Time Frame for Reporting Needlestick Injuries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Totala</td>
<td></td>
<td>283</td>
<td>297</td>
<td>85</td>
<td>24</td>
<td>3.22</td>
<td>0.79</td>
</tr>
<tr>
<td>(N = 689)</td>
<td></td>
<td>(39.86%)</td>
<td>(41.83%)</td>
<td>(11.97%)</td>
<td>(3.38%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td></td>
<td>163</td>
<td>185</td>
<td>51</td>
<td>18</td>
<td>3.19</td>
<td>0.81</td>
</tr>
<tr>
<td>(n = 417)</td>
<td></td>
<td>(37.73%)</td>
<td>(42.82%)</td>
<td>(11.81%)</td>
<td>(4.17%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td></td>
<td>120</td>
<td>112</td>
<td>34</td>
<td>6</td>
<td>3.27</td>
<td>0.76</td>
</tr>
<tr>
<td>(n = 272)</td>
<td></td>
<td>(43.17%)</td>
<td>(40.29%)</td>
<td>(12.23%)</td>
<td>(2.16%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Follow-up Care for Needlestick Injuries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totala</td>
<td></td>
<td>258</td>
<td>322</td>
<td>83</td>
<td>14</td>
<td>3.22</td>
<td>0.73</td>
</tr>
<tr>
<td>(N = 677)</td>
<td></td>
<td>(36.34%)</td>
<td>(45.35%)</td>
<td>(11.69%)</td>
<td>(1.97%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td></td>
<td>148</td>
<td>195</td>
<td>58</td>
<td>12</td>
<td>3.16</td>
<td>0.77</td>
</tr>
<tr>
<td>(n = 413)</td>
<td></td>
<td>(34.26%)</td>
<td>(45.14%)</td>
<td>(13.43%)</td>
<td>(2.78%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td></td>
<td>110</td>
<td>127</td>
<td>25</td>
<td>2</td>
<td>3.31</td>
<td>0.67</td>
</tr>
<tr>
<td>(n = 264)</td>
<td></td>
<td>(39.57%)</td>
<td>(45.68%)</td>
<td>(8.99%)</td>
<td>(0.72%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Preventive Medical Treatment Following Needlestick Injuries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totala</td>
<td></td>
<td>263</td>
<td>328</td>
<td>70</td>
<td>14</td>
<td>3.24</td>
<td>0.72</td>
</tr>
<tr>
<td>(N = 675)</td>
<td></td>
<td>(37.04%)</td>
<td>(46.20%)</td>
<td>(9.86%)</td>
<td>(1.97%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td></td>
<td>156</td>
<td>198</td>
<td>47</td>
<td>11</td>
<td>3.21</td>
<td>0.75</td>
</tr>
<tr>
<td>(n = 412)</td>
<td></td>
<td>(36.11%)</td>
<td>(45.83%)</td>
<td>(10.88%)</td>
<td>(2.55%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td></td>
<td>107</td>
<td>130</td>
<td>23</td>
<td>3</td>
<td>3.30</td>
<td>0.67</td>
</tr>
<tr>
<td>(n = 263)</td>
<td></td>
<td>(38.49%)</td>
<td>(46.76%)</td>
<td>(8.27%)</td>
<td>(1.08%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(table continued)
### Instructional Component Levels of Emphasis

<table>
<thead>
<tr>
<th>Program’s Exposure Control Plan</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total(^a)</td>
<td>263</td>
<td>328</td>
<td>70</td>
<td>14</td>
<td>3.18</td>
<td>0.78</td>
</tr>
<tr>
<td>((N = 675))</td>
<td>((37.04%))</td>
<td>((46.20%))</td>
<td>((9.86%))</td>
<td>((1.97%))</td>
<td>(3.18)</td>
<td>(0.78)</td>
</tr>
<tr>
<td>BS(^b)</td>
<td>136</td>
<td>194</td>
<td>67</td>
<td>12</td>
<td>3.11</td>
<td>0.78</td>
</tr>
<tr>
<td>((n = 409))</td>
<td>((31.48%))</td>
<td>((44.91%))</td>
<td>((15.51%))</td>
<td>((2.78%))</td>
<td>(3.11)</td>
<td>(0.78)</td>
</tr>
<tr>
<td>AD(^c)</td>
<td>119</td>
<td>107</td>
<td>31</td>
<td>6</td>
<td>3.29</td>
<td>0.76</td>
</tr>
<tr>
<td>((n = 263))</td>
<td>((42.81%))</td>
<td>((38.49%))</td>
<td>((11.15%))</td>
<td>((2.16%))</td>
<td>(3.29)</td>
<td>(0.76)</td>
</tr>
</tbody>
</table>

*Note.* Ratings were assigned to levels of emphasis by the researcher, as follows: \(4 = \) greater than given any other area, \(3 = \) greater than given most other areas, \(2 = \) less than given most other areas, \(1 = \) less than given any other area). Nonresponses were omitted, since non-response rate for all groups was less than 5%. BS = Baccalaureate Nursing Program. AD = Associate Degree Nursing Program.

\(^a\)N = 710. \(^b\)n = 432. \(^c\)n = 278.

### Description of Nursing Students’ Knowledge

Objective two was to describe and compare nursing students' knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety by degree program. The data were gathered with an 86 item questionnaire (see Appendix A for a copy of the complete instrument) which addressed knowledge of needlestick safety and related areas, actions related to compliance, observations of environmental risk factors, and demographic information. Section I of the questionnaire which was composed of 30 multiple choice items was used to assess knowledge related to disease transmission by needlestick injury, such as: transmission of disease through bloodborne pathogens, recommended needle handling precautions, and factors affecting occupational exposure to bloodborne pathogens. Except for items 27 through 30, each item had one correct answer (see Appendix E for a table of correct and incorrect responses). Answering items 27 through 30 correctly required the
selection of every choice. Each choice was then scored as a separate item. Knowledge score means and standard deviations for total respondents, baccalaureate nursing students and associate degree nursing students are presented in Table 6. An independent samples t test was calculated comparing means of baccalaureate students’ knowledge scores with means of associate degree students’ knowledge scores. No significant difference was found, \( t(708) = -0.153, p > 0.05 \). Students from the two programs did not differ in their knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety.

Table 6. Mean Scores and Standard Deviations on Knowledge of Disease Transmission and Recommended Practices of Needle Safety

<table>
<thead>
<tr>
<th>Degree</th>
<th>Mean (M)</th>
<th>Standard Deviation (SD)</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>67.92%</td>
<td>9.71</td>
<td>20.51</td>
<td>92.31</td>
<td>710</td>
</tr>
<tr>
<td>AD</td>
<td>67.99%</td>
<td>9.12</td>
<td>20.51</td>
<td>89.74</td>
<td>278</td>
</tr>
<tr>
<td>BS</td>
<td>67.87%</td>
<td>10.08</td>
<td>38.46</td>
<td>92.31</td>
<td>432</td>
</tr>
</tbody>
</table>

Note: Possible scores ranged from 0 to 100%. No significant difference existed in mean scores by degree program (\( t(708) = -0.153, p > 0.05 \)).

*AD = Associate Degree Nursing Program. *BS = Baccalaureate Nursing Program.

**Curriculum Content Placement**

Objective three sought to describe the curriculum content placement used for needlestick injury and needle safety in selected associate degree and baccalaureate nursing programs. Students were asked to indicate when they received initial instruction about prevention of occupational exposure to bloodborne pathogens in the nursing program. In both baccalaureate and associate degree programs more students received initial instruction before the first clinical course than at any other time. When
combined, the categories of “before first course” and “during first course” accounted for more than 90% of responses in both baccalaureate and associate degree programs. Frequencies and percentages of responses for the total group, baccalaureate, and associate degree students are reported in Table 7.

Table 7. Curriculum Placement of Initial Instruction about Prevention of Occupational Exposure to Bloodborne Pathogens in Associate Degree and Baccalaureate Degree Programs

<table>
<thead>
<tr>
<th>Placement of Initial Instruction</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Respondents: Initial Instruction in Clinical Nursing Courses Occurred</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before first course</td>
<td>487</td>
<td>68.59</td>
</tr>
<tr>
<td>During first course</td>
<td>173</td>
<td>24.37</td>
</tr>
<tr>
<td>During intermediate course</td>
<td>19</td>
<td>2.68</td>
</tr>
<tr>
<td>During last course</td>
<td>3</td>
<td>0.42</td>
</tr>
<tr>
<td>Not yet received</td>
<td>4</td>
<td>0.56</td>
</tr>
<tr>
<td>No Response</td>
<td>24</td>
<td>3.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>710</td>
<td>100.00</td>
</tr>
<tr>
<td><strong>AD Respondents: Initial Instruction in Clinical Nursing Courses Occurred</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before first course</td>
<td>197</td>
<td>70.86</td>
</tr>
<tr>
<td>During first course</td>
<td>65</td>
<td>23.38</td>
</tr>
<tr>
<td>During intermediate course</td>
<td>7</td>
<td>2.52</td>
</tr>
<tr>
<td>During last course</td>
<td>1</td>
<td>0.36</td>
</tr>
<tr>
<td>Not yet received</td>
<td>1</td>
<td>0.36</td>
</tr>
<tr>
<td>No Response</td>
<td>7</td>
<td>2.52</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>278</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(table continued)
Students were asked to indicate the approximate size of the group in which they received initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens. Baccalaureate students were taught in groups of 25 or fewer more frequently than associate degree nursing students who were most frequently taught in groups of 26 to 50 students. Frequencies and percentages of students’ group sizes are reported in Table 8.

<table>
<thead>
<tr>
<th>Placement of Initial Instruction</th>
<th>BS⁺ Respondents: Initial Instruction in Clinical Nursing Courses Occurred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before first course</td>
<td>290 67.12</td>
</tr>
<tr>
<td>During first course</td>
<td>108 25.00</td>
</tr>
<tr>
<td>During intermediate course</td>
<td>12 2.78</td>
</tr>
<tr>
<td>During last course</td>
<td>2 0.46</td>
</tr>
<tr>
<td>Not yet received</td>
<td>3 0.69</td>
</tr>
<tr>
<td>No Response</td>
<td>17 3.93</td>
</tr>
<tr>
<td>Total</td>
<td>432 100.00</td>
</tr>
</tbody>
</table>

Note: N = 710. n = 432 for BS respondents. n = 278 for AD respondents.
⁺AD = Associate Degree Nursing Program. ⁺BS = Baccalaureate Nursing Program.
Table 8. Group Size for Initial Instruction about Prevention of Occupational Exposure to Bloodborne Pathogens in Nursing Program

<table>
<thead>
<tr>
<th>Number in Group</th>
<th>BS(^a) Frequency (Percentage)</th>
<th>AD(^a) Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 or fewer</td>
<td>241 (55.78%)</td>
<td>35 (12.59%)</td>
</tr>
<tr>
<td>26 to 50</td>
<td>61 (14.12%)</td>
<td>132 (47.48%)</td>
</tr>
<tr>
<td>51 to 75</td>
<td>85 (19.68%)</td>
<td>95 (34.17%)</td>
</tr>
<tr>
<td>76 to 100</td>
<td>26 (6.02%)</td>
<td>6 (2.16%)</td>
</tr>
<tr>
<td>101 or more</td>
<td>5 (1.16%)</td>
<td>3 (1.08%)</td>
</tr>
<tr>
<td>No Response</td>
<td>14 (3.24%)</td>
<td>7 (2.52%)</td>
</tr>
<tr>
<td>Total</td>
<td>432 (100.00%)</td>
<td>278 (100.00%)</td>
</tr>
</tbody>
</table>

Note. \(N = 710\).
\(^a\)BS = Baccalaureate Nursing Program. \(^a\)AD = Associate Degree Nursing Program.

Four questions also addressed the impact of role modeling by teachers and hospital staff nurses. Respondents were asked to indicate if the teachers and hospital staff nurses they most admired followed recommended needle safety precautions always (5), usually (4), sometimes (3), seldom (2), or never (1). Students were also asked to indicate how often they would be following recommended needle safety precautions, when they followed the example set by teachers and nurses. Frequencies, percentages, means, and standard deviations are displayed in Table 9.
<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groupa</td>
<td>5 (Always)</td>
<td>4 (Usually)</td>
<td>3 (Sometimes)</td>
<td>2 (Seldom)</td>
<td>1 (Never)</td>
</tr>
<tr>
<td>When you follow actions of teachers you admire, you are following needle safety precautions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>487</td>
<td>131</td>
<td>50</td>
<td>4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>(68.59%)</td>
<td>(18.45%)</td>
<td>(7.04%)</td>
<td></td>
<td>(0.56%)</td>
<td>(1.27%)</td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td>295</td>
<td>77</td>
<td>32</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>(68.29%)</td>
<td>(17.82%)</td>
<td>(7.41%)</td>
<td></td>
<td>(0.46%)</td>
<td>(1.62%)</td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td>192</td>
<td>54</td>
<td>18</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(69.06%)</td>
<td>(12.50%)</td>
<td>(4.17%)</td>
<td></td>
<td>(0.46%)</td>
<td>(0.46%)</td>
<td></td>
</tr>
<tr>
<td>When you follow actions of hospital staff nurses you admire, you are following needle safety precautions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>274</td>
<td>222</td>
<td>138</td>
<td>32</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>(38.59%)</td>
<td>(31.27%)</td>
<td>(19.44%)</td>
<td></td>
<td>(4.51%)</td>
<td>(1.69%)</td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td>166</td>
<td>141</td>
<td>82</td>
<td>13</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>(38.43%)</td>
<td>(32.64%)</td>
<td>(18.98%)</td>
<td></td>
<td>(3.01%)</td>
<td>(2.78%)</td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td>108</td>
<td>81</td>
<td>56</td>
<td>19</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(38.85%)</td>
<td>(29.14%)</td>
<td>(20.14%)</td>
<td>(6.83%)</td>
<td>(1.44%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often do your teachers follow needle safety precautions?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>454</td>
<td>193</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(63.94%)</td>
<td>(27.18%)</td>
<td>(3.38%)</td>
<td>(0.42%)</td>
<td>(0.42%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSb</td>
<td>268</td>
<td>126</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(62.04%)</td>
<td>(29.17%)</td>
<td>(2.78%)</td>
<td>(0.69%)</td>
<td>(2.31%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADc</td>
<td>186</td>
<td>67</td>
<td>12</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(66.91%)</td>
<td>(24.10%)</td>
<td>(43.32%)</td>
<td>(0.0%)</td>
<td>(0.72%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(table continued)
### Observations of Environmental Risk Factors

Objective four sought to describe and compare the nursing students’ observations of environmental risk factors concerning disease transmission by needlestick injury by program and course level. Items 42 to 53 in Section III of the instrument (see Appendix A for complete instrument) were designed to measure nursing students’ observations of environmental risk factors. The maximum possible score was 48 and the minimum possible score was 12. Ratings were assigned by the researcher to students’ responses, as follows: four for always; three for usually; two for sometimes; and one for never. Scores were calculated by summing the ratings assigned to the students’ responses. Both groups scored a mean of approximately 40 points out of 48 with a median of 41. An independent samples t test was calculated comparing

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency (Percentage)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Always</td>
<td>110 (15.49%)</td>
<td>3.55</td>
</tr>
<tr>
<td></td>
<td>4 Usually</td>
<td>319 (44.93%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Sometimes</td>
<td>213 (30.00%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Seldom</td>
<td>29 (4.08%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Never</td>
<td>1 (0.14%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BS&lt;sup&gt;b&lt;/sup&gt;</td>
<td>70 (16.20%)</td>
<td>3.79</td>
</tr>
<tr>
<td></td>
<td>4 Always</td>
<td>201 (46.53%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Usually</td>
<td>118 (27.31%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Sometimes</td>
<td>16 (3.70%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Seldom</td>
<td>1 (0.23%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AD&lt;sup&gt;c&lt;/sup&gt;</td>
<td>40 (14.39%)</td>
<td>3.70</td>
</tr>
<tr>
<td></td>
<td>4 Always</td>
<td>118 (42.45%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Usually</td>
<td>95 (34.17%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Sometimes</td>
<td>13 (4.68%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Seldom</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Non-responses have been excluded from table, because they account for less than 5% of responses.

<sup>a</sup>N = 710 for total students. n = 432 for BS students. n = 278 for AD students. <sup>b</sup>BS = Baccalaureate Nursing Program; <sup>c</sup>AD = Associate Degree Nursing Program.
means of baccalaureate students’ observation of environmental risk factor scores with means of associate degree students’ observation of environmental risk factor scores. No significant difference was found, \( t(645) = .347, p > .05 \). Students from the two programs did not differ in their observation of environmental risk factors related to disease transmission by needlestick injury. Mean scores and standard deviations for all useable scores for total respondents, baccalaureate degree, and associate degree nursing students are reported in Table 10. Of the 63 students who did not respond to this section of the questionnaire, 19 were enrolled in associate degree programs and 44 were enrolled in baccalaureate programs.

Table 10. Observations of Environmental Risk Factors Scores, According to Type of Program

<table>
<thead>
<tr>
<th>Program Type</th>
<th>N</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD(^a)</td>
<td>259</td>
<td>20</td>
<td>48</td>
<td>40.61</td>
<td>5.66</td>
</tr>
<tr>
<td>BS(^b)</td>
<td>387</td>
<td>25</td>
<td>48</td>
<td>40.20</td>
<td>5.29</td>
</tr>
<tr>
<td>Total</td>
<td>646</td>
<td>20</td>
<td>48</td>
<td>40.37</td>
<td>5.44</td>
</tr>
</tbody>
</table>

Note. Observations of Environmental Risk Factor Scores ranged from a low of 20 to a maximum of 48. No significant difference existed in mean scores of students by program \( t(645) = .347, p > .05 \).

\(^a\)AD = Associate Degree Nursing Program. \(^b\)BS = Baccalaureate Nursing Program.

A one-way ANOVA was computed to compare mean scores of students in three levels of clinical courses on Section III, observations of environmental risk factors. A significant difference was found among the students in different levels of courses, \( F(2,640) = 14.34, p < .01, f = .20 \). Tukey’s HSD was used to determine the nature of the differences between students. Students enrolled in the first clinical course
scored higher than students in the intermediate or last clinical courses. A breakdown of mean scores and standard deviations, according to the course in which students were currently enrolled, is reported in Table 11.

Table 11. Observations of Environmental Risk Factor Scores, According to Clinical Course Enrollment

<table>
<thead>
<tr>
<th>Clinical Course</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Course</td>
<td>128</td>
<td>42.50</td>
<td>5.43</td>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>Intermediate Course</td>
<td>305</td>
<td>40.23</td>
<td>5.13</td>
<td>25</td>
<td>48</td>
</tr>
<tr>
<td>Last Course</td>
<td>210</td>
<td>39.34</td>
<td>5.49</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Did Not Respond</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>710</td>
<td>40.39</td>
<td>5.42</td>
<td>20</td>
<td>48</td>
</tr>
</tbody>
</table>

Note. Possible scores ranged from 12 to 48. A significant difference existed between mean scores of students at different course levels, \( F(2,640) = 14.34, p < .01 \).

**Compliance Actions**

Objective five sought to compare the nursing students' compliance with standard and transmission-based precautions concerning needlestick injury and needle safety by degree program and course level. Items 31 to 41 of the questionnaire (see Appendix A for complete instrument) were designed to determine the frequency that students’ actions were in compliance with proper procedure. The maximum possible score for items 31 to 41 was 44 and the minimum possible score was 11. Scores were calculated by summing the ratings assigned to the students’ responses. Ratings were assigned to positively stated items, as follows: Mean scores and standard deviations for
all useable scores for total respondents, baccalaureate degree, and associate degree nursing students are reported in Table 12. Out of a total of 710 students, 25 associate degree students and 65 baccalaureate students (12.68%) did not respond to this section of the questionnaire.

Traditionally, nursing programs regard test scores below approximately 80% correct with concern when mastery of knowledge or skill is expected. In order to reach this standard on Section II of the questionnaire, students would have had to score at least 35.50. The number of students in both types of programs who scored below this level on Section II, compliance actions, was 307 (49.51%). No associate degree students attained the maximum score and 91 (35.97%) associate degree nursing students scored at or above the equivalent of 80% of the maximum score possible with 162 (64.03%) scoring below this standard. Ten baccalaureate students reached the maximum score and 222 (51.39%) students scored between 80 and 100% of the maximum score. The number of students who scored below 80% was 210 (48.61%). For students in associate degree programs the mean score was 34.24 while for students in baccalaureate programs the mean score was 36.52. An independent $t$ test comparing the mean scores of the students in each type of program found a significant difference between the means of the groups, $t(617) = 7.62, p < .001, d = .31$. The mean of the baccalaureate group was significantly higher than the mean of the associate degree group. Cohen’s (1988) $d$ of .31 indicated a medium effect size.
Mean scores of students in three levels of clinical courses (first course, intermediate course, or last course) were compared, using a one way ANOVA. No significant difference was found, $F(2,611) = 1.78, p = > .05$. Regardless of the level of the clinical course in which the students were enrolled, scores were not higher than the scores of students at either of the other levels of clinical courses. A breakdown of mean scores and standard deviations, according to the course in which students were currently enrolled, is reported in Table 12.

**Teaching Strategies by Nursing Program**

Objective six sought to describe and compare the strategies used by baccalaureate and associate degree nursing programs to teach content related to needlestick injury, recommended practices of needle safety, and prevention of disease transmission by needlestick injury. Respondents were asked to describe the main teaching method used in teaching recommended needlestick safety precautions, the next most often used teaching method, the most helpful teaching method, the size of the group in which they first learned about protecting themselves from occupational exposure to bloodborne pathogens, and the frequency of faculty/student interaction. Although the most frequently used methods of teaching were lecture and videotaped presentations, students indicated that the most helpful method was the less frequently used demonstration. Frequencies and percentages for nursing students’ choices are depicted in Table 13.
Table 12. Needlestick Safety Compliance Action Scores, According to Clinical Course Enrollment and Type of Nursing Program

<table>
<thead>
<tr>
<th>Program &amp; Course</th>
<th>N</th>
<th>No Response</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADa</td>
<td>253</td>
<td>25</td>
<td>23</td>
<td>43</td>
<td>34.24</td>
<td>3.55</td>
</tr>
<tr>
<td>First</td>
<td>36</td>
<td>10</td>
<td>23</td>
<td>43</td>
<td>34.22</td>
<td>4.53</td>
</tr>
<tr>
<td>Intermediate</td>
<td>110</td>
<td>6</td>
<td>27</td>
<td>43</td>
<td>34.31</td>
<td>3.39</td>
</tr>
<tr>
<td>Last</td>
<td>106</td>
<td>7</td>
<td>24</td>
<td>42</td>
<td>34.16</td>
<td>3.37</td>
</tr>
<tr>
<td>BSb</td>
<td>366</td>
<td>64</td>
<td>27</td>
<td>44</td>
<td>36.52</td>
<td>3.76</td>
</tr>
<tr>
<td>First</td>
<td>75</td>
<td>43</td>
<td>29</td>
<td>44</td>
<td>36.85</td>
<td>3.80</td>
</tr>
<tr>
<td>Intermediate</td>
<td>184</td>
<td>16</td>
<td>27</td>
<td>44</td>
<td>36.55</td>
<td>3.62</td>
</tr>
<tr>
<td>Last</td>
<td>107</td>
<td>5</td>
<td>27</td>
<td>44</td>
<td>36.32</td>
<td>4.03</td>
</tr>
<tr>
<td>Total</td>
<td>614</td>
<td>87</td>
<td>23</td>
<td>44</td>
<td>35.61</td>
<td>3.86</td>
</tr>
<tr>
<td>First</td>
<td>111</td>
<td>53</td>
<td>23</td>
<td>44</td>
<td>36.00</td>
<td>4.21</td>
</tr>
<tr>
<td>Intermediate</td>
<td>294</td>
<td>22</td>
<td>27</td>
<td>44</td>
<td>35.73</td>
<td>3.70</td>
</tr>
<tr>
<td>Last</td>
<td>213</td>
<td>12</td>
<td>24</td>
<td>44</td>
<td>35.22</td>
<td>3.86</td>
</tr>
</tbody>
</table>

Note. Minimum possible score = 11. Maximum possible score = 44. A significant difference between mean compliance action scores by degree program existed ($t(617) = 7.62, p < .001$). No significant difference existed between mean scores of students in different course levels ($F(2,611) = 1.78, p > .05$).

aAD = Associate Degree Nursing Program. bBS = Baccalaureate Nursing Program.
Table 13. Methods of Teaching Content Related to Needlestick Injuries in Baccalaureate and Associate Degree Programs

<table>
<thead>
<tr>
<th>Method</th>
<th>Main Method</th>
<th>Second Method</th>
<th>Most Helpful Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>AD&lt;sup&gt;b&lt;/sup&gt;</td>
<td>BS&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lecture</td>
<td>224 (51.97%)</td>
<td>199 (71.58%)</td>
<td>118 (27.38%)</td>
</tr>
<tr>
<td>Videotapes</td>
<td>129 (29.93%)</td>
<td>42 (15.11%)</td>
<td>140 (32.48%)</td>
</tr>
<tr>
<td>Discussion</td>
<td>19 (4.41%)</td>
<td>6 (2.16%)</td>
<td>64 (14.85%)</td>
</tr>
<tr>
<td>Demonstration</td>
<td>38 (8.82%)</td>
<td>22 (7.91%)</td>
<td>86 (19.96%)</td>
</tr>
<tr>
<td>Other</td>
<td>9 (2.09%)</td>
<td>2 (0.72%)</td>
<td>6 (1.39%)</td>
</tr>
<tr>
<td>No Response</td>
<td>12 (2.78%)</td>
<td>7 (2.52%)</td>
<td>17 (3.94%)</td>
</tr>
</tbody>
</table>

*Note. n = 432 for BS Students; n = 278 for AD Students
<sup>a</sup>BS = Baccalaureate Nursing Program. <sup>b</sup>AD = Associate Degree Nursing Program.

Students were also asked to report the approximate frequency of interaction with faculty during their initial instruction in the nursing program. A four point scale was assigned to the respondents’ answers, ranging from four for “many times” to one for “not at all.” Respondents in baccalaureate programs ($M = 3.23, SD = .81$) reported less frequent interaction with faculty than respondents in associate degree programs ($M = 3.38, SD = 0.78$), but the category selected most often by both groups was “many times.” Frequencies and percentages for all categories of faculty/student interaction are displayed in Table 14. An independent samples $t$ test was calculated on the mean
scores of baccalaureate and associate degree nursing students which revealed that the
frequency of interaction with faculty was significantly lower for baccalaureate
students, \( t(686) = -2.37, p < .05, d = .19 \). Cohen’s (1988) \( d \) indicated a small effect size.

Table 14. Frequency of Faculty/Student Interaction during Initial Instruction in Nursing Program

<table>
<thead>
<tr>
<th>Frequency of Interaction</th>
<th>BS(^a) Frequency (Percentage)</th>
<th>AD(^b) Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many Times</td>
<td>189 (43.75%)</td>
<td>150 (53.96%)</td>
</tr>
<tr>
<td>Several Times</td>
<td>145 (33.56%)</td>
<td>76 (27.34%)</td>
</tr>
<tr>
<td>Few Times</td>
<td>77 (17.83%)</td>
<td>41 (14.75%)</td>
</tr>
<tr>
<td>Not at All</td>
<td>7 (1.62%)</td>
<td>3 (1.08%)</td>
</tr>
<tr>
<td>No Response</td>
<td>14 (3.24%)</td>
<td>8 (2.88%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>432 (100.00%)</td>
<td>278 (100.00%)</td>
</tr>
</tbody>
</table>

*Note. N = 710. M = 3.38, SD = 0.78 for AD students. M = 3.23, SD = 0.81 for BS students. A significant difference existed between mean scores by program, \( t(686) = -2.37, p < .05 \).*\(^a\)BS = Baccalaureate Nursing Program. \(^b\)AD = Associate Degree Nursing Program.

**Relationship between Knowledge and Compliance**

Objective seven sought to determine if a relationship existed between nursing students’ knowledge of disease transmission and needlestick injury and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Knowledge of disease transmission was represented by respondents’ scores on Section I of the instrument, items one through thirty. Compliance was measured by respondents’ scores on Section II (see Appendix A for complete instrument) of the instrument, items 31 through 41. Pearson’s Product
Moment Correlation was calculated between the respondents’ knowledge scores and compliance action scores, revealing a significant positive correlation \( (r = .128, p < 0.01) \) for the total group. In addition, Pearson’s Product Moment Correlations were calculated between the respondents’ knowledge scores and compliance action scores of baccalaureate \( (r = .114, p < 0.05) \) and associate degree students \( (r = .148, p < 0.05) \), which were also significant. The results indicate that knowledge of disease transmission and needlestick injury and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens are related but that factors other than knowledge account for a large proportion of variance in compliance. Using Cohen’s (1988) conventional definitions of effect size, correlation coefficients for the total group, baccalaureate students, and associate degree students were in the range of small effect size.

**Comparison of Observations of Environmental Risk Factors and Compliance Actions**

Objective eight sought to determine if a relationship existed between nursing students’ observations of environmental risk factors and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Nursing students’ observations of environmental risk factors was measured by respondents’ scores on Section III of the instrument, items 42 through 53. Compliance scores were represented by items 31 through 41. Pearson’s Product Moment Correlation was calculated between the respondents’ observation of environmental factor risk scores and compliance actions scores, revealing a significant
positive but low correlation \((r = .18, p < 0.01)\). Using Cohen’s (1988) conventional definitions of effect size, the correlation coefficient was in the range of a small effect, indicating that nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and their observations of environmental risk factors were related but did not account for much of the variance. One reason that may explain the low relationship is the increased homogeneity and resulting decreased variability of the group.

**Efficacy of LAB Model**

Objective nine sought to examine the efficacy of the LAB Model that utilizes knowledge and environmental factors to explain the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. A multiple linear regression was calculated to determine if subjects’ compliance action scores could be explained for the 15 variables relevant to the LAB model. Variable coding is explained in Appendix F.

The stepwise regression analysis was conducted with a significant probability value of \(.05\) for a variable to enter and a significant probability of \(.10\) to exit. All independent variables were entered using the stepwise method. The proportion of variation in the dependent variable, compliance action scores, that could be explained by differences in the independent variables was 20.60\%. An \(R^2\) of \(.21\) was interpreted as a small effect size (Cohen, 1988). A significant regression equation was found, \(F(7,570) = 21.13, p < .000\). Seven of the 15 independent variables had significance levels of \(< .05\) and explained at least 1\% of the variance in compliance with
recommended precautions. Significant explanatory variables which met this criterion included: type of degree program, work experience in a health care setting before enrollment, initial instruction in or outside of the nursing program, score on observation of environmental risk section of questionnaire, size of class receiving initial instruction in the nursing program, score on knowledge section of questionnaire, and unreported NSI. The multiple linear regression analysis model summary data, the ANOVA summary, and the independent variables’ unstandardized and standardized coefficients are reported in Table 15.

**Emphasis of Initial Instruction and Compliance with Recommended Precautions**

Hypothesis one stated that the emphasis given concerning recommended precautions for the prevention of occupational exposure to bloodborne pathogens in a program of study at the time of initial instruction was positively related to the extent of compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens by nursing students. The emphasis given to initial instruction was measured by five items, 65 through 69 (See Appendix A for complete instrument) which addressed the level of emphasis given to selected components in the initial instruction about recommended precautions for the prevention of occupational exposure to bloodborne pathogens. The subset of items was analyzed, yielding a Cronbach’s alpha of .87 ($N = 670$). Scores on the five items were summed to arrive at one score for each respondent.
Figure 2. Variation in Compliance Action Scores
<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>1772.29</td>
<td>7</td>
<td>253.18</td>
<td>21.13</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>6829.65</td>
<td>570</td>
<td>11.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Total | 8601.95 | 577 | \multicolumn{4}{l|}{|}

<table>
<thead>
<tr>
<th>Model</th>
<th>Cumulative $R^2$</th>
<th>$R^2$ Change</th>
<th>SE</th>
<th>B</th>
<th>SE B</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Type of degree</td>
<td>.081</td>
<td>.081</td>
<td>3.7055</td>
<td>-1.941</td>
<td>.307</td>
<td>-.246</td>
</tr>
<tr>
<td>2 = Model 1 + OERF Score</td>
<td>.120</td>
<td>.039</td>
<td>3.6293</td>
<td>.139</td>
<td>.027</td>
<td>.193</td>
</tr>
<tr>
<td>3 = Model 2 + Class Size for Initial Instruction in Nursing Program</td>
<td>.146</td>
<td>.026</td>
<td>3.5769</td>
<td>.672</td>
<td>.145</td>
<td>.179</td>
</tr>
<tr>
<td>4 = Model 3 + Knowledge Score</td>
<td>.167</td>
<td>.021</td>
<td>3.5370</td>
<td>5.772E-02</td>
<td>.015</td>
<td>.142</td>
</tr>
<tr>
<td>5 = Model 4 + Work Experience in Health Care Setting before Enrollment</td>
<td>.180</td>
<td>.013</td>
<td>3.5124</td>
<td>1.291</td>
<td>.323</td>
<td>.167</td>
</tr>
<tr>
<td>6 = Model 5 + Initial Instruction in/out of Nursing Program</td>
<td>.195</td>
<td>.015</td>
<td>3.4835</td>
<td>1.092</td>
<td>.332</td>
<td>.138</td>
</tr>
<tr>
<td>7 = Model 6 + Unreported NSI</td>
<td>.206</td>
<td>.012</td>
<td>3.4615</td>
<td>-.948</td>
<td>.329</td>
<td>-.108</td>
</tr>
</tbody>
</table>

(table continued)
<table>
<thead>
<tr>
<th>Variables not in the Equation</th>
<th>$t$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age*</td>
<td>2.728</td>
<td>.007</td>
</tr>
<tr>
<td>Gender*</td>
<td>2.221</td>
<td>.027</td>
</tr>
<tr>
<td>Current Course</td>
<td>.499</td>
<td>.618</td>
</tr>
<tr>
<td>Work at Hospital in Paid Job</td>
<td>1.167</td>
<td>.244</td>
</tr>
<tr>
<td>Work in Non-Hospital Health Care Setting in Paid Job</td>
<td>1.976</td>
<td>.049</td>
</tr>
<tr>
<td>Instruction Emphasis on Prevention of Transmission of BBP by NSI</td>
<td>-.337</td>
<td>.736</td>
</tr>
<tr>
<td>Emphasis on NSI Safety in Initial Instruction</td>
<td>.185</td>
<td>.853</td>
</tr>
<tr>
<td>Perceived Support of Compliance by Faculty &amp; Clinical Staff</td>
<td>.717</td>
<td>.474</td>
</tr>
</tbody>
</table>

*Note. NSI = Needlestick Injury. BBP = Bloodborne Pathogens. OERF Score = Score on Section III of Questionnaire. Dependent Variable: Compliance Actions Score = Score on Section III of Questionnaire. Variables were statistically significant but did not meet the criterion of 1% additional variance; therefore, they were excluded from model.
A Spearman’s *rho* correlation was calculated between the summed emphasis scores (items 65 through 69) and compliance action scores derived from Section II of the questionnaire (See Appendix A for complete questionnaire). No significant relationship was found between emphasis scores and compliance action scores for the total group, $r = .042, p > .05$. A significant correlation was found between emphasis scores and compliance action scores for the group which had initial instruction outside the nursing program ($n = 234$), $r = .127, p = .026$. Using Cohen’s (1988) conventional definitions of effect size, the correlation coefficient was in the range of a small effect. Hypothesis one was accepted for respondents whose initial instruction took place outside of the nursing program, but rejected for respondents who had initial instruction within the nursing program.

**Teaching Strategies and Compliance with Recommended Precautions**

The second hypothesis stated that teaching strategies used in nursing students’ initial instructions for the prevention of occupational exposure to bloodborne pathogens are positively related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. For purposes of this hypothesis teaching strategies were defined as (a) the size of the group in which respondents received initial instruction about recommended precautions for the prevention of occupational exposure to bloodborne pathogens, (b) the emphasis placed on initial instruction components, (c) and the frequency of interaction between faculty and students. Group size was coded as follows: (a) 25 or fewer as “5,” (b) 26 to
50 as “4,” (c) 51 to 75 as “3,” (d) 76 to 100 as “2,” and (e) 101 or more as “1.” Coding for the emphasis placed on initial instruction components (questions 65 through 69) was as follows: (a) greater than given any other area as “4,” (b) greater than given most other areas as “3,” (c) less than given most other areas as “2,” and (d) less than given any other area as “1.” Ratings were assigned by the researcher to the respondents’ reported description of the frequency of faculty/student interaction (question 74), ranging from four for “many times” to one for “not at all.”

Spearman’s rho correlation was calculated between the size of the group in which respondents’ received initial instruction about recommended precautions for the prevention of occupational exposure to bloodborne pathogens and compliance action scores on Section II of the questionnaire. A significant correlation, \( \rho(611) = .272, p = 0.01 \) was found between respondents’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and initial instruction group size, indicating that compliance was higher when instruction took place in smaller groups. Using Cohen’s (1988) conventional definitions of effect size, the correlation coefficient was in the range of a small effect.

Additional Spearman’s rho correlations were calculated between respondents’ ratings of each question concerning the level of emphasis placed on initial instructional components (questions 65 through 69). As indicated, all correlations were non-significant, including: (a) the need for reporting needlestick injuries, \( \rho(607) = -.005, p > .05 \), (b) the ideal time frame for reporting needlestick injuries, \( \rho(606) = .033, p > .05 \), (c) follow-up care for needlestick injuries, \( \rho(600) = .038, p > .05 \), (d) the need
for preventive medical treatment following needlestick injuries, \( r\rho(599) = .045, p > .05 \) and (e) the program’s exposure control plan, \( r\rho(597) = .052, p > .05 \). The level of emphasis placed on the described instructional components was not related to compliance action scores.

Pearson’s Product Moment Correlation was also calculated between frequency of interaction between faculty and student and compliance action scores. No significant relationship was found between the variables, \( r = .038, p > .05 \). An additional Pearson’s was calculated between the amount of class and clinical time spent on needle handling and needle safety in the nursing program and compliance. Again, no significant relationship was found between the variables, \( r = -.007, p > .05 \).

The findings and effect size support accepting the hypothesis for group size but rejecting the hypothesis for frequency of interaction and the amount of class and clinical time spent on needle handling and needle safety.

**Perceived Support and Compliance with Recommended Precautions**

Hypothesis three specified that nursing students’ perceived support of compliance with standard and transmission-based precautions by faculty and clinical staff was positively related to nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. The score for perceived support of compliance with standard and transmission-based precautions by faculty and clinical staff was derived by summing assigned ratings for survey items 77 through 80. Students were asked to identify the frequency with which they would follow recommended needle safety precautions when following the actions
of admired teachers and clinical staff. In addition, students were asked to identify how often teachers and clinical staff followed needle safety precautions. For each item respondents were asked to answer, using the following scale: five (always), four (usually), three (sometimes), two (seldom), and one (never). Cronbach alpha was calculated for this scale and yielded results of .68.

Pearson’s Product Moment Correlation was calculated between the respondents’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and perceived support of compliance by faculty and clinical staff, revealing no significant correlation for the total respondent group. When separate Pearson’s Product Moment Correlations were calculated for respondents from each type of program, baccalaureate and associate degree, a significant correlation \( r = .250, p = 0.01 \) was found between associate degree students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and perceived support of compliance by faculty and clinical staff. Again, effect size was in the small range, using Cohen’s (1988) conventional definitions; however, results inconsistently support the hypothesis. The hypothesis was accepted for associate degree students but rejected for baccalaureate students.
Post Hoc Analysis

Examination of means for items 77 through 80 of the questionnaire (See Appendix A for the complete questionnaire) revealed obvious discrepancies between means for the total group of respondents (See Table 9). These four questions addressed the impact of role modeling by teachers and hospital staff nurses. Based on these results, a decision was made to conduct more testing, although this was not built into the study, initially.

Paired samples $t$ tests were computed to determine if the mean scores on questions 77 and 78 and questions 79 and 80 differed from one another. In the first pair of questions (77 and 78) students were asked what they would do if they followed the actions of either “teachers you admire” or “hospital nurses you admire.” A significant decrease in the frequency of following recommended needle safety precautions was found when students’ behavior was modeled after hospital staff rather than faculty, $t(709) = 14.25, p = .000, d = .53$. Cohen’s (1988) $d$ indicated a medium effect size. In a second similarly worded pair of questions (79 and 80), students were asked how often “your teachers” and “hospital nurses” followed needle safety precautions. A significant decrease in the frequency of following recommended needle safety precautions was found, indicating that hospital staff nurses followed precautions less often than faculty, $t(709) = 21.40, p = .000, d = .80$. In this instance Cohen’s (1988) $d$ indicated a large effect size.
CHAPTER V: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the relationships between selected institutional and personal demographic factors, knowledge, observations of environmental risk factors, and the degree of nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases.

The objectives of the study were: (a) Describe the nursing students in Louisiana on selected demographic characteristics, (b) Describe and compare the nursing students’ knowledge of factors related to disease transmission by needlestick injury and knowledge of recommended practices of needle safety by degree program and course level, (c) Describe the curriculum content placement used for needlestick injury and needle safety in selected associate degree and baccalaureate nursing programs, (d) Describe and compare the nursing students’ observations of environmental risk factors concerning disease transmission by needlestick injury by degree program and course level, (e) Describe and compare the nursing students’ compliance with standard and transmission-based precautions concerning needlestick injury and needle safety by degree program and course level, (f) Describe and compare the strategies used by baccalaureate and associate degree nursing programs to teach content related to needlestick injury, recommended practices of needle safety, and prevention of disease transmission by needlestick injury, (g) Determine if a significant relationship existed between nursing students’ knowledge of disease transmission and needlestick injury.
and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens, (h) Determine if a significant relationship existed between nursing students’ observation of environmental factors and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens, and (i) Examine the efficacy of the LAB Model that utilizes knowledge and environmental factors to explain the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.

The hypotheses of the study included: (a) The emphasis given at the time of initial instruction concerning recommended precautions for the prevention of occupational exposure to bloodborne pathogens in a program of study was positively related to the extent of compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens by nursing students, (b) The teaching strategies used in nursing students’ initial instructions for the prevention of occupational exposure to bloodborne pathogens were positively related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens, and (c) Nursing students’ perceived support of compliance with standard and transmission-based precautions by faculty and clinical staff is positively related to nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens.
**Methodology**

Using a sampling with replacement model, a random sample of approximately one-third of the baccalaureate nursing programs and one-third of the associate degree nursing programs in the state was drawn which resulted in the selection of four baccalaureate and three associate degree programs for inclusion in the study. Surveys were collected from 710 students enrolled in clinical nursing courses; 432 (60.85%) were enrolled in baccalaureate programs and 278 (39.15%) were enrolled in associate degree programs.

A researcher developed questionnaire was constructed based on relevant literature review and input from experts in nursing education and infection control in order to meet the needs of the study. The questionnaire was divided into four sections: (a) Section I consisted of a 30 item multiple choice survey of the students’ knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety; (b) Section II consisted of 11 items with a Likert-type four point scale designed to measure students compliance with recommended practices for needlestick safety; (c) Section III consisted of 12 items with a Likert-type four point scale designed to measure students observations of environmental risk factors; and (d) Section IV which was designed to collect demographic data about subjects. Data were analyzed with descriptive, correlation, and regression statistics.
Summary of Findings

Objective one was to describe the nursing students in Louisiana on selected demographic characteristics. Demographic data revealed that the typical respondent was female, 20 to 29 years of age, and in the upper level of the nursing program. In addition 325 (45.77%) had worked in a health care setting prior to entering the nursing program. Most students received their initial instruction in the nursing program rather than in another setting. More than 75% of respondents indicated that emphasis on particular components of the initial instruction about the prevention of occupational exposure to bloodborne pathogens was greater than given any other area or greater than given most other areas.

The second objective was to describe and compare nursing students’ knowledge of factors related to disease transmission by needlestick injury, including recommended practices of needle safety by degree program. Mean scores on Section I of the questionnaire, knowledge survey, for students from baccalaureate and associate degree programs did not differ, t(708) = -.153, p > .05, but scores for both groups were lower than might be expected for mastery level achievement.

Objective three sought to describe the curriculum content placement used for needlestick injury and needle safety in selected associate degree and baccalaureate nursing programs. Most students (>90%) received instruction either before or during the first clinical course.
Objective four was to describe and compare the nursing students’ observations of environmental risk factors concerning disease transmission by needlestick injury by degree program and course level. Mean scores on Section III of the questionnaire for associate degree and baccalaureate students did not differ significantly on observations of environmental risk factors related to disease transmission by needlestick injury, $t(645) = .347, p > .05$. A significant difference was found among students in different levels of courses, $F(2,640) = 14.34, p = .000, f = .20$. Effect size was in the small range (Cohen, 1988). Tukey’s HSD revealed that students in the first clinical courses scored higher than students in either intermediate or final clinical courses.

Objective five sought to describe the nursing students’ compliance with standard and transmission-based precautions concerning needlestick injury and needle safety. Baccalaureate nursing students scored significantly higher on Section II of the questionnaire, compliance actions, than associate degree students, based on $t$ test results, $t(617) = 7.62, p = .000, d = .31$.

Objective six sought to compare the strategies used by baccalaureate and associate degree nursing programs to teach content related to needlestick injury, recommended practices of needle safety, and prevention of disease transmission by needlestick injury. The most frequently used method of teaching content related to needlestick injuries in both associate degree and baccalaureate programs was lecture. Videotaped presentation was the second most widely used method. Although students identified demonstration as the most helpful teaching method, it was used less often than either lecture or video presentation by both types of programs. Faculty-student
interaction during initial instruction in the nursing program was significantly higher for associate degree students, \( t(686) = -2.37, p < .05, d = .19 \). Students followed recommended needle safety precautions more often when modeling the actions of admired teachers than when modeling the actions of admired hospital staff nurses. In addition, students indicated that staff nurses followed needle safety precautions less often than teachers. Baccalaureate students were taught in class size groups of 25 or fewer more frequently than associate degree students who were most frequently taught in groups of 26 to 50 students; however, associate degree students reported greater frequency of faculty/student interaction than did baccalaureate students.

Objective seven sought to determine if a relationship existed between nursing students’ knowledge of disease transmission and needlestick injury and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. When mean scores for the total group, baccalaureate students, and associate degree students on Sections I (knowledge) and II of the questionnaire (compliance actions) were compared, significant positive correlations were noted. Based on the results of Pearson’s Product Moment Correlations \( r = .128, p < 0.01 \) for the total group, \( r = .114, p < 0.05 \) for baccalaureate students, and \( r = .148, p < 0.05 \) for associate degree students) and small effect sizes, it was concluded that a large proportion of variance in compliance actions was accounted for by factors other than knowledge.

Objective eight sought to determine if a relationship existed between nursing students’ observations of environmental risk factors and their compliance with
recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Comparison of students’ scores on Sections II (compliance actions) and III (observations of environmental risk factors) using Pearson’s Product Moment Correlation indicated that the relationship between the two sets of scores was significant ($r = .181, p = 0.01$). According to Cohen’s (1988) effect size definitions, the correlation coefficient was in the range of a small effect.

Objective nine was to examine the efficacy of the LAB Model that utilizes knowledge and environmental risk factors to explain the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Based on the results of multiple linear regression analysis, $F(7,570) = 21.13, p < .000$, seven variables were found to explain 20.6% of the variance in compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens, including: type of degree, observations of environmental risk factors score, class size for initial instruction in nursing program, knowledge score, work experience in health care setting before enrollment, initial instruction in/out of the nursing program, and unreported needlestick injuries. An $R^2$ of .21 was interpreted as a small effect size (Cohen, 1988).

Hypothesis one stated that the emphasis given recommended precautions for the prevention of occupational exposure to bloodborne pathogens at the time of initial instruction in a program of study was positively related to the extent of compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens by nursing students. A point biserial correlation was calculated
between the summed emphasis scores (items 65 through 69) and compliance action scores derived from Section II of the questionnaire. Based on a point biserial correlation, \( r = .049, p > .05 \), no significant relationship was found between emphasis scores and compliance action scores for the total group. A significant correlation was found between emphasis scores and compliance action scores for the group which had initial instruction outside the nursing program (\( n = 234 \), \( r = .127, p = .026 \)). Using Cohen’s (1988) conventional definitions of effect size, the correlation coefficient was in the range of a small effect. Hypothesis one was accepted for respondents whose initial instruction took place outside of the nursing program, but rejected for respondents who had initial instruction within the nursing program.

Hypothesis two stated that the teaching strategies used in nursing students’ initial instruction for the prevention of occupational exposure to bloodborne pathogens were positively related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Compliance action scores were higher when small group instruction was used. This finding is based on the significant correlation, Spearman’s \( \rho(611) = .272, p = 0.01 \), found between respondents’ initial instruction group size and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. Using Cohen’s (1988) conventional definitions of effect size, the correlation coefficient was in the range of a small effect.

Hypothesis three specified that nursing students’ perceived support of compliance with standard and transmission-based precautions by faculty and clinical
staff was positively related to nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. A positive relationship between perceived support of compliance and nursing student compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens was found. This finding is based on a significant Pearson’s correlation, $r = .250$, $p < .01$, and small effect size (Cohen, 1988).

**Conclusions**

The conclusions presented in this section are derived from the findings of this study. Nursing students’ knowledge level of factors related to disease transmission by needlestick injury, including recommended practices of needle safety, is inadequate. This conclusion was based on the relatively low mean score on Section I, knowledge, of the questionnaire and is consistent with the findings of Jeffe et al. (1998). Considering the gravity of potential consequences of needlestick injuries, greater mastery of content is desirable and justified.

Teaching strategies which may be more effective are underutilized. This conclusion is based on the finding that more students in both baccalaureate and associate degree programs reported that demonstration was the most helpful teaching strategy but also reported that it was used less frequently than lecture and videotaped presentations. The use of demonstration as an effective technique was consistent with the findings of Wurtz, Dolan, O’Neal, & Azarcon (1994). In addition, almost half of the respondents had work experience in a health care setting prior to entering the nursing program. Such students may require different teaching strategies to change
already learned behaviors.

Current teaching strategies most frequently used for needlestick injury and needle safety instruction in baccalaureate and associate degree nursing programs are lecture and videotape presentations, even though students preferred demonstration. This conclusion is based on the finding that three-quarters of the respondents reported having received instruction via these methods most often, yet selected demonstration as the most helpful method. Furthermore, respondents’ scores on Section III of the questionnaire, reported observations of environmental risk factors reveal that students’ competency and clinical laboratories are conducted in settings where they observe less than full use of recommended safety equipment and practices designed to reduce environmental risk factors concerning disease transmission by needlestick injury. This finding is consistent with the findings of Henry, Campbell, Collier, and Williams (1994) who documented high rates of non-compliance by health care workers with both self-reported and observer-recorded data.

Nursing students’ compliance with standard and transmission-based precautions concerning needlestick injury and needle safety is unacceptable. This conclusion is supported by the finding that more than half of the respondents scored below the level that would be considered mastery on Section II, compliance actions, of the questionnaire. Other studies have also reported low compliance rates (Henry, Campbell, Collier, & Williams, 1994; Ramsey et al., 1996).

Baccalaureate faculty interact with students less frequently than associate degree faculty during students’ initial instruction in the nursing program. This
conclusion is based on findings of an independent samples \( t \) test, \( t(686) = -2.37, p < .05, d = .19 \). Using Cohen’s (1988) conventional definitions, the effect size was in the small range.

Nursing students’ knowledge of disease transmission and needlestick injury and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens are related. This conclusion is based upon finding a significant positive correlation \( (r = .13, p < 0.01) \) between scores on Section I of the questionnaire, knowledge, and scores on Section II, compliance actions. No clear association of knowledge and compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens is documented in the current literature.

Nursing students’ observations of environmental risk factors and their compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens are related. This conclusion is based upon finding a significant positive correlation \( (r = .18, p = 0.01) \) between scores on Section II of the questionnaire, compliance actions and scores on Section III, observations of environmental risk factors. Environmental factors have been shown to influence compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens (Makofsky & Cone, 1993; D’Arco & Hargreaves, 1995).

Personal factors, learning experiences, and knowledge can explain an appreciable proportion of the variance in compliance with recommended precautions.
for the prevention of occupational exposure to bloodborne pathogens. This conclusion is based on discovery of a significant regression equation, $F(7,570) = 18.30, p < .000$.

Current teaching strategies are not related to nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens. This conclusion is based on nonsignificant correlation results.

Nursing students’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens is not related to their perception of faculty and clinical staff support. This conclusion is based on nonsignificant results of Pearson’s Product Moment Correlation calculated between the respondents’ compliance with recommended precautions for the prevention of occupational exposure to bloodborne pathogens and perceived support of compliance by faculty and clinical staff.

**Implications for Nursing Education and Practice**

The findings of this study suggest that nurse educators reconsider current curriculum design, course content, and teaching strategies concerning nursing student compliance with standard and transmission-based precautions for the prevention of transmission of infectious diseases. Nursing students in both baccalaureate and associate degree programs possessed inadequate knowledge of items related to needlestick injuries. Reexamination of the curriculum devoted to transmission of infectious disease, as well as nursing interventions for the prevention of transmission of disease by bloodborne pathogens, should be seriously considered. The importance of the content should be emphasized through the increased use of demonstration,
modeling of behaviors, and guided practice. More interaction and small group work and less lecture and video presentations should be considered, if nursing students are to appreciate and integrate into their practice recommended precautions for the prevention of needlestick injuries. Students should have adequate practice of the techniques supported by positive reinforcement of successful application in competency and clinical laboratories. Students who are successful should be allowed to assist others to reach the same level of proficiency which not only rewards the successful student but also sustains and extends modeling of the desirable behaviors.

Employers of nurses should incorporate similar techniques in their orientation programs, regular inservice programs on infection control, and unit management preparation. The seriousness of the consequences of needlestick injury should be emphasized in interactions with clinical nurses in a workplace environment which supports the use of proper procedure. Nurses who consistently use proper procedure should be chosen to assist others to reach the same level, since it appears that students are using clinical staff as role models more often than faculty.

The difficulty of achieving full compliance, even with varied and multidisciplinary approaches, has been well documented (Hersey & Martin, 1994; Jeffe et al., 1998; & Ramsey et al., 1996). However, the nursing profession must strive to improve the current compliance situation.

**Recommendations for Further Research**

The need for further research is based on the conclusions of the study. The importance of improving workplace safety in all occupations cannot be
overemphasized. Remarkable strides were made toward increasing worker safety in the United States throughout the twentieth century; however, data do not always permit association of safety events, such as fatalities and injuries, with specific interventions (CDC, 1999b). Similarly, comparison of compliance rates across occupations is difficult due to the various types of recordkeeping and reporting of the agencies involved. For example, the Federal Motor Carrier Safety Administration’s (2000) profile of large truck crashes admittedly makes no effort to provide information on crash causation or fault; however, the agency noted that the data could steer readers toward problem areas and potential remedies. In its annual report for 2001 the United States Department of Labor (2001) listed the reduction of worker injury and illness rates through increased compliance assistance among its challenges, which serves to accent the need for continued research in this area. Nurse educators must provide evidence that teaching interventions achieve the intended results. Continued study and examination of the teaching strategies in common use with needlestick injury and safety issues are necessary and should include additional research of personal factors, such as work experience and education. In addition, the association between knowledge and compliance is not clear and merits further study. Since factors other than knowledge account for a large proportion of variance in compliance, exploration of currently unidentified factors is warranted.

Compliance with recommended precautions for the prevention of transmission of infectious diseases by needlestick injury is complex. Qualitative study, such as focus interviews with practicing nurses, would add to the body of nursing knowledge by
exploring factors which are difficult to quantify. Also, continued study of the workplace environment and risk factors which affect compliance is needed.
REFERENCES


Makofsky, D. & Cone, J. E. (1993). Installing needle disposal boxes closer to the bedside reduces needle-recapping rates in hospital units. *Infection Control and Hospital Epidemiology, 14*(3), 140-144.


APPENDIX A: QUESTIONNAIRE

Section I

Directions: Please answer the following questions by circling the letter of the best option.

1. The guidelines for isolation published by the Centers for Disease Control and prevention (CDC) are intended for use in:
   A. Acute care hospitals
   B. Day care settings
   C. All health care settings
   D. Home care settings.

2. “Standard Precautions” are designed to be used in situations where:
   A. Risk of transmission of pathogens by contact with blood, body fluids, skin, and mucous membranes must be reduced.
   B. Sources of infection can be identified.
   C. Pathogens may be transferred through airborne or droplet transmission or contact with skin or contaminated surfaces.
   D. Temporary precautions must be put in place while awaiting confirmation of a diagnosis.

3. The most likely source of HIV and hepatitis B virus is:
   A. Airborne pathogens.
   B. Feces and urine.
   C. Blood and bloody body fluids.

4. The most important measure that should be taken to reduce the risk of disease transmission is:
   A. Appropriate patient placement.
   B. Gloving.
   C. Respiratory and eye protection.
   D. Handwashing.

5. “Transmission-based Precautions” are designed to be used in situations where:
   A. Risk of transmission of pathogens via contact with blood, body fluids, skin, and mucous membranes must be reduced.
   B. Sources of infection can be identified.
   C. Sources of infection cannot be identified.
   D. Additional precautions are needed for a patient known to be infected with an epidemiologically important pathogen.
6. The CDC reports the approximate number of deaths each year due to hepatitis B infections in healthcare workers is:
   A. 8700
   B. 1300
   C. 200
   D. 25

7. More years of experience with exposure to blood on the job results in:
   A. Decreased risk of hepatitis B in healthcare workers.
   B. Increased risk of hepatitis B in healthcare workers.
   C. No change in healthcare workers’ risk of infection with hepatitis B virus.

8. Standard Precautions taken by healthcare workers are to be applied:
   A. Uniformly to all hospitalized patients.
   B. When the healthcare worker has a known or suspected infection.
   C. When the patient has a known or suspected infection.
   D. At the discretion of the healthcare worker.

9. Which of the following groups of healthcare workers has the highest incidence of occupationally acquired HIV?
   A. Surgeons.
   B. Laboratory professionals.
   C. Health aides.
   D. Nurses.

10. Which route of occupational exposure resulting in transmission of HIV is most common?
    A. Mucous membrane or skin exposure, such as splashes to the mouth or skin.
    B. Contact of the eyes with blood, such as splashes.
    C. Contact involving penetration of the skin, such as needlestick injuries.
    D. Inhalation of aerosolized blood.

11. Which of the following percentages most accurately represents the average risk of HIV transmission to healthcare workers, following occupational exposure to HIV by a needlestick injury?
    A. Less than 1%.
    B. Greater than 1%, but less than 10%.
    C. Greater than 10% but less than 20%.
    D. Greater than 20%.
12. For nurses, the average risk of hepatitis C transmission following occupational exposure to hepatitis C by needlestick injuries, varies from 1 to 10 in:
   A. 100.
   B. 300.
   C. 1000.
   D. 10,000.

13. The risk of hepatitis C transmission to healthcare workers, after a needlestick injury is:
   A. Less than HIV.
   B. Greater than HIV.
   C. Equal to the risk of HIV.

14. If treatment is indicated following occupational exposure to HIV by needlestick, it should be started within:
   A. One to six months.
   B. One to four weeks.
   C. 24 to 72 hours.
   D. One to two hours.

15. AIDS cases per 100,000 population in Louisiana are:
   A. Lower than the national average.
   B. Approximately the same as the national average.
   C. Higher than the national average.

16. Which of the following violates Standard Precautions?
   A. Aspirating for blood before administering an intramuscular injection.
   B. Recapping needles after use.
   C. Leaving needles attached to syringes after use.

17. The risk of transmitting disease with needlestick injury is greater with the type of needle used for intramuscular injections than with suture needles. This statement is:
   A. False, because all needles carry the same risk.
   B. False, because risk is greater with suture needles.
   C. True, because needles used for intramuscular injections hold more blood than suture needles.
   D. True, because red blood cells are more likely to cling to the outside of needles used for intramuscular injections.
18. During which of the following activities is a needlestick injury most likely to occur?
   A. Recapping.
   B. Transporting to the sharps’ disposal box.
   C. Handling equipment before use.
   D. Handling equipment after disposal.

19. Needle recapping should be performed, if:
   A. The HCW can safely push down on the tip of the needle cover to secure it.
   B. There is no other feasible alternative.
   C. The HCW has several years of experience with few needlestick injuries.
   D. There is little or no risk of disease transmission.

20. The only correct use of a needle is to:
   A. Connect a secondary medication delivery system to a primary intravenous tubing.
   B. Administer medication by direct intravenous push.
   C. Flush intravenous lines.
   D. Administer an intramuscular injection.

21. A vaccine is currently available for:
   A. HIV/AIDS
   B. Hepatitis B
   C. Hepatitis C

22. The concept of “universal precautions” is based upon the:
   A. Knowledge that patients are rarely truthful about their health histories.
   B. Inability of health care workers to detect infectious disease in all patients.
   C. Uncertainty about infectious diseases which have not yet been discovered.

23. How many needlesticks could be prevented if all safety precautions were used?
   A. None.
   B. Some.
   C. Most.
   D. All.

24. The National Institute for Occupational Safety and Health estimates the number of needlestick injuries in hospitals each year is:
   A. Less than 500,000.
   B. More than 500,000.
25. Hospital employees who may be exposed to blood and body fluids must receive training every:
   A. 90 days.
   B. Year.
   C. Other year.
   D. 5 years.

26. Hospital employee exposures to bloodborne pathogens must be:
   A. Reported and documented in the employees health record.
   B. Reported, but not documented by employing institution.
   C. Reported and documented according to the employing institution’s Exposure Control Plan.

Directions: Questions 27-30 may have more than one answer. Circle the letter of all correct answers.

27. The factors which determine a health care worker’s risk of infection following a contaminated needlestick injury are:
   A. Specific pathogen.
   B. Immune status of the worker. (Mark all that apply.)
   C. Severity of the needlestick injury.
   D. Use of proper post-exposure prophylaxis.

28. Safety devices which are designed to reduce needlestick injuries are currently available for:
   A. Phlebotomy needles.
   B. Lancets. (Mark all that apply.)
   C. Intravenous catheters.
   D. Syringes with attached needles.

29. Which of the following is(are) included in the OSHA standard for prevention of needlestick injuries?
   A. Universal Precautions. (Mark all that apply.)
   B. Engineering controls, such as self-sheathing needles.
   C. Work Practice controls, such as needlestick prevention programs.
   D. Personal Protective Equipment, such as gloves and goggles.

30. Needlestick injuries often are not reported, because reporting is:
   A. Inconvenient.
   B. Time consuming. (Mark all that apply.)
   C. Unnecessary.
   D. Embarrassing.
Section II

Directions: Circle the choice which best matches your actions in competency lab or clinical lab. Please use the following definitions when answering:

**Competency Lab** – any lab class held for the purpose of practicing skills without patient contact (May also be called skills lab or in-house lab).

**Clinical Lab** – any lab class in a clinical agency or other patient care setting.

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<tr>
<td>31. I wear gloves to start IV’s and draw blood.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<td>32. I dispose of sharps in designated containers.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<td>33. I use the one-handed scoop technique of recapping competently.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<td>34. The protective equipment I use for a procedure depends on my observation of the patient.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<tr>
<td>35. I wear gloves when administering injections.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<td>36. I do not use protective equipment in stressful or hurried situations.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<tr>
<td>37. Whenever I have a choice of using a traditional needle, a safer needle, or a needleless system, I use a traditional needle.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
</tr>
<tr>
<td>38. I wear safety glasses when starting IV’s in the competency lab.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<tr>
<td>39. I recap used needles in the competency lab.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
</tr>
<tr>
<td>40. I wear safety glasses when starting IV’s in the clinical lab.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<tr>
<td>41. I recap contaminated needles in clinical lab.</td>
<td>Always</td>
<td>Usually</td>
<td>Sometimes</td>
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<tr>
<td>Directions: Circle the choice which best describes your observations of actual nursing practices related to needlestick injuries.</td>
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<tr>
<td>42. Disposal boxes for needles and other sharps are located within a few feet of where I practice in competency lab.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
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<td>43. Personal protective equipment is conveniently located for use with potential blood splashes in the competency lab.</td>
<td>Always Usually Sometimes Never</td>
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<td>44. The importance of needle safety is stressed in competency lab.</td>
<td>Always Usually Sometimes Never</td>
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<td>45. Safe needle handling techniques are demonstrated in competency lab.</td>
<td>Always Usually Sometimes Never</td>
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<tr>
<td>46. Disposal boxes for needles and other sharps are located at the bedside in clinical lab.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
<td></td>
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<tr>
<td>47. Personal protective equipment is conveniently located for use with potential blood splashes in clinical lab.</td>
<td>Always Usually Sometimes Never</td>
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<tr>
<td>48. The agencies where I am assigned for clinical lab supply the units with equipment that eliminates the need for recapping used needles.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
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<tr>
<td>49. The importance of needle safety is stressed in clinical lab.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
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<tr>
<td>50. Faculty have a zero tolerance policy for student violations of safe needle handling precautions in clinical lab.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
<td></td>
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<tr>
<td>51. I suggest the use of personal protective equipment to another student in clinical lab, who is not using proper precautions.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52. I suggest the use of personal protective equipment to a staff nurse in clinical lab, who is not using proper precautions.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. I suggest the use of personal protective equipment to a teacher in clinical lab, who is not using proper precautions.</td>
<td>Always Usually Sometimes Never</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section IV

Directions: Please complete the following information as accurately as possible by filling in the blank or circling the appropriate letter. For the purpose of this study safety precautions refers to the precautions used to prevent the transmission of bloodborne pathogens. All information will be kept confidential and used only for research purposes.

54. My current age is _________ years.

55. The type of nursing program in which I am enrolled is:
   A. Associate Degree
   B. Bachelor’s Degree

56. I am currently enrolled in:
   A. The first clinical course.
   B. An intermediate clinical course.
   C. The last clinical course.

57. My gender is: A. Male  
   B. Female

58. Not counting clinical laboratories, do you currently work at a hospital in a paid job?
   A. Yes
   B. No

59. Not counting clinical laboratories, do you currently work in a paid job at a health care setting other than a hospital?
   A. Yes
   B. No

60. Did you have work experience in a health care setting prior to entering your nursing program?
   A. Yes
   B. No

61. Which of the following best describes the emphasis placed on the prevention of transmission of bloodborne pathogens by needlestick injury in the instruction you have received?
   A. The most important aspect of occupational safety.
   B. Equal in importance to other aspects of occupational safety.
   C. Less important than other aspects of occupational safety.
62. Have you worked as any of the following? (Mark all that apply)
   A. Nurse technician.
   B. Licensed practical nurse.
   C. Registered nurse.

Questions 63 through 69 refer to initial instruction which is defined as your first instruction about the prevention of occupational exposure to bloodborne pathogens. You may have received this instruction in one of a variety of settings (class, competency lab, clinical lab, job, or other) within the nursing program or outside the nursing program.

63. I received my initial instruction about the prevention of occupational exposure to bloodborne pathogens in a:
   A. Classroom setting.
   B. Skills laboratory setting.
   C. Clinical setting.
   D. Other setting (Please specify ______________).

64. I received my initial instruction about the prevention of occupational exposure to bloodborne pathogens:
   A. While in the nursing program.
   B. Outside of the nursing program.

65. In your initial instruction about the prevention of occupational exposure to bloodborne pathogens, the emphasis given to the need for reporting needlestick injuries was:
   A. Greater than given any other area.
   B. Greater than given most other areas.
   C. Less than given most other areas.
   D. Less than given any other area.

66. In your initial instruction about the prevention of occupational exposure to bloodborne pathogens, the emphasis given to the ideal time frame for reporting needlestick injuries was:
   A. Greater than given any other area.
   B. Greater than given most other areas.
   C. Less than given most other areas.
   D. Less than given any other area.
67. In your initial instruction about the prevention of occupational exposure to bloodborne pathogens, the emphasis given to follow-up care for needlestick injuries was:
   A. Greater than given any other area.
   B. Greater than given most other areas.
   C. Less than given most other areas.
   D. Less than given any other area.

68. In your initial instruction about the prevention of occupational exposure to bloodborne pathogens, the emphasis given to the need for preventive medical treatment following needlestick injuries was:
   A. Greater than given any other area.
   B. Greater than given most other areas.
   C. Less than given most other areas.
   D. Less than given any other area.

69. In your initial instruction about the prevention of occupational exposure to bloodborne pathogens, the emphasis given to your program’s exposure control plan was:
   A. Greater than given any other area.
   B. Greater than given most other areas.
   C. Less than given most other areas.
   D. Less than given any other area.

Questions 70 through 75 are specifically about initial instruction in your nursing program.

70. I received my initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens in a group of approximately:
   A. 25 or fewer students.
   B. 26 to 50 students.
   C. 51 to 75 students.
   D. 76 to 100 students.
   E. 101 or more students.
71. The main method of teaching used for my initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens was:
   A. Lecture.
   B. Videotaped presentations.
   C. Group discussion.
   D. Demonstration.
   E. Other (Please specify ________________________).

72. The second most often used method of teaching in my initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens was: (Do not circle the same answer as in #71)
   A. Lecture.
   B. Videotaped presentations.
   C. Group discussion.
   D. Demonstration.
   E. Other (Please specify ________________________).

73. The most helpful teaching method used in my initial instruction in the nursing program was:
   A. Lecture.
   B. Videotaped presentations.
   C. Group discussion.
   D. Demonstration.
   E. Other (Please specify ________________________).

74. Interaction between faculty and student during my initial instruction in the nursing program occurred:
   A. Many times.
   B. Several times.
   C. Few times.
   D. Not at all.

75. I received my initial instruction in the nursing program about the prevention of occupational exposure to bloodborne pathogens:
   A. Before the first clinical course.
   B. During the first clinical course.
   C. During an intermediate clinical course.
   D. During the last clinical course.
   E. Have not yet received instruction.
76. The amount of class or clinical time spent on needle handling and needle safety in your nursing program was:
   A. Equal to the amount of time spent on gloving and other safety precautions.
   B. More than the amount of time spent on gloving and other safety precautions.
   C. Less than the amount of time spent on gloving and other safety precautions.
   D. Not sure.

77. Concerning needle safety, when you follow the actions of teachers you admire, you are following recommended needle safety precautions:
   A. Always.
   B. Usually.
   C. Sometimes.
   D. Seldom.
   E. Never.

78. Concerning needle safety, when you follow the actions of hospital staff nurses you admire, you are following recommended needle safety precautions:
   A. Always.
   B. Usually.
   C. Sometimes.
   D. Seldom.
   E. Never.

79. How often do your teachers follow needle safety precautions?
   A. Always.
   B. Usually.
   C. Sometimes.
   D. Seldom.
   E. Never.

80. How often do the hospital staff nurses follow needle safety precautions?
   A. Always.
   B. Usually.
   C. Sometimes.
   D. Seldom.
   E. Never.

81. How many needlestick injuries have you had in a competency lab setting, since you began your nursing education?_______
   *82. How many did you report?_______

83. How many needlestick injuries have you had in a clinical lab setting, since you began your nursing education?_______
   *84. How many did you report?_______
85. How many needlestick injuries have you had in a paid job setting?_______
   *86. How many did you report?_______

87. What do you think are the most important reasons for less than 100% compliance with universal precautions among nursing students?

88. What do you think could be done in your nursing education program to improve nursing students’ compliance with universal precautions?

89. Please add any comments you wish, including comments about the survey.

---

Thank you for participating in this study. The information you have provided will contribute to understanding the factors which influence compliance with universal precautions.
APPENDIX B: LETTER TO ADMINISTRATORS

October 26, 2000

Dean Donnie F. Booth, PhD, RN
Southeastern Louisiana University
College of Nursing and Health Sciences
SLU 10835
Hammond, LA 70402

Dear Dean Booth:

I am writing to request your support for a study I am conducting on needlestick injury instruction. Needlestick injuries are a serious workplace concern and compliance with universal precautions is much lower than advocated. Consequently, I am interested in studying the contribution of nursing education to compliance. Currently, I am a doctoral student at Louisiana State University and a faculty member in the department of nursing at Southeastern Louisiana University. The study was pilot tested last summer and is now ready for the next phase of data collection which I hope to complete this semester.

I would like to request your permission to survey nursing students who are enrolled in clinical nursing courses in Southeastern Louisiana University’s nursing program. Students would be asked to complete a paper and pencil survey which would take approximately 15 to 30 minutes of their time. In order to facilitate my data collection procedures, I would come to the school on the appointed day and distribute and collect the surveys. I am asking if you could make time available, so that I might request the students’ participation and have those who agree to participate complete the form. Of course, all student participation is voluntary and I will make no effort to pressure students to complete the survey. Attached is a letter which is a part of each survey that students will be given. In addition, the proposal and questionnaire received a full review by the Institutional Review Board at Southeastern Louisiana University and were given full approval. No institution will be identified by name in the final report.

Please let me know by email (see email address below), if you will allow students to participate at your earliest convenience. I can also be reached by telephone at 225-765-2324. In appreciation of your support of the study, I will be glad to send you a summary of the data collected from Southeastern’s students.

Sincerely,

Cynthia A. Logan
email address: clogan@selu.edu
Department of Nursing
4849 Essen Lane
Baton Rouge, LA 70809
APPENDIX C: COVER LETTER TO RESPONDENTS

Dear Nursing Student:

Occupational exposure to disease through needlestick injuries is a serious hazard which can often be prevented. However, no one knows how current teaching about needlestick injury prevention affects compliance with safe needle handling. I am conducting a study to learn more about the relationships between knowledge, perceptual factors, and the degree of nursing student compliance with precautions for the prevention of transmission of infectious diseases, such as human immunodeficiency virus, hepatitis B virus, and hepatitis C virus. **One way to find out is to ask you.** The information you provide will be used to help improve programs for other nursing students.

Participation in the study is completely voluntary and you are free to withdraw any time. All responses on survey forms will be kept confidential, so please do not put your name or any other identifying information on the forms. You will also receive a large envelope. When you have completed the forms, please place them in the envelope and seal the envelope. Please place the sealed envelope in the secured container at the exit as you leave the room. All forms will be kept in a locked file in my office until the study is completed and then shredded. They will be viewed only by me.

Although I encourage you to answer all questions on the questionnaire, you are not obliged to answer. If you skip a question, just leave it blank and go on to the next question. I want to assure you that neither your course grade nor your standing in the nursing department will be affected by your participation in the study. No faculty member will view any of the completed surveys.

Answering the survey should take approximately 15 to 30 minutes. Completion of the forms will serve as your consent to participate in the study. Please feel free to ask any questions you wish about the forms. I will also be available for questions after the surveys are completed. If you have questions about the study at a later date, please call me at 225-272-9991.

A summary of the results of this study will be made available to the school. Thank you for your assistance.

Sincerely,

Cynthia A. Logan
Assistant Professor
Southeastern Louisiana University
APPENDIX D: INSTITUTIONAL REVIEW BOARD APPROVAL

CAMPUS CORRESPONDENCE
Southeastern Louisiana University
Sponsored Research and Contracts
Phone: (504) 549-5312
FAX: (504) 549-5094
Faculty Box: 10508

TO: Cynthia Logan
FROM: Dr. Michelle Hall, Interim Chair
DATE: April 19, 2000
RE: IRB Action on Proposed Project

This memo is to inform you of the IRB action with regard to your proposal:

Title: Nursing Students’ Knowledge, Perception of Risk, and Compliance with Precautions for the Prevention of Disease Transmission

This proposal was given:
- Expedited Review: 
- Full Committee Review: X
- Exempt: 

The result was:
- Full Approval: X
- Conditional Approval: 
- Emergency Approval: 
- Provisional Approval: 
- Denied Approval: 

If anything other than Full Approval is recommended, it is your responsibility, as investigator, to submit changes/corrections or plans to accommodate conditions listed below to the Office of Sponsored Research and Contracts prior to initiating the project.

Failure to acquire full approval by IRB before implementation for any project which involves humans or live vertebrate animals means that the PI is not acting in "good faith" with university policy and is not, therefore, guaranteed the protection of the university.

Committee Comments: 

OSR&C 3/99
### APPENDIX E: RESPONSES TO SECTION I OF QUESTIONNAIRE

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Note: See Appendix A for complete statement of the items. No item selection available = --.

<sup>a</sup>For items 1 through 26 number of students responding correctly is in bold type. For items 27a through 30d A = number of students selecting option (correct response), B = number of students not selecting option (incorrect response). <sup>b</sup>N = 710.
# APPENDIX F: MULTIPLE REGRESSION ANALYSIS VARIABLE CODING

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coding</th>
</tr>
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</table>
| Type of degree program in which respondents were enrolled               | 1 = baccalaureate degree  
|                                                                         | 2 = associate degree     |
| Gender                                                                  | 1 = male                   
|                                                                         | 2 = female                |
| Age                                                                     | exact number of years      |
| Course currently enrolled in                                            | 1 = first clinical course  
|                                                                         | 2 = intermediate course    
|                                                                         | 3 = for the last clinical course. |
| Not counting clinical laboratories, do you currently work at a hospital in a paid job? | 1 = yes                  
|                                                                         | 2 = no                    |
| Not counting clinical laboratories, do you currently work in a paid job at a health care setting other than a hospital? | 1 = yes                  
|                                                                         | 2 = no                    |
| Did you have work experience in a health care setting prior to entering your nursing program? | 1 = yes                  
|                                                                         | 2 = no                    |
| Emphasis on prevention of transmission of bloodborne pathogens by NSI in the instruction respondents have received | 1 = most important aspect of occupational safety  
|                                                                         | 2 = equal in importance to other aspects of occupational safety  
|                                                                         | 3 = less important than other aspects of occupational safety      |
| Initial instruction about the prevention of occupational exposure took place in relation to nursing program | 1 = while in the nursing program  
|                                                                         | 2 = outside of the nursing program       |
| Knowledge                                                               | percent correct on Section I of the questionnaire                  |
| Observation of environmental risk factors                                | summated score of respondents’ ratings on Section III of the questionnaire |

(table continued)
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<tr>
<td>Perceived support of compliance by faculty and clinical</td>
<td>summated score on four questions (77, 78, 79, 80)</td>
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<tr>
<td></td>
<td>5 = always</td>
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<td>4 = usually</td>
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<td>3 = sometimes</td>
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<td>2 = seldom</td>
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<tr>
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<td>1 = never</td>
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<td>Student group size in which respondents received initial instruction in</td>
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<td>3 = 51 to 75</td>
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<td>1 = 101 or more</td>
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<td>difference between the total NSI and the number of NSI reported</td>
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<td>summated score on five questions (65, 66, 67, 68, 69)</td>
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<td>4 = greater than given any other area</td>
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<tr>
<td></td>
<td>3 = greater than given most other areas</td>
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<tr>
<td></td>
<td>2 = less than given most other areas</td>
</tr>
<tr>
<td></td>
<td>1 = less than given any other area</td>
</tr>
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</table>

>Note. NSI = needlestick injury. BBP = bloodborne pathogens.
VITA

Cynthia Ann Logan was born in Lafayette, Louisiana. After completing undergraduate work at the University of Southwestern Louisiana in 1967, she served two years on active duty in the United States Navy Nurse Corps. Following active duty, she worked in the nursing field in Houston, Texas and earned a Master of Science degree in nursing from Texas Woman’s University in 1972. She began her teaching career in 1973 at Southeastern Louisiana University where she is currently employed. In addition to working in the education field, she maintains an interest in direct nursing care by working for a local hospice. She was accepted by the Graduate School of Louisiana State University and A. and M. College in 1997 and is a candidate for the degree of Doctor of Philosophy.