

**HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION IN  
ALBERTA**

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ALBERTA

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### **ABSTRACT**

Nursing students must be prepared to demonstrate professional accountability and safe practice. Hand hygiene, a core skill and leading measure in the prevention of health care-associated infections, is a vital component of patient safety. The purpose of this study was to investigate the methods and frequency used to teach and assess hand hygiene during nursing education and students' hand hygiene knowledge, beliefs, and practices, with the goal of providing information useful to nursing educators. Using a cross-sectional survey, data were collected from 285 senior nursing students from three universities in Alberta. The results indicated that although participants received frequent education on HH, there were gaps in their knowledge and practices. Assessment of hand hygiene was found to be inconsistent. The frequency of assessment was associated with positive beliefs, and positive beliefs were associated with higher rates of hand hygiene. Recommendations for nursing education were offered.

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**TABLE OF CONTENTS**

ABSTRACT..... iii

ACKNOWLEDGEMENTS ..... iv

TABLE OF CONTENTS.....v

LIST OF TABLES ..... viii

LIST OF FIGURES .....x

CHAPTER ONE: INTRODUCTION..... 1

    Statement of the Problem.....2

    Purpose and Research Questions .....3

    Theoretical Framework.....4

        Dependent Variables .....5

        Independent Variables .....5

    Significance of the Study .....6

    Overview of the Thesis .....6

    Definition of Terms.....7

CHAPTER TWO: LITERATURE REVIEW .....9

    The Burden of Health Care-Associated Infections .....9

    The Role of Hand Hygiene in Preventing Health Care-Associated Infections.....11

    Hand Hygiene Practices .....13

    Barriers to Compliance with Recommended Hand Hygiene Practice .....14

    Strategies to Improve Hand Hygiene .....15

        System Change.....15

        Training and Education.....16

        Evaluation and Feedback .....18

        Safety Climate.....18

    Hand Hygiene Habits .....20

    Nursing Students’ Hand Hygiene .....20

    Theory of Planned Behaviour .....22

    Conclusion .....26

CHAPTER THREE: STUDY DESIGN .....28

    Dependent Variables .....29

    Independent Variables .....29

    Design, Advantages, Limitations, and Delimitations .....29

    Population and Sample .....31

    Ethics.....32

        Consent .....32

        Confidentiality .....32

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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Data Collection .....	33
Survey Instrument.....	33
Dependent Variables.....	35
Hand hygiene knowledge.....	35
Hand hygiene beliefs.....	35
Hand hygiene practices .....	35
Independent Variables .....	36
Validity and Reliability.....	36
Data Entry and Preparation.....	37
Summary .....	39
CHAPTER FOUR: RESULTS .....	40
Response Rates .....	41
Demographic Variables .....	42
Dependent Variables.....	42
RQ 1: What Level of Knowledge about HH do Senior Nursing Students Have? .....	43
RQ 2: To What Extent do Senior Nursing Students Have Positive Beliefs about HH? .....	44
RQ 3: What are the Self-Reported HH Practices of Senior Nursing Students?.....	46
Independent Variables .....	48
Number of Teaching Methods .....	48
RQ 4: What Methods of HH Education do Nursing Students Find Most Effective? .....	50
RQ 5: How Frequently is HH Assessed and What Methods Are Used for Assessment?.....	52
Importance Given to Hand Hygiene .....	54
Social Desirability Responding.....	55
Employment in Health Care .....	56
Infection Control Projects.....	57
RQ 6: Are There Any Associations between Students' HH Knowledge, Beliefs, and Practice and the Methods and Frequency of HH Education and Assessment? .....	57
Multiple Regression Analyses: Knowledge.....	60
Multiple Regression Analyses: Beliefs.....	61
Multiple Regression Analyses: Practices.....	63
Summary .....	65
CHAPTER FIVE: DISCUSSION.....	66
Research Findings.....	67
What Level of Knowledge about HH do Senior Nursing Students Have?.....	67
To What Extent do Senior Nursing Students Have Positive Beliefs about HH?...71	
What are the Self-Reported HH Practices of Senior Nursing Students? .....	73
What Methods of HH Education do Nursing Students Find Most Effective? .....	77

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

---

How Frequently is HH Assessed and What Methods Are Used for Assessment? .....	78
Are There Any Associations between Students' HH Knowledge, Beliefs, and Practice, and the Methods and Frequency of HH Education and Assessment? .....	79
Limitations and Recommendations for Future Research .....	82
Conclusions and Recommendations for Education .....	84
REFERENCES .....	88
APPENDICES .....	97
Appendix A: Expanded Model of the Theory of Planned Behaviour .....	97
Appendix B: Survey Information Letter .....	98
Appendix C: Hand Hygiene Questionnaire .....	99

**LIST OF TABLES**

Table 1. Student Population by University .....	31
Table 2. Variables and Scales .....	34
Table 3. Distribution of Respondents by University .....	41
Table 4. Comparison of Demographic Variables among Universities .....	42
Table 5. Percent of Correct Answers to Knowledge Questions.....	43
Table 6. Distribution of Knowledge Scores by University.....	44
Table 7. Mean Scores on Statements in the HH Beliefs Scale .....	45
Table 8. Distribution of Beliefs Scores by University .....	46
Table 9. Self-Reported HH Practices.....	47
Table 10. Distribution of Self-Reported HH Practices by University .....	48
Table 11. Number of Teaching Methods Used by University .....	50
Table 12. Perceived Effectiveness of Teaching Methods.....	51
Table 13. Distribution of Teaching Effectiveness Scores by University .....	52
Table 14. Frequency of Assessment by University .....	53
Table 15. Importance Given to Hand Hygiene by Statement .....	54
Table 16. Hand Hygiene Importance Scale by University .....	55
Table 17. Social Desirability Responding by University.....	55
Table 18. Employment in Health Care by University.....	56
Table 19. Participation on Infection Control Project by University .....	57
Table 20. Distribution of Knowledge, Beliefs, and Practice Scores by Type of Employment in Health Care .....	59
Table 21. Regression Coefficients and Squared Semi-Partial Correlations .....	61
Table 22. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with Beliefs .....	62

HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

---

Table 22. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with HH Importance Scale ..... 63

Table 23. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with Practices ..... 64

**LIST OF FIGURES**

Figure 1. Theory of Planned Behaviour (Ajzen, 1991). ..... 5

Figure 2. Percentage of participants taught hand hygiene by method (N = 275). ..... 49

Figure 3. Effectiveness of teaching methods. .... 51

Figure 4. Frequency of assessment ..... 53

## CHAPTER ONE: INTRODUCTION

Health care-associated infections are the most common adverse event in health care resulting in a significant burden on patients, their families, and health care systems (World Health Organization [WHO], 2011). In addition, every time a patient is treated for a health care-associated infection, the opportunity for microorganisms to develop resistance to antimicrobial drugs increases. The increasing incidence of multi-drug resistant organisms and emerging infections such as Ebola virus disease continue to heighten the need for taking every possible measure to control the spread of infectious diseases. Hand hygiene is the leading measure for preventing the spread of pathogens and reducing health care-associated infections, but health care providers' adherence to recommended practices remains suboptimal in most settings, and improvement is difficult to sustain (Public Health Agency of Canada [PHAC], 2102; WHO, 2009b). The hand hygiene practices of health care providers, the reasons for suboptimal practice, and the intractable nature of changing practice have been extensively researched; based on this research, an increasing number of health care agencies are implementing programs aimed at addressing the barriers to hand hygiene.

Barriers to hand hygiene are highly complex and multifactorial, influenced by elements at both the organizational and individual levels (WHO, 2009a). Common barriers at the organizational level include inadequate hand hygiene facilities and workplace climates that do not value or emphasize the importance of hand hygiene. At the individual level, habits developed early in life and a lack of knowledge combined with misconceptions about hand hygiene during the delivery of care produce barriers to appropriate practice. While single one-time interventions that do not address the multiple

barriers have been unsuccessful in sustained improvements in hand hygiene practices, ongoing multimodal programs have been more effective (WHO, 2009a). Key elements of successful programs include system change within the organization, combined with ongoing education, and assessment and performance feedback to health care providers.

Nurses make up over one-third of the Canadian health care workforce and provide the largest percentage of direct patient care (Advisory Committee on Health Human Resources, 2002). Nursing students represent the future nursing workforce and must be prepared to demonstrate professional accountability and safe practice (College and Association of Registered Nurses of Alberta, 2013). Hand hygiene is a basic skill and key component of patient safety, and affects the morbidity and mortality of clients in all health care settings (PHAC, 2012). The hand hygiene habits nursing students develop in the course of their clinical rotations will affect their future practice (Kelčíkova, Skodova, & Straka, 2012; Nicol, Watkins, Donovan, Wynaden, & Cadwallader, 2009). In addition, nursing students are actively engaged in direct patient care while in their clinical practice rotations and, consequently, have an important role in infection control during their education. Ensuring that nursing students recognize the importance of hand hygiene in the prevention of health care-associated infections, know when and how hand hygiene should be performed, and follow recommended practice is of utmost importance.

### **Statement of the Problem**

Although extensive research has been conducted to investigate the hand hygiene (HH) knowledge, beliefs, and practices of health care providers (WHO, 2009b) and widespread multimodal interventions aimed at improving HH practices are being implemented by health care agencies, it is unknown if a similar emphasis on HH is being

included in health care providers' pre-licensing education. There is limited research on HH involving nursing students, and no reports of studies conducted in Canada. The results of studies conducted to explore the HH practices of nursing students in other countries have indicated a lack of emphasis on HH in undergraduate nursing curricula. Although similar studies have not been reported in Canada, observational audits conducted in Southern Alberta found low rates of adherence to HH policies among nursing students (Alberta Health Services South Zone, 2012). Indeed, as few as 30% of the nursing students observed in the audits performed HH prior to performing clean or aseptic procedures (Alberta Health Services South Zone, 2012)—a critical point in care for patient safety. The results of these audits suggest that there is a similar lack of emphasis within Canadian nursing education. Greater understanding of this phenomenon is needed to inform future development of relevant nursing curricula.

### **Purpose and Research Questions**

The purpose of this research was to investigate senior nursing students' HH knowledge beliefs and practices and to examine if the methods and frequency used to teach and assess HH during baccalaureate nursing education influenced their beliefs and practices. The study was designed to answer the following research questions:

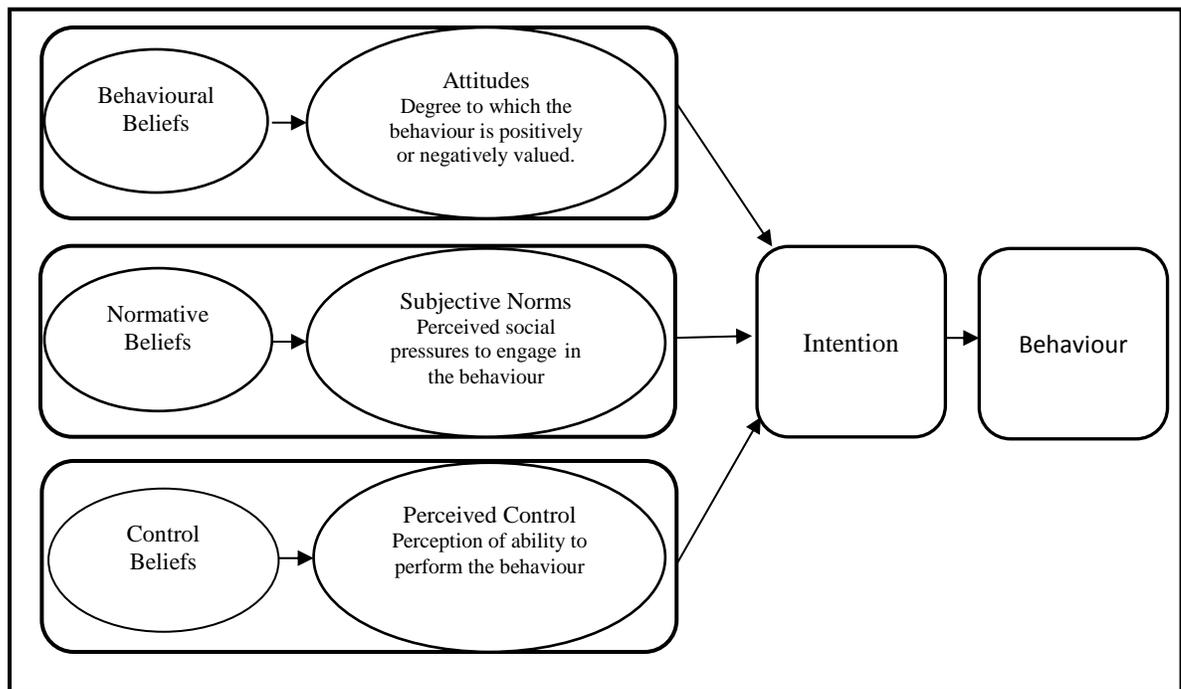
1. What level of knowledge about HH do senior nursing students have?
2. To what extent do senior nursing students have positive beliefs about HH?
3. What are the self-reported HH practices of senior nursing students?
4. What methods of HH education do nursing students find most effective?
5. How frequently is HH assessed and what methods are used for assessment?

6. Are there any associations between students' HH knowledge, beliefs, and practice, and the methods and frequency of HH education and assessment?

### **Theoretical Framework**

The theory of planned behaviour (Ajzen, 1991) was used as a theoretical framework for the research design. The theory of planned behaviour is a social cognitive model that defines the nature and relationship of the cognitive determinants of behaviour, positing that social behaviour is a function of people's perceptions as opposed to objective facts (Ajzen, 1991). In the theory of planned behaviour model, it is postulated that a given behaviour is predicated on the intention to perform the behaviour and that intention is directly affected by three variables: (a) an individual's attitudes toward the behaviour, (b) an individual's beliefs about the subjective norms of the behaviour, and (c) an individual's beliefs about personal control in performing the behaviour (Ajzen, 1991).

Ajzen (2001) further explained that attitudes toward behaviour comprise the degree to which performance of the behaviour is positively or negatively valued. As shown in Figure 1, attitudes are shaped by behavioural beliefs, the subjective probability that the behaviour will produce a given outcome. Subjective norms, defined as the perceived social pressures to engage or not to engage in a given behaviour, are determined by normative beliefs. Normative beliefs refer to the perceived behavioural expectations of important referent individuals or groups. The third proximal variable, perceived behavioural control, refers to an individual's perceptions of his or her ability to perform a given behaviour that in turn is based on control beliefs. Control beliefs are the perceived presence of factors that either facilitate or impede performance of the behaviour (Ajzen, 2006).



**Figure 1. Theory of Planned Behaviour (Ajzen, 1991).**

Based on the findings from previous research and using the theory of planned behaviour as the theoretical framework, the following independent and dependent variables were measured in this study. Operationalization of the variables is discussed in the ensuing methods section.

### **Dependent Variables**

1. Nursing students' knowledge of recommended HH practices.
2. Nursing students' beliefs about the importance of HH.
3. Nursing students' self-reported HH practices.

### **Independent Variables**

1. Students' perception of the effectiveness of approaches used to deliver HH education.

2. Students' recall of the number of approaches used to deliver HH education.
3. Students' recall of the frequency that HH is assessed during nursing students' education.
4. Students' perceptions of the importance given to HH in the curriculum, by clinical nursing instructors, and by the facilities where they had completed clinical rotations.

It was proposed that (a) repetitive education is positively associated with knowledge, (b) repetitive education is also positively associated with positive beliefs, (c) frequent assessment is positively associated with positive beliefs, and (d) students' perception of the importance given to HH in the curriculum is positively associated with positive beliefs.

### **Significance of the Study**

The overall aim of the research was to collect and interpret data on the knowledge and beliefs of nursing students about HH, the frequency that HH is taught and assessed during undergraduate nursing education, and the methods of teaching HH that students find most effective, with the goal of providing information useful for undergraduate nursing curriculum development in the area of HH. Results of the study will be provided to the nursing programs involved in the study and to participants upon request. The results will also be submitted for presentation at conferences and publication in peer reviewed journals on nursing education and infection control.

### **Overview of the Thesis**

This thesis includes five chapters. Chapter 1 presented an introduction to the problem under investigation, a brief summary of literature and research on the topic, the

statement of the problem, research questions, and variables. Chapter 2 provides a review of literature and research relevant to health care-associated infections and HH during the delivery of health care and nursing students' education in the following sections: the burden of health care-associated infections, the role of HH in preventing health care-associated infections, HH practices, barriers to compliance with recommended HH practices, interventions to improve HH, and HH habits and nursing students. The methodology and procedures used to gather data for the study are presented in Chapter 3. Chapter 4 includes the results of the data analysis, and in Chapter 5, a summary of the study findings, discussion and conclusions drawn, limitations, and recommendations for future research are presented.

### **Definition of Terms**

- Alcohol-based hand rubs. The term ABHR is used to refer to alcohol-containing preparations, at concentrations from 60% to 90%, in the form of gels, rinses, or foams with added glycerol or emollients approved for use within the health care setting.
- Beliefs. Belief has been defined as:  
  
Mental reliance on or acceptance of a particular concept, arrived at by weighing external evidence, facts, and personal observation and experience. Belief is essentially a subjective feeling about the validity of an idea or set of facts. It is more than a mere suspicion and less than concrete knowledge. Unlike suspicion, which is based primarily on inner personal conviction, belief is founded upon assurance gained by empirical evidence and from other people. ("Belief," 2008, para. 1)
- Hand hygiene (HH). PHAC (2012, p. 5) has defined HH as:  
  
Encompasses hand washing, hand antisepsis and actions taken to maintain healthy hands and fingernails. Hand washing is the process of using soap and water to remove soil and transient microorganisms from the hands. Hand antisepsis includes

either rubbing the hands with alcohol-based hand rub or hand washing with antiseptic soap, to destroy resident and transient microorganisms on the hands.

- Health care-associated infections (HAI). The WHO (2009a, p. 4) has defined HAI

as:

An infection occurring in a patient during the process of care in a hospital or other health care facility which was not present or incubating at the time of admission. HAI can affect patients in any setting where they receive care and can also appear after discharge. Furthermore, they include occupational infections among staff.

- Patient. The term patient is used to refer to any individual receiving health care regardless of the setting, including hospital, private and public clinics, public health offices, long-term care, assisted living, or home care, and it encompasses client and resident.

## **CHAPTER TWO: LITERATURE REVIEW**

In this chapter, I begin by providing a synopsis of the impact and prevalence of health care-associated infections (HAI) from the individual to global levels, followed by the role of hand hygiene (HH) in reducing HAI. A review of literature on the barriers to performing HH in health care settings and interventions that are recommended to reduce barriers and improve HH are provided. A review of research conducted to investigate HH during nursing education is presented, followed by research on HH conducted using the theory of planned behaviour as the theoretical framework. A summary of the literature review is given last.

### **The Burden of Health Care-Associated Infections**

HAI are the most common serious complication of health care delivery, with an impact of “prolonged hospital stay, long-term disability, increased resistance of microorganisms to antimicrobials, a massive additional financial burden for health systems, high costs for patients and their family, and unnecessary deaths” (WHO, 2009b, p. 1). The WHO (2011) estimated the prevalence of HAI in developing countries to be between 5% and 19%; between 3.5% and 12% of hospitalized patients in developed countries acquired at least one infection. Among developed countries, Canada has one of the highest rates of HAI, with 11.6% of patients admitted to Canadian hospitals acquiring an infection as a consequence of their stay (WHO, 2011).

In intensive care units, approximately 30% of patients develop at least one HAI (WHO, 2011), and endemic and epidemic infections are common in long-term care facilities (Provincial Infectious Diseases Advisory Committee, 2010). The associated mortality rates vary from 12% up to 80% among high-risk patients (WHO, 2011). Each

year, an estimated 8,000 deaths result from the more than 200,000 HAI that occur in Canada—and the rates appear to be rising (PHAC, 2013). Merwan N. Saher, the Auditor General of Alberta (2013, p. 20), reported that in Canada “there are more deaths associated with health care-acquired infections than with diabetes (6,923 deaths in 2009), Alzheimer’s disease (6,281 deaths in 2009), or influenza and pneumonia (5,826 deaths in 2009).” Patients with HAI remain in hospital on average three times longer than uninfected patients (Plowman et al., 1999), resulting in longer wait times for new admissions and increased financial cost in an already overburdened system. The direct costs of HAI in Canada were estimated at approximately \$1 billion annually (Van Iersel, 2007). In addition, every time a patient is treated for an HAI with antimicrobial drugs, the opportunity for microorganisms to develop resistance increases.

Microorganisms commonly associated with HAI are developing resistance to an increasing number of antimicrobial drugs. The Institute for Healthcare Improvement (n.d., para. 1) suggested that multidrug-resistant organisms pose “a serious global health care threat,” as the drugs available to treat them are progressively depleted. The Canadian Nosocomial Infection Surveillance Program (2007) reported that rates of HAI with multidrug-resistant organisms had increased dramatically over the last decade. The rate of HAI caused by methicillin-resistant *Staphylococcus aureus* (MRSA) increased more than 1,000% in Canadian hospitals between 1995 and 2009 (PHAC, 2013), and the incidence of infections caused by vancomycin-resistant *Enterococci* (VRE) rose from .08 to .51 cases per 1,000 patient admissions (PHAC, 2011). In addition to becoming more resistant to antibiotics, some organisms are becoming increasingly virulent. Deaths in Canada

attributed to *Clostridium difficile* infections almost tripled between 2007 and 2011 (PHAC, 2013). It is now widely recognised that antimicrobial drugs alone cannot be depended upon for the control of infections and that there is an “*urgent* [emphasis added] need for better strategies to prevent transmission and infection caused by HAI” (Institute for Healthcare Improvement, n.d., para. 2). Harbarth, Sax, and Gastmeier (2003) contended that up to 70% of HAI can be prevented; the hands of health care providers (HCPs) have been identified as the single most important source of preventable HAI (WHO, 2009b).

### **The Role of Hand Hygiene in Preventing Health Care-Associated Infections**

Health care professionals touch a continuous sequence of patients, environmental surfaces, and their own bodies, and with each contact a bidirectional exchange of microorganisms occurs (Sax, Allegranzi, et al., 2007). Contamination of the hands with pathogens can occur not only from contact with patients’ body fluids or waste, with or without glove use, but also from contact with patients’ dry and intact skin and from contact with environmental surfaces (Pittet et al., 2006). Pathogens are frequently present on the hands, upper extremities, and trunk of infected and colonized patients, and HCPs can contaminate their hands through direct contact with the patient even during what may be perceived as low-risk interactions such as taking a patient’s pulse (Pittet et al., 2006). In addition, because large numbers of skin cells containing viable microorganisms are shed onto objects in the patient’s environment, contamination of patients’ gowns, linens, furniture, and equipment results (Pittet et al., 2006).

Microorganisms can survive and multiply on the hands depending on a number of variables, including the type of microorganism and the level of contamination; for example *Staphylococcus aureus* including MRSA strains can survive for more than 150 minutes and

VRE for up to 60 minutes (Kampf & Kramer, 2004). Unless the hands are cleaned, HCPs carry microorganisms from one patient to another and to environmental surfaces, and from environmental surfaces to patients and other environmental surfaces (Pittet et al., 2006). The spread of microorganisms throughout a health care environment can occur in hours (Sax, Allegranzi, et al., 2007). Many of the most common HAI pathogens can persist on dry surfaces for months, thus providing a continuous source of transmission (Kramer, Schwebke, & Kampf, 2006). HH performed at key times in the sequence of cross-transmission of pathogens interrupts the spread of HAI (Pittet et al., 2006). Routine HH may be performed either by using soap and running water, or with alcohol-based hand rubs.

HH with alcohol-based hand rubs, when correctly applied, kills microorganisms within seconds, whereas HH with soap and water removes them. Alcohol-based hand rubs provide rapid antibacterial effects and broad-spectrum coverage and have been demonstrated to be more effective than hand washing in reducing the number of microorganisms on hands, providing hands are not visibly soiled (Girou, Loyeau, Legrand, Oppein, & Brun-Buisson, 2002; Zaragoza, Salles, Gomez, Bayas, & Trilla, 1999). Additional advantages of using alcohol-based hand rubs for HH are that it takes less time than hand washing, and dispensers can be installed within reach of where care and procedures are performed. As well, alcohol-based hand rubs have been shown to cause less skin irritation and dryness than that frequently associated with hand washing (Trampuz & Widmer, 2004). Hand washing is indicated when hands are visibly soiled or when caring for patients with known or suspected norovirus or *Clostridium difficile* infections, but owing to its efficacy, ease of application, accessibility, and tolerability, alcohol-based hand

rubs are now recommended as the primary method for all other indications for HH during routine patient care (WHO, 2009b).

### **Hand Hygiene Practices**

Although regional, national, and international health agencies concur that HH is the primary measure for interrupting the transmission of microorganisms (Alberta Health Services [AHS], 2010; Centers for Disease Control and Prevention [CDC], 2006; Community and Hospital Infection Control Association, Canada Standards and Guidelines Core Committee, 2008; PHAC, 2012; WHO, 2009a, 2009b), poor compliance among health care professionals has been extensively documented (Erasmus et al., 2010). HCPs' adherence to recommended HH practice ranges from 5% to 89%, with an overall average of 38.7% (WHO, 2009a). The WHO identified improved HH as the key component of the First Global Patient Safety Challenge, and in 2005 launched the global campaign, *Clean Care is Safer Care* (WHO, 2005), with the goal of gaining "international focus and action on the critical patient safety issue of HCAI and on the central role that hand hygiene compliance by health-care workers plays in reducing such infections" (WHO, 2009a, p. 7). In 2009, WHO launched *Save Lives: Clean Your Hands* to ensure ongoing focus on HH. Over 100 international experts contributed to the development of the *WHO Guidelines on HH in Health Care* (WHO, 2009b), a comprehensive review of scientific evidence for focusing on HH. Based on that guideline, the WHO (2009a) developed the *Guide to Implementation of the WHO Multimodal HH Improvement Strategy* to support health care agencies in improving HH.

More than 40 countries, including Canada, joined the WHO's First Global Patient Safety Challenge and have since developed national programs aimed at reducing HAI

through improving HH practices (WHO, 2015). After joining the WHO campaign in 2005, Canada launched the Canadian Patient Safety Institute's Stop! Clean Your Hands program (PHAC, 2013). In addition to national programs, extensive regional programs have been implemented. AHS, the governing body for all health care services in the province where this study was conducted, has employed several strategies to improve HCPs' adherence to recommended HH, and it provides information and resources on HH for HCPs on the AHS (2014) website. AHS initiatives aimed at reducing barriers to HH are discussed in the following sections under Strategies to Improve HH that are based on the *Guide to Implementation of the WHO Multimodal HH Improvement Strategy* (WHO, 2009a).

### **Barriers to Compliance with Recommended Hand Hygiene Practice**

Numerous factors have been identified as influencing adherence to recommended HH practices, including (a) lack of access to HH facilities at point of care, (b) time constraints, (c) skin irritation from frequent hand washing, (d) lack of knowledge of the potential risks of transmission of microorganisms to patients and the impact of improved HH on reducing HAI, (e) misconceptions about HH, (f) uncertainty of the essential times to clean hands in health care settings, and finally, (g) a lack of role models among colleagues and superiors (WHO, 2009b). Based on the diverse nature of these factors, the WHO (2009a) stresses that successful HH improvement requires multiple strategies to address the different barriers. Strategies identified by the WHO as critical components of programs aimed to improve HH include system change, workplace reminders, training and education, evaluation and feedback, and creating a patient safety climate.

### **Strategies to Improve Hand Hygiene**

#### **System Change**

The WHO (2009a) stresses that compliance with HH is only possible if there is adequate infrastructure and a reliable and permanent supply of HH products available in health care settings. Leaving the patient bedside to find a sink exacerbates a common barrier to performing HH, which is lack of time. HCPs are required to perform HH a multitude of times in a shift, and as the intensity of patient care increases, the numbers of indications for HH increases (CDC, 2002). Leaving the patient to find a sink, then washing and drying the hands can take up to two minutes, whereas HH with ABHR can be completed in less than 30 seconds without leaving the patient room (Trampuz & Widmer, 2004). The promotion of alcohol-based hand rubs (ABHR) as the primary method of HH addresses barriers associated with lack of time to wash hands (WHO, 2009b). In addition, because emollients are now added to ABHR products they cause less damage to the skin than frequent hand washing (Boyce, Kelliher, & Vallande, 2000).

Health care facilities in the Province of Alberta are required to ensure ABHR is available at the point of care, patient room entrances, nursing and computer stations, and locations where medications are prepared (AHS, 2011). Numerous workplace reminders in the form of posters are prominently displayed throughout AHS facilities, and ABHR is promoted as the primary method for HH. However, in spite of the documented advantages of ABHR and the widespread installation of dispensers throughout many hospitals, HCPs continue to primarily wash their hands (Naikoba & Hayward, 2001). Reluctance to use ABHR arises from a lack of knowledge of the advantages of ABHR or misconceptions

about its use (WHO, 2009b). Therefore, information on the benefits of ABHR as the primary method for HH is an important component in HH education.

### **Training and Education**

Education is frequently cited as the cornerstone for improvement with HH practices (CDC, 2002; Provincial Infectious Diseases Advisory Committee, 2008; WHO, 2009b). The WHO (2009a) stresses that education is critical for success and, further, that education must be provided on a regular basis, with one-time education typically resulting in only very short-term change. The WHO (2009a) recommends that teaching should include not only educational content, but also training strategies for promoting, practicing, and assessing knowledge and practice performance. Teaching and training strategies should aim at progressive educational objectives and preferably facilitate different ways of learning (WHO, 2009a). As well, refresher sessions should be provided to strengthen and sustain awareness and to update knowledge (WHO, 2009a). Topics identified by the WHO (2009a) as essential to educational programs include the rationale for HH, indications and technique for HH, and methods to maintain hand skin integrity.

The rationale for HH should stress the risks of transmission of microorganisms to patients and the morbidity, mortality, and costs associated with HAI (WHO, 2009a). Unlike other adverse events in health care that have an immediate consequence and can be traced to a specific error or omission, HAI are slower to develop and can seldom be linked to the actions or inaction of one individual; as a result, many HCPs fail to make an association between their own omission to perform HH and a patient developing an infection (Nicol et al., 2009). Jenner, Watson, Miller, Jones, and Scott (2002, p. 321) also suggested that the “length of the interval between failing to perform HH and a patient developing an infection

makes it unlikely that the two events will be naturally associated.” Consequently, HCPs require knowledge of the types of activities that can result in hand contamination, the role their hands play in the chain of transmission, and the indications for HH that interrupt the chain of transmission.

Many HCPs do not have a clear understanding of all the HH indications required during patient care, particularly those activities when potential contamination is not readily apparent (Cole, 2007), such as contact with patient’s intact skin or surfaces in the patient environment. Whitby, McLaws, and Ross (2006, p. 490) proposed that nurses act through a self-developed “hierarchy of risk” to assess when HH is indicated, but in busy, complex, and unstable practice situations, biased and flawed assessments occur. A framework that clearly identifies when HH is required to prevent transmission of microorganisms is valuable in reducing individual assessments (Sax, Allegranzi, et al. 2007). Research conducted at the University of Geneva Hospital led to the development of “My Five Moments for HH,” which is a framework easily applied to all health care settings and care sequences (Sax, Allegranzi, et al., 2007). The framework captures the indications for HH that are necessary to interrupt microbial transmission during care into five easily remembered reference points (Sax, Allegranzi, et al., 2007). The Ontario Ministry of Health and Long-Term Care (2008, p. 20) revised the framework into “Your 4 Moments for HH.” The four moments for HH have been adopted by the Canadian initiative “Stop! Clean Your Hands” (Canadian Patient Safety Institute, n.d.) and by AHS (2011). The indications for HH defined by AHS are included in its HH policy (AHS, 2011, p. 2). In their HH policy, AHS (2011, p. 2) also stipulates that all staff “will at minimum, upon initial orientation and on an annual basis, receive standardized Alberta Health Services

education and training on hand hygiene and the hand hygiene policy and procedures.” In addition, AHS (2014) conducts a province-wide system of regular HH audits, which incorporate performance feedback to the health care professionals observed.

### **Evaluation and Feedback**

After educational programs are delivered, the WHO (2009b) recommends verifying the competency of all health care professionals as a critical certification step. The WHO (2009a) recommends evaluations of not only HH compliance through direct observation, but also HCPs’ knowledge and perception of HAI and HH. Regular observation of HH practices and feedback on performance is increasingly being implemented in hospitals, sometimes as a requirement for accreditation. Accreditation Canada (2008) requires both ongoing education and audits on compliance with HH as required organizational practices.

Unfortunately, while systems change, education, and observation and feedback have resulted in transient increases in HH practice, sustained improvements have seldom been documented (Gould, Moralejo, Drey, & Chudleigh, 2010), thus supporting the need for additional strategies and long-term commitments. The final component identified by the WHO (2009a) as a priority in multimodal programs is creating a safety climate.

### **Safety Climate**

The WHO (2009a, p. 29) defined an institutional safety climate “as an environment and the perceptions that facilitate awareness-raising about patient safety issues while guaranteeing consideration of hand hygiene improvement as a high priority at all levels.”

*The Guide to Implementation of the WHO Multimodal Hand Hygiene Improvement Strategy* (WHO, 2009a) includes recommendations and resources focused on promoting commitment from managers and guidance for engaging patients in HH initiatives, with the

overall aim of embedding a culture of HH excellence. In contrast, Singer and Vogus (2013, p. 374) suggested that an organization's culture is the "basic mechanism through which patient safety is achieved."

Singer and Vogus (2013, p. 374) defined safety culture, a construct related to safety climate, as "the shared values, attitudes and patterns of behavior." They proposed that interventions are often unsuccessful because they fail to address the fundamental problem, a weak organizational safety culture. They offered a theoretical model, identifying three interrelated and recursive processes of enabling, enacting, and elaborating, and they recommended that all need to be considered. Enabling includes leaders' actions, policies, and practices that emphasize safety. Leaders within an organization who model safe behaviour and disseminate information on patient safety have a strong and consistent impact on creating a safety climate. Enacting, which is comprised of the frontline actions that improve patient safety, is influenced by the safety climate, which in turn, creates a safety culture. Finally, elaborating involves learning practices, systematically reflecting on and learning from safe behaviours (p. 375). Learning practices encompass education, operational improvement, system monitoring, and system improvement.

Compared to the WHO (2009a) recommendations focusing on safety climate, Singer and Vogus (2013) offered a theoretical model to guide interventions at multiple levels within an organization's climate and culture. The model developed by Singer and Vogus provides conceptual categorizations of interventions and illustrates the interrelationships between processes involved in creating a safety culture (p. 375). In addition, the model highlights the need for sustained commitment to an iterative approach to change over time. Of particular note, within the context of nursing education, is the

application of the model to different patient safety issues and contexts and balancing relational and behavioural interventions.

### **Hand Hygiene Habits**

Whitby et al. (2006, p. 490) posited that HH is a habit, referred to as “intrinsic hand washing behaviour” and that this habit is often established before the age of eight and continues relatively unchanged throughout life. Whitby et al. explained that intrinsic hand washing behaviour is based on self-protection and is triggered when hands are visibly dirty, when they feel sticky or gritty, or by activities that are perceived as being dirty. HH indications in the health care settings, such as touching a client to take a pulse or touching environmental surfaces, are not triggered by the “habit” to clean the hands (Whitby et al., 2006); indeed, this indication for HH is the most frequently missed by HCPs. Erasmus et al. (2010, p. 287) reported that compliance with HH was consistently higher after completing a dirty task as compared to a clean task. Whitby et al. recommended that highlighting activities in health care that are not triggered by intrinsic hand washing is needed to create new habits. McGeer (2007) and Nicol et al. (2009) also suggested that indications for HH in the health care setting must become habit, and Nicol et al. further advised that these habits should be “embedded during training” (p. 40).

### **Nursing Students’ Hand Hygiene**

Within the vast body of research reports on the HH practices of health care professionals, few included nursing students; the majority of those that do were conducted in Europe. Only two studies focused on students in the United States, and there was no research involving Canadian nursing students. A qualitative approach to gain greater understanding of nursing students’ experiences and perceptions of HH was used in two of

the studies (Barrett & Randle, 2008; Lusardi, 2007). Five investigative teams used surveys: one to collect data on knowledge and practices of nursing students in Singapore (Nasirudeen et al., 2012); another to assess HH practices of nursing students in Turkey (Çelik & Koçaşlı, 2008). One research team compared the knowledge, attitudes, and practices of second- and third-year nursing students in the UK (Kennedy & Burnett, 2011), and in two of the studies, the HH knowledge, beliefs, and practices of nursing students were compared with those of medical students (van de Mortel, Apostolopoulou, & Petrikkos, 2010; van de Mortel, Kermode, Prozano, & Sansoni, 2011). Snow, White, Alder, and Stanford (2006) used a quasi-experimental design to explore the influence of mentors' HH practices on nursing students' HH rates. A mixed-method design, combining a questionnaire and interview, was used to assess if nursing students' perceptions of their adherence to recommended HH practices corresponded to their actual HH behaviour (Cole, 2009). In another mixed-method design, but using a survey combined with observation and curricular analysis, Kelčíkova et al. (2012) analyzed the effectiveness of HH training in basic nursing education in Slovakia.

Common findings among these studies included the following: (a) students' knowledge of HH was low (Barrett & Randle, 2008; Çelik & Koçaşlı, 2008; van de Mortel et al., 2011); (b) there is a need for greater emphasis on HH during undergraduate education (Çelik & Koçaşlı, 2008; Cole, 2009; van de Mortel et al., 2010); (c) mentor's HH practices were a strong predictor of students' compliance with recommended HH (Barrett & Randle, 2008; Lusardi, 2007; Snow et al., 2006); (d) a lack of positive role models in the practice settings had a negative influence on both nursing students' perceptions of the importance of HH and their rate of compliance (Barrett & Randle, 2008; Lusardi, 2007;

Snow et al., 2006); and finally, (e) where HH practices were investigated, they were reported to be low (Cole, 2009; Snow et al., 2006).

In contrast, Nasirudeen et al. (2012) found good levels of knowledge and compliance with HH among nursing students in Singapore, where the students receive various types of HH education and are frequently assessed. The findings of these studies shared many similarities with research on the knowledge, beliefs, and practices of health care professionals. Also, similar to recommendations to improve health care professionals' HH practices, the authors of the studies on nursing students advised on the importance of education, including more frequent education and assessment, particularly in the clinical setting (Çelik & Koçaşli, 2008; Cole, 2009; van de Mortel et al., 2010). The use of a variety of teaching-learning strategies was also stressed (Cole, 2009; van de Mortel et al., 2010). Perhaps of particular importance when considering HH in undergraduate nursing education is the vital role of instructors in modeling, assessing, and reinforcing the HH practices of students. Leaders within an organization who model and clearly establish the expectations for safe behaviours have a strong impact on creating a safety climate (Singer & Vogus; 2013; WHO, 2009b). Perceived expectations comprise a central construct within the theory of planned behaviour.

### **Theory of Planned Behaviour**

The theory of planned behaviour has been used extensively to identify constructs predictive of health care professionals' HH behaviours (Jenner et al., 2002; Nicol et al., 2009; O'Boyle, Henly, & Larson, 2001; Pessoa-Silva et al., 2005; Sax, Uckay, Richet, Allegranzi, & Pittet, 2007; Tai, Mok, Shing, Seto, & Pittet, 2009; Whitby et al., 2006). Nicol et al. (2009), O'Boyle et al. (2001), Pessoa-Silva et al. (2005), and Tai et al. (2009)

reported that all three proximal variables of the theory of planned behaviour (i.e., attitude, subjective norms, and behavioural control) were predictive of intention to perform HH. However, Whitby et al. (2006) found that only attitude and subjective norms were strongly correlated to intention, and Jenner et al. (2002) found only attitude and behavioural control predicted intention. Interestingly, only Sax, Uckay, et al. (2007) stated that the results of their study did not demonstrate that positive attitudes toward HH were predictive of intention to adhere to HH recommendations; it is important to note that the sample for this study was from a population that had wide-ranging experiences with HH campaigns. Indeed many of the differences in the findings of the above studies may be explained by differences in the types of population, the health care setting in which the study was conducted, and the research tools used.

Different populations from which the samples were drawn included nurses (Nicol et al., 2009; O'Boyle et al., 2001; Whitby et al., 2006) and nurses, physicians, and nursing attendants (Jenner et al., 2002; Pessoa-Silva et al., 2005; Sax, Uckay, et al., 2007; Tai et al., 2009). In addition, the samples were drawn from diverse health care settings for each of the studies. Health care settings ranged from neonatal critical care (Pessoa-Silva et al., 2005), critical care (O'Boyle et al., 2001), medical and surgical wards (Nicol et al., 2009), hospital wide (Jenner et al., 2002; Sax, Uckay, et al., 2007; Tai et al., 2009), to tertiary care hospitals (Whitby et al., 2006). Although questionnaires were used by Jenner et al. (2002), O'Boyle et al. (2001), Pessoa-Silva et al. (2005), Sax, Uckay, et al. (2007), Tai et al. (2009), and Whitby et al. (2006) and development of the questionnaires was based on the constructs of the theory of planned behaviour, none of the studies used the same

questionnaire. Despite the differences among the above studies, positive attitudes were almost universally shown to be predictive of intent.

Factors reported to be strongly associated with attitude were a sense of personal responsibility (Jenner et al., 2002; Nicol et al., 2009) and beliefs about the importance of HH, and formal education and training (Jenner et al., 2002; Nicol et al., 2009; Sax, Uckay, et al., 2007; Tai et al., 2009; Whitby et al., 2006). Repetitive education, both in the classroom and in the clinical setting, was identified as being equally important. A variety of educational methods including oral presentations, demonstrations, and experiential learning were all noted to be valuable methods of teaching. Nicol et al. (2009, p. 38) reported that experiential learning in particular “had a profound effect on attitudes.” Variables associated with subjective norms included positive role models, the belief that supervisors and administrators expected HH compliance, and peer pressure. Role models, in particular senior staff, preceptors, and managers, who valued and promoted adherence to HH recommendations were also reported to have had a major effect on attitudes (Jenner et al., 2002; Nicol et al., 2009). Perceived behavioural control was associated with the ability to know what to do in specific circumstances, which is based on education and training.

Although the studies demonstrated, albeit to varying degrees, that the variables of the theory of planned behaviour were predictive of the intention to perform HH, there was less agreement on the strength of the relationship between intention to adhere to recommended HH practices and actual compliance. Jenner et al. (2002), Sax, Uckay, et al. (2007), and Tai et al. (2009) used self-reported adherence to recommended HH practice as the measure of behaviour and reported a strong association between intent and behaviour. However, self-reported adherence has been documented as an unreliable indicator of actual

HH compliance (Haas & Larson, 2007) and the WHO (2009b) reported that health care professionals frequently overestimate their compliance. Nicol et al. (2009) and O'Boyle et al. (2001) used both self-reported and observed adherence to measure HH behaviour and found that although attitudes, subjective norms, and perceived behavioural control were associated with intention, and intention was associated with self-reported adherence, there was only a low positive correlation between intent and observed behaviour. O'Boyle et al. recommended caution when assuming intention will predict behaviour, and Ajzen (2001) and Pessoa-Silva et al. (2005) suggested that intention may be largely irrelevant when a behaviour has become habit.

Based on the above research, the theory of planned behaviour was expanded to include elements identified as predictive of HH. As illustrated in Appendix A, attitudes toward HH (i.e., the degree to which HH is positively or negatively valued) are shaped by behavioural beliefs. Positive behavioural beliefs have been shown to be associated with repetitive HH education, using a variety of teaching methods, and by frequent assessment of HH practices. Subjective norms (i.e., the perceived social pressures to perform HH) are formed by the perceived expectation of leaders to perform HH (i.e., normative beliefs). Positive normative beliefs have been demonstrated as being influenced by positive role models and the belief that supervisors expect HH as demonstrated by frequent assessment. Finally, perceptions of the ability to perform HH, defined for the purposes of this study as knowledge of when and how HH should be performed, are dependent on training and education. Additional factors associated with perceived control, such as the availability of HH facilities, are not directly under the control of educational institutions and, as such, were not included in the model.

### **Conclusion**

HAI are a serious patient safety concern that also threaten our future ability to treat infections. HH is the leading measure for reducing HAI and antimicrobial resistance, but adherence to recommended practice in the health care setting remains low and resistant to change. The ongoing emphasis on HH by the WHO and other regulatory and accrediting agencies highlights the importance of improving HH practices. The simple task of performing HH is, in fact, a complex behavioural phenomenon influenced by factors at both the individual and organizational levels, including knowledge, beliefs, habits, role models, and workplace culture. Knowledge of why, when, and how HH should be performed during the delivery of health care and positive beliefs about HH have been identified as critical elements to ensuring correct practices. Repetitive education, both in the classroom and in the clinical setting, using different methods of delivery, is associated with both knowledge and positive beliefs. Frequent assessments combined with performance feedback are also associated with positive beliefs about the importance of HH.

A vast amount of research has been conducted to investigate the HH knowledge, beliefs, and practices of HCPs, but there is a dearth of similar research involving nursing students—most notably within the Canadian context. The majority of research conducted in other countries found a lack of emphasis on HH in undergraduate nursing curricula. Differences in educational requirements between countries make it problematic to extrapolate the results. Investigation of Canadian nursing students' HH knowledge, beliefs, and practices as well as associations with the frequency and methods used to teach and assess HH are important to undergraduate nursing curriculum in the area of HH.

The methods and procedures used to collect and analyse data on HH education, and the HH knowledge, beliefs, and practices of nursing students, from three Canadian Universities in the province of Alberta, are presented in Chapter 3. In addition to the research design, a description of the population and sample is provided. Ethical approval and considerations are presented, and the process used for data collection is provided. Details of the survey instrument, data entry, and cleaning is presented last.

### CHAPTER THREE: STUDY DESIGN

In this chapter, the research questions are reviewed, and the research design developed to answer those questions is presented, along with the strengths, limitations, and delimitations of the design. The population and sample, ethical considerations, and a detailed description of the data collection process are provided. The analysis process is also described.

The overall aim of the research was to collect and interpret data on nursing students' knowledge and beliefs about HH, their self-reported HH practices, recall of the frequency that HH was taught and assessed during undergraduate nursing education, and the methods of teaching HH that students found most effective. The study was designed, using a quantitative research approach, to answer the following research questions:

1. What level of knowledge about HH do senior nursing students have?
2. To what extent do senior nursing students have positive beliefs about HH?
3. What are the self-reported HH practices of senior nursing students?
4. What methods of HH education do nursing students find most effective?
5. How frequently is HH assessed and what methods are used for assessment?
6. Are there any associations between students' HH knowledge, beliefs, and practice, and the methods and frequency of HH education and assessment?

The theory of planned behaviour (Ajzen, 1991) has been demonstrated to be a suitable framework to aid in understanding the relationships among the multiple factors that influence HH practice. Based on the findings from previous research, and using the theory of planned behaviour as the theoretical framework, the following independent and dependent variables were identified.

### **Dependent Variables**

1. Nursing students' knowledge of recommended HH practices.
2. Nursing students' beliefs about the importance of HH.
3. Nursing students' self-reported HH practices.

### **Independent Variables**

1. Students' perception of the effectiveness of approaches used to deliver HH education.
2. Student recall of the number of approaches used to deliver HH education.
3. Student recall of the frequency that HH is assessed during nursing students' education.
4. Students' perceptions of the importance given to HH in the curriculum, by clinical nursing instructors, and by the facilities where they had completed clinical rotations.

### **Design, Advantages, Limitations, and Delimitations**

The research was conducted within a cross-sectional design using a group-administered, self-completed, paper-based survey consisting of closed questions. Use of a cross-sectional design enables the collection of quantitative data on multiple variables at a single point in time and is appropriate to explore patterns of association among variables (Bryman, 2004). Advantages of using a cross-sectional study design are that multiple outcomes can be studied; as well, it facilitates the description of population characteristics and identification of associations among the variables. The primary limitation of a cross-sectional design is the inability to establish causal connections.

A survey was chosen because of its usefulness in gathering data when little is known about the variables of interest (LoBiondo-Wood, Haber, & Singh 2005). Survey research involves systematically gathering information from respondents for the purpose of understanding specific characteristics of a group (Fowler, 2002). An advantage of using this approach to data collection is that large amounts of information can be obtained from a large sample in a relatively economical way (Bryman, Teevan, & Bell, 2009). In addition, because the participants are not deliberately manipulated, there are fewer ethical concerns (Fowler, 2002). The use of an anonymous survey also reduces ethical concerns in terms of confidentiality. Advantages of using self-completed, group-administered surveys in collecting data include convenience, efficiency, and a potentially higher response rate than is typical with mail or web-based surveys. A limitation of surveys is that they do not provide exact measurements, but only estimates of the true population, and a low response rate can limit the ability to generalize findings to the population (Fowler, 2002). In addition, bias may occur from intentional or unintentional inaccuracy of responses (Polit & Beck, 2004).

A number of strategies were used to reduce non-response in this study. An anonymous self-completed, paper-based survey reduces the potential fear of being identified. Inviting the entire population of students to participate ensured that all potential participants were contacted. Providing an opportunity to complete the survey during a period of time when all students were required to meet ensured that all participants could participate if they wished. The 11-item short form of the Marlowe-Crowne SD scale, developed by Reynolds (1982), was included in the survey to examine the presence,

degree, and effect of social desirability responding (van de Mortel, 2009), a potential source of inaccuracy in self-report.

### **Population and Sample**

The target population in this study was undergraduate nursing students enrolled in the final term of 4-year baccalaureate programs at three universities in Southern Alberta. Although baccalaureate nursing programs in Alberta must all address the mandated Entry to Practice Competencies as defined by the College and Association of Registered Nurses of Alberta (2013), differences exist in the sequencing and specific content of courses, with the exception of the final consolidated practice experience. Therefore, to increase homogeneity, only those students who had completed all but the final course were included. Additionally, inclusion of only those students going into their final practice course provided a closer approximation of the HH knowledge and beliefs with which new graduates would enter the workforce. The entire population of nursing students enrolled in the last semester of each of the programs was eligible for inclusion ( $N = 410$ ) and was invited to participate in the survey. The numbers of nursing students eligible to participate from each university are presented in Table 1.

**Table 1. Student Population by University**

University	Population
A	142
B	141
C	127
Total	410

### **Ethics**

Ethical approval for the study was obtained from the University of Lethbridge Human Subject Research Committee as well as the equivalent boards at each of the participating universities. Permission to survey fourth-year nursing students from each of the universities was sought from the Deans or Associate Deans of the respective faculties following ethical approval as required by each institution.

### **Consent**

All participants were deemed proficient in the English language and competent to provide consent based on their required status as nursing students in the participating universities. Immediately prior to distribution of the survey, potential participants were advised about the nature and purpose of the research; the length of time required to complete the survey; a description of their involvement and rights, including voluntary participation, right to withdraw at any time, and a statement of potential risks and benefits. In addition, a cover letter (see Appendix B) that included all the information normally provided in a consent form was affixed to the front of the questionnaire. Signed consent was not required, but was implied by completion of the survey.

### **Confidentiality**

To maintain anonymity, the names of participants or other personal identifiers were not collected. There was a slight possibility that some individuals could be identified by gender and/or age because of the low numbers of male nursing students and students outside the average age range; therefore, participants were instructed to leave the questions on gender and age blank if they preferred. The names of the universities are not used in the presentation of the results; rather they have been coded A, B, or C.

Completed questionnaires are stored in a locked cabinet, located in my office at the University of Lethbridge, to which only my thesis supervisor and I have access. All data files are kept in password-protected files. Data will be maintained for a period of seven years after completion of the study as per research policy of the participating universities.

### **Data Collection**

Data were collected between January 9 and January 14, 2014, from a volunteer sample of the entire population of students entering their final semester. At each university, the presentation detailing the nature and purpose of the research was delivered during a mandatory orientation session. Following the presentation, students were invited to participate in the survey. No incentives were offered for participation. Students were then provided with a survey and the attached information sheet and were given 20 minutes to complete it. Students were instructed to draw an “X” over the first page of the questionnaire to indicate withdrawal. Questionnaires, including those from participants who chose to withdraw, were collected in a closed box located at the exit to the room.

### **Survey Instrument**

The HH Questionnaire (see Appendix C) developed by van de Mortel (2009), with additional demographic and educational questions (indicated in italics), was used to collect data. The survey was designed to elicit quantitative data about health care students’ HH knowledge, beliefs, and practices as well as the methods and frequency that HH is taught and assessed during undergraduate education (van de Mortel, 2009). Permission to use the questionnaire was received from van de Mortel (personal communication, September 26, 2012).

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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The HH Questionnaire has seven main sections. The first consists of demographic data including age and gender. Two items, discipline and weeks of clinical placement, from van de Mortel's (2009) original HH Questionnaire were not applicable to the current study and were removed. Two additional items, one to identify employment in a health care setting prior to or during nursing education and another to identify the type of employment, were added to the original survey. Students who worked or had worked as paid employees in a health care setting would have participated in mandatory HH training and education and, thus, would have been exposed to HH practice beyond what they received in their nursing program. The remaining sections in the HH questionnaire are reviewed below, under the headings for the dependent and independent variables each section was used to measure. The dependent and independent variables, and the scales within the HHQ used to measure them, are summarized in Table 2.

**Table 2. Variables and Scales**

Dependent Variables	Section	# of Items	Measurement
1. Knowledge	HH Knowledge Questionnaire	12	Multiple Choice
2. Beliefs	HH Beliefs Scale	17	5-Point Likert
3. Practices	HH Practices Inventory	13	5-Point Likert
Independent Variables			
1. Variety of teaching methods	Teaching Methods	12	5-Point Likert
2. Perceived effectiveness of teaching methods	Teaching Methods	12	5-Point Likert
3. Frequency of assessment	Assessment	4	5-Point Likert
4. Perceived Importance given to HH	HH Importance Scale	3	5-Point Likert

### **Dependent Variables**

**Hand hygiene knowledge.** Data on the first dependent variable in the study, knowledge, were collected with the HH knowledge questionnaire. This section of the survey included 12 multiple-choice questions based on the Centers for Disease Control HH guidelines (van de Mortel, 2009). Van de Mortel (2009, p. 11) consulted three infection control experts “to advise on the accuracy and comprehensiveness” of these questions. Six of the multiple choice questions were related to indications for HH, six to correct technique, and two with associated incidence and costs of treating HAI. The questions in the HH knowledge questionnaire were consistent with information provided in the AHS (2011) HH policy and procedure documents, the AHS HH website, and PHAC (2012).

**Hand hygiene beliefs.** Data for the second dependent variable, HH beliefs, were collected through the use of the HH Beliefs Scale. This section consisted of 17 items measured on a 5-point Likert scale with a strongly disagree to strongly agree response continuum. A response of strongly agree indicated a positive belief about HH on the majority of items, but eight of the items are reverse scored. For example, a response of strongly agree to the statement that “performing hand hygiene slows down building immunity to disease” indicated a negative belief about HH.

**Hand hygiene practices.** The 13-item HH Practices Inventory, also measured on a 5-point scale, was used to collect data on the third dependent variable, students’ self-reported HH practices. Possible responses to questions about specific HH indications, such as “I cleanse my hands before entering a patient room”, included never, some of the time, half of the time, mostly always, or always.

### **Independent Variables**

The independent variables, perceived effectiveness and number of methods used for teaching HH, were measured with the teaching section of the Hand Hygiene Questionnaire (HHQ). This section included 12 items asking students to recall the use of strategies and resources to teach HH during the nursing program and to rate their effectiveness on a scale ranging from 1, indicating not effective, to 4 indicating highly effective. A score of 0 was included to indicate that the type of teaching strategy was not used.

Data on the third independent variable, frequency of assessment, were collected from four items, measured on a 5-point Likert-type scale, asking how frequently HH was assessed by written examination, verbal examination, in a simulated clinical setting, and in a clinical setting. Response options were never, once, twice, three times, or four or more times. The last independent variable, importance given to HH, was measured on a 5-point Likert scale with a strongly disagree to strongly agree response continuum named the HH Importance Scale.

### **Validity and Reliability**

Van de Mortel (2009) reported that content validity, a subjective measure of how well an instrument measures what it is meant to measure, readability, accuracy, comprehensiveness, and relevance of the items in the scales, was assessed by a panel of three infection control experts. Validity of the HHQ was described as high (van de Mortel, 2009, p. 9). Two-week test-retest coefficients of 0.85 on the HH Beliefs Scale, 0.79 on the HH Practices Inventory, and 0.89 on the HH Importance Scale were reported (p. 13). Cronbach's alpha values were 0.80, 0.74 and 0.77 for the HH Beliefs Scale, the HH

Practices Inventory, and the HH Importance Scale respectively (p. 13). A second method of checking internal consistency, item-to-total correlations, was also used to check for internal consistency. Mean item-to-total correlations of the HH Beliefs Scale, HH Practices Inventory, and HH Importance Scale were reported as 0.37, 0.33, and 0.61 respectively.

The use of a previously validated and reliable survey tool reduce the time and expense involved in developing, pilot testing, and revising a new tool (Perrin, 2015). The HHQ developed by van de Mortel (2009) was particularly suited to this research because it permitted collection of data on each of the dependent and independent variables. In addition, the questionnaire was developed to survey medical and nursing students. Use of an existing instrument also contributes to assessing the reliability of the tool for future research.

### **Data Entry and Preparation**

Data were entered into the IBM Statistical Package for the Social Sciences (SPSS™) software package version 21. Questionnaires with entire sections that had not been completed or with more than 30% of a section of related questions that had not been answered were not entered for data analysis ( $n = 7$ ). To ensure accuracy of data entry, 20% of cases were checked for data entry errors. Few errors were found, and these were corrected. This process was repeated until no errors were found.

New variables were generated from the raw data for each of the sections in the HHQ. New dummy coded variables were generated for each of the multiple-choice questions in the HHQ, with 0 representing an incorrect answer and 1 representing a correct answer. A new variable, called the knowledge score, was created by adding the correct

answers to all 12 questions. The reverse scored items in the HH Beliefs Scale were recoded, and a new variable, called the beliefs score, was created by adding participants' ratings to each of the 17 items in the scale. A new variable, called the practices score, was similarly created by adding the frequencies participants assigned each of the 13 HH indications in the Practices Inventory.

A new dummy coded variable was created for the number of teaching methods used to teach HH, by recoding responses on the teaching effectiveness scale to 0 if the teaching strategy was not used and 1 if it was used, regardless of the rating of perceived effectiveness. New variables were generated for: the number of teaching methods used, the perceived effectiveness of teaching methods, the HH Importance Scale, and the HH Assessment Scales by adding the scores within each of the scales. All items in the scales were equally measured and weighted.

For each item in the scales, sample mean scores, standard deviation, and the range of means were calculated. The higher the mean on the HH Practices Inventory, the more positive were the student's HH practices. The higher the mean value of the HH Beliefs Scale, the more positive were the student's HH beliefs. A high mean value on the HH Importance Scale indicated that students felt considerable importance was given to HH in the curriculum by their clinical supervisors and in the practice setting.

Descriptive statistics, mean, and standard deviation were used to calculate the overall values for each of the scales. All dependent variable were checked for normality, and mathematical transformations were performed where necessary to achieve a distribution that approximated normality. Relationships among variables were assessed using parametric Pearson  $r$  tests, and nonparametric Kendall's Tau tests when data did not

meet the assumptions required for the parametric test. Alpha was set to 0.05 in the interpretation of statistical significance for each statistical test, and all tests were assumed to be two-tailed.

### **Summary**

The HHQ developed by van de Mortel (2009) was identified as a reliable and validated instrument suitable for collecting data on both the dependent and independent variables in this study. Permission to use the questionnaire was obtained. Two changes were made to the types of demographical information collected, and two additional educational questions were added. Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS™) software package version 21. The results of the data analysis are presented in Chapter 4.

## CHAPTER FOUR: RESULTS

This chapter presents the results of data analyses conducted to answer the following research questions:

1. What level of knowledge about HH do senior nursing students have?
2. To what extent do senior nursing students have positive beliefs about HH?
3. What are the self-reported HH practices of senior nursing students?
4. What methods of HH education do nursing students find most effective?
5. How frequently is HH assessed and what methods are used for assessment?
6. Are there any associations between students' HH knowledge, beliefs, and practice, and the methods and frequency of HH education and assessment?

Data were collected from nursing students entering their final semester at three universities in the province of Alberta, through the use of an HH Questionnaire (see Appendix C) designed to collect data on students' HH knowledge, beliefs, practices, and the methods and frequency HH was taught and assessed (van de Mortel, 2009). Reliability of the scales for this study was assessed using Cronbach's alpha. Cronbach's alpha for the HH Beliefs Scale was 0.74, for the HH Practices Inventory 0.81, for the HH Importance Scale 0.71, and 0.66 for the 11-item Social Desirability Scale. A Cronbach's alpha of 0.70 to 0.80 is generally considered acceptable and values below 0.70 can be suitable for psychological constructs (Field, 2005).

Response rates are presented first, followed by demographic data and descriptive statistics on the independent and dependent variables, the Social Desirability Scale, and the demographic and educational questions added to the HH Questionnaire. The descriptive statistics on each of the dependent variables provide the results of the data analyses

conducted to examine the first three research questions. Results of the data analyses conducted to examine the fourth and fifth research questions are incorporated into the descriptive statistics on the independent variables. The results of the tests applied to examine the last research question, relationships among the variables, follows.

**Response Rates**

A total of 285 participants submitted completed questionnaires. Response rates from the universities ranged from 65% to 74%, with a mean of 69%. The distribution of respondents by university is presented in Table 3.

**Table 3. *Distribution of Respondents by University***

University	<i>N</i>	<i>n</i> (Response rate)
A	142	98 (69%)
B	127	82 (65%)
C	141	105 (74%)
Total	410	285 (69%)

Based on the population size of 410 and assuming a 5% margin of error, a 95% confidence interval, and a 50% response distribution, the recommended sample size (Raosoft, 2004) from all three universities was 199. The number of participants was 285, resulting in a lower margin of error (3.21%).

**Demographic Variables**

Descriptive statistics were calculated for the demographic variables for the total sample and for each university. Comparisons among the universities were conducted using chi-square, for nominal variables, and Kruskal-Wallis, for continuous variables. The mean age of all participants was 23.25 years ( $SD = 3.74$ ), with ages ranging from 20 to 42 years. Most respondents (90.2%) were female, 9.1% male, and there were 2 missing values.

The mean age of participants was significantly lower at university C than at the other universities, chi-square (2,  $n = 277$ ) = 42.26,  $p < .001$ . There were no significant differences in gender distribution among universities, chi-square (2,  $n = 283$ ) = 1.52,  $p = .469$ . Demographic characteristics for each university are presented in Table 4.

**Table 4. Comparison of Demographic Variables Among Universities**

University	Age			Gender	
	<i>M</i>	<i>SD</i>	<i>R</i>	Female	Male
A	23.88	4.13	20-42	88	9
B	24.03	4.12	21-42	76	5
C	22.07	2.63	20-37	93	12

**Dependent Variables**

Descriptive statistics, mean, standard deviation, and range were calculated on each of the three dependent variables (a) nursing students’ knowledge of recommended HH practices, (b) students’ beliefs about the importance of HH, and (c) students’ self-reported HH practices providing the results of the data analyses conducted to examine the first three research questions (RQ 1-3). Results are given for the total sample and for each university.

Comparisons among the universities were conducted using Kruskal-Wallis tests. Cases with missing values were not included in the analyses.

**RQ 1: What Level of Knowledge about HH do Senior Nursing Students Have?**

The HH knowledge questionnaire comprised 12 multiple-choice questions. Scores on the questionnaire are presented as a percent of correct answers. The combined scores on the 12 questions ranged from 33% to 100% with a mean of 72.46% ( $SD = 12.10$ ). The percent of correct scores for each question on the knowledge questionnaire is shown in Table 5.

**Table 5. Percent of Correct Answers to Knowledge Questions**

Correct Response	Percent correct ( $N = 284$ )
1. Alcohol-based hand rubs should not be used when hands are visibly soiled.	81.8%
2. Alcohol-based hand rubs can be effective if applied for less than 60 seconds.	44.2%
3. Hand hygiene is required following the removal of gloves.	92.6%
4. Single-use cloth towels and paper towels are acceptable for drying hands in patient care areas.	81.8%
5. Hand hygiene must be performed before patient contact, following emptying of a drainage reservoir, and prior to and following venipuncture.	97.5%
6. When using an alcohol-based hand rub to decontaminate hands, they should be rubbed together until dry.	72.6%
7. Performing hand hygiene after handling paper is not one of the recommended indications.	87.0%
8. Hand hygiene is required following contact with the bed linen of a patient with MRSA.	79.3%
9. Hand creams and lotions are recommended for health care workers' hands.	43.9%
10. Gloves should not be reused when caring for different patients.	94.7%
11. The average cost of a hospital-acquired infection in developed countries is approximately \$10,000 US.	28.8%
12. Approximately 30% of Intensive Care patients develop hospital-acquired infections in developed countries.	53.7%

There was no significant difference in the distribution of knowledge scores among universities, chi-square (2,  $n = 272$ ) = .309,  $p = .857$ . The distribution of knowledge scores by university is presented in Table 6.

**Table 6. Distribution of Knowledge Scores by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	95	3	71.67%	12.89	33.33%	100.00%
B	76	6	73.25%	12.72	50.00%	100.00%
C	101	4	72.61%	10.89	50.00%	91.67%

**RQ 2: To What Extent do Senior Nursing Students Have Positive Beliefs about HH?**

Data for the second dependent variable were collected through the use of the HH Beliefs Scale, consisting of 17 items measured on a 5-point Likert scale, with a strongly disagree to strongly agree response continuum. The mean score on the HH Beliefs Scale was 64.27 ( $SD = 6.76$ ), with scores ranging from 47 to 81 out of a possible high score of 85; the higher the score the more positive the beliefs. Scores on individual items in the scale ranged from 1 to 5. Mean scores on each of the scale items are shown in Table 7.

**Table 7. Mean Scores on Statements in the HH Beliefs Scale**

Statement	<i>M (SD)</i>
I have a duty to act as a role model for other health care workers.	4.40 (0.58)
When busy it is more important to complete my tasks than to perform hand hygiene. *	3.77 (0.97)
Performing hand hygiene in the recommended situations can reduce patient mortality.	4.53 (0.57)
Performing hand hygiene in the recommended situations can reduce medical costs associated with hospital-acquired infections.	4.58 (0.76)
I can't always perform hand hygiene in recommended situations because my patient's needs come first. *	3.11 (1.11)
Prevention of hospital-acquired infection is a valuable part of a health care worker's role.	4.59 (0.54)
I follow the example of senior health care workers when deciding whether or not to perform hand hygiene. *	3.6 (1.08)
An infectious disease contracted in the health care setting may threaten my life or my career.	4.22 (0.76)
I believe I have the power to change poor practices in the workplace.	3.92 (0.88)
Failure to perform hand hygiene in the recommended situations can be considered negligence.	4.17 (0.75)
Hand hygiene is a habit for me in my personal life.	4.35 (0.65)
I am confident I can effectively apply my knowledge of hand hygiene to my clinical practice.	4.44 (0.58)
It is an effort to remember to perform hand hygiene in the recommended situations.*	2.71( 1.32)
I would feel uncomfortable reminding a health professional to perform hand hygiene. *	2.49 (1.01)
Performing hand hygiene slows down building immunity to disease.*	3.43 (1.11)
Dirty sinks can be a reason for not washing hands.*	3.16 (1.12)
Lack of an acceptable soap product can be a reason for not cleansing hands. *	2.82 (1.20)

*Note.* \* indicates the item was reverse scored. Mean scores are out of a possible score of 5.

There was no significant difference in the distribution of beliefs among universities, chi-square (2,  $n = 281$ ) = .3.776,  $p = .151$ . The distribution of scores on the HH Beliefs Scale by university is presented in Table 8.

**Table 8. Distribution of Beliefs Scores by University**

University	N		M	SD	Minimum	Maximum
	Valid	Missing				
A	97	1	63.46	7.51	47.00	81.00
B	81	1	65.60	6.71	51.00	81.00
C	103	2	63.97	5.90	48.00	80.00

**RQ 3: What are the Self-Reported HH Practices of Senior Nursing Students?**

Data on the third dependent variable, participants’ self-reported HH practices, were collected through the use of the HH Practices Inventory. Participants were asked to indicate the frequency they performed HH on 13 specific indications contained in the inventory. Possible responses to each indication ranged from 1, specifying never, to 5, specifying always. The frequency that participants reported performing HH is presented in percentages. The mean on the HH Practices Inventory was 93% ( $SD = 6.19$ ), with scores ranging from 66% to 100%; 100% signified HH was always performed on every indication. Scores for each indication in the HH Practices Inventory are shown in Table 9.

**Table 9. Self-Reported HH Practices**

Statement: I clean my hands:	<i>M (SD)</i>
After going to the toilet	97.6% (0.44)
Before caring for a wound	97.8% (0.36)
After caring for a wound	98.6% (0.30)
After touching potentially contaminated objects	94.2% (0.53)
After contact with blood or body fluids	99.6% (0.19)
After inserting an invasive device	99.0% (0.22)
Before entering a room	80.9% (0.88)
After contact with a patient's skin	87.2% (0.79)
After exiting a room	85.9% (0.77)
After contact with a patient's secretions	99.4% (0.17)
Before patient contact	85.0% (0.81)
After removing gloves	90.4% (0.70)
If they look or feel dirty	98.4% (0.32)

*Note.* Cases with missing values were not included in the calculation of the scores.

The distribution of self-reported HH practices was significantly lower for university A than for universities B and C, chi-square (2,  $n = 284$ ) = 30.53,  $p < .001$ . Self-reported HH practices by university are shown in Table 10.

**Table 10. Distribution of Self-Reported HH Practices by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	98	0	90.77%	6.16	75.38%	100%
B	81	1	94.77%	5.53	78.46%	100%
C	105	0	94.71%	5.99	66.15%	100%

### Independent Variables

Descriptive statistics were calculated on each of the four independent variables, which included: (a) students' recall of the number of methods used to deliver HH education; (b) nursing students' perception of the effectiveness of methods used to deliver HH education; (c) students' recall of the frequency that HH is assessed during their education; and (d) students' perceptions of the importance given to HH in the curriculum, by clinical nursing instructors, and by the facilities in which they had completed clinical rotations. The descriptive statistics for the independent variables, frequency of assessment, and effectiveness of teaching methods provided the results of the data analyses conducted to examine the fourth and fifth research questions. Results are provided for the total sample and for each university. Comparisons among the universities were conducted using Kruskal-Wallis tests. Cases with missing values were not included in the analyses.

### Number of Teaching Methods

Data on the number of methods used to teach HH were collected on the teaching section of the HHQ. The teaching section included 12 methods commonly used to teach HH. Participants were asked to rate the effectiveness of each method or to indicate if they

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

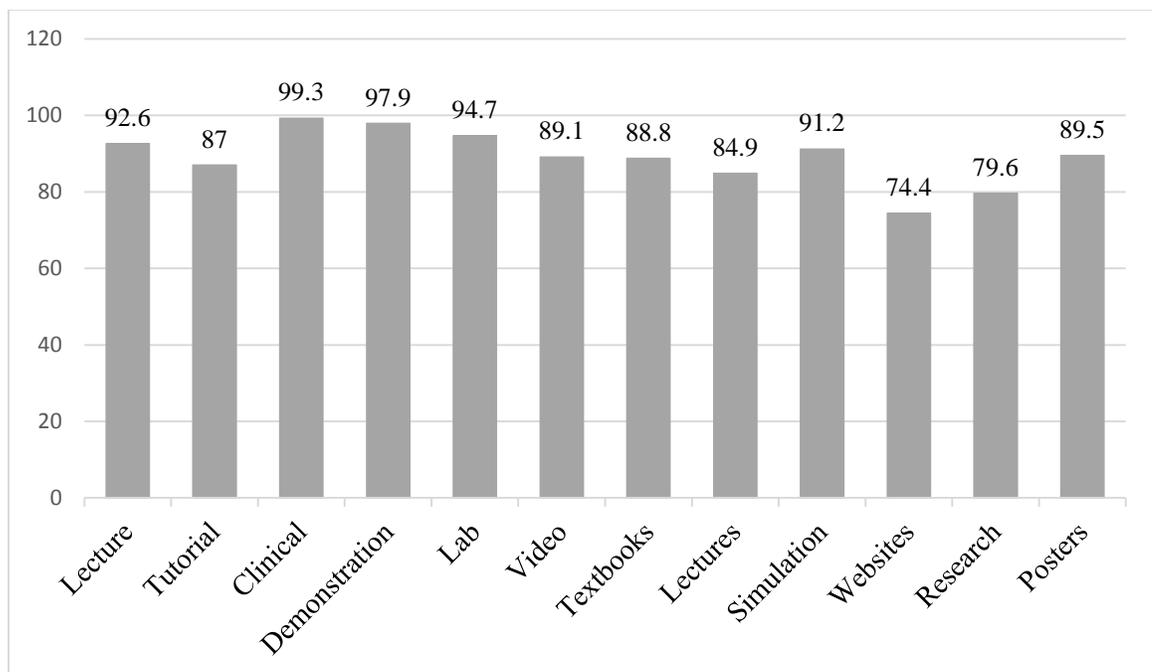
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did not recall use of the method. The mean number of methods participants recalled being used was 10.73 ( $SD = 2.06$ ). The minimum number used was 1 and the maximum 12.

Almost all participants (99.3%) recalled being taught HH during clinical rotations.

Websites were the least frequently used resource, with only 74.4% of participants recalling their use. The percentages of participants reporting the use of each method are presented in

Figure 2.



**Figure 2. Percentage of participants taught hand hygiene by method ( $N = 275$ ).**

The number of methods used to deliver HH education was significantly lower at university C than at universities A and B, chi-square ( $2, n = 275$ ) = 15.31,  $p < .001$ . The mean number of methods used at each university is shown in Table 11.

**Table 11. Number of Teaching Methods Used by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	97	1	10.96	1.99	4	12
B	78	5	11.16	1.56	6	12
C	101	4	10.18	2.32	1	11

*Note.* Mean scores are out of a total possible score of 12.

**RQ 4: What Methods of HH Education do Nursing Students Find Most Effective?**

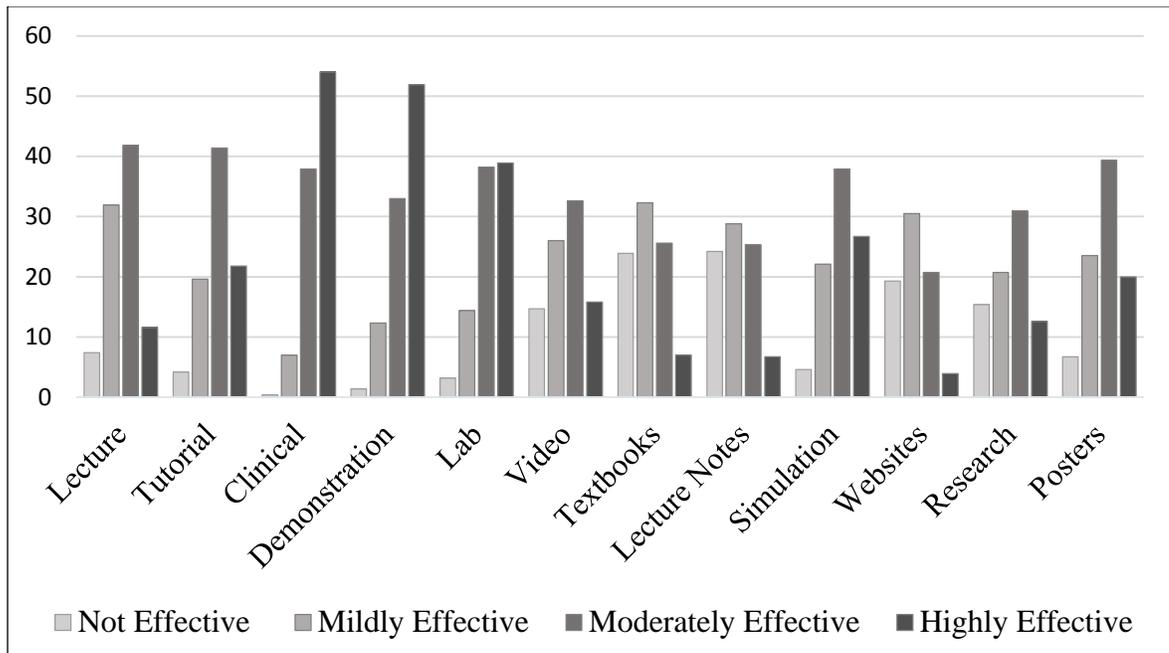
Participants were asked to rate the effectiveness of each of the 12 teaching methods on a scale ranging from 1, indicating not effective, to 4, indicating highly effective. Cases where a score of 0 had been given for a method, indicating that method had not been used, were not included in the analysis of the effectiveness for that method. The mean scores for each of the teaching methods are shown in Table 12. Teaching methods that participants rated as the most effective were clinical and demonstration, with mean scores of 3.47 and 3.32 respectively, out of a possible score of four.

More than half the participants rated clinical and demonstrations as highly effective. The majority rated laboratory, lecture, tutorials, videos, and simulations as moderately effective. The lowest-rated methods included websites, lecture notes, and textbooks, with more than half of the participants rating each as mildly effective and not effective. The percentages of responses to each of the methods in the scale are shown in Figure 3.

**Table 12. Perceived Effectiveness of Teaching Methods**

Teaching Method	<i>M (SD)</i>
Lecture	2.45 (1.01)
Tutorial	2.56 (1.23)
Clinical	3.47 (0.64)
Demonstration	3.32 (0.85)
Lab	3.02 (1.07)
Video	2.29 (1.20)
Textbooks	1.95 (1.10)
Lecture notes	1.85 (1.16)
Simulation	2.69 (1.17)
Websites	1.58 (1.19)
Research	2.00 (1.34)
Posters	2.52 (1.18)

*Note.* Mean scores are out of a total possible score of 4.



**Figure 3. Effectiveness of teaching methods.**

The mean on the combined scores on teaching effectiveness was 29.67 ( $SD = 8.03$ ) out of a possible high score of 48. A score of 48 signified all methods were rated as highly effective. There was no significant difference among student ratings of the combined scores on all teaching methods at the three schools, chi-square ( $2, n = 276$ ) = 5.431,  $p = .066$ . Overall scores on teaching effectiveness for each university are shown in Table 13.

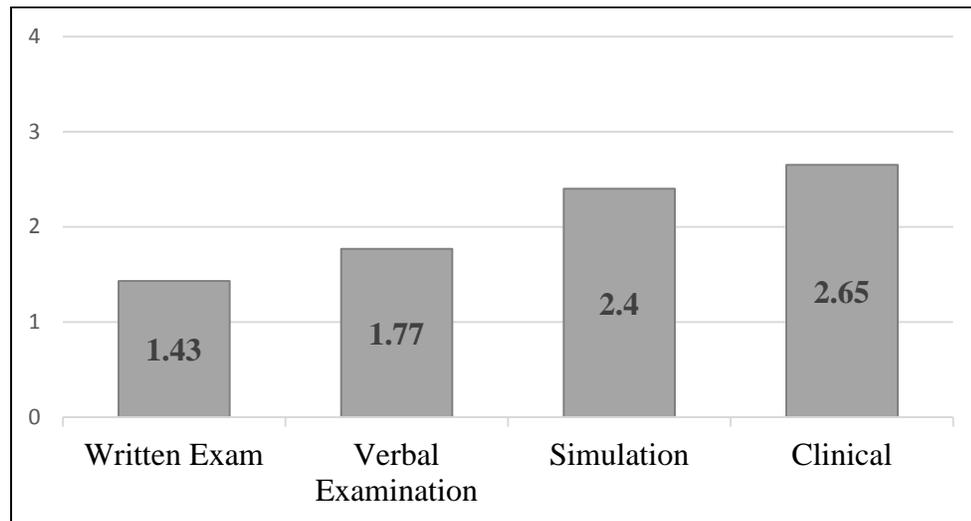
**Table 13. Distribution of Teaching Effectiveness Scores by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	97	1	30.45	8.29	10	48
B	77	5	30.78	6.94	14	48
C	101	4	28.09	8.38	3	45

**RQ 5: How Frequently is HH Assessed and What Methods Are Used for Assessment?**

Data on HH assessment were collected on four items, measured on a 5-point scale, asking how frequently HH was assessed by written examination, verbal examination, in a simulated clinical setting, and in a clinical setting. Response options ranged from never to four or more times; as a result, mean scores on HH assessment do not reflect the absolute number of times HH was assessed. The overall mean that HH was assessed during participants' education was 8.26 ( $SD = 4.36$ ) and ranged from 0 to 16 times. Of the 285 respondents, 34.0% (97) did not recall being assessed by written exam, 23.2% (66) by verbal questioning, 12.6 % (36) did not recall ever being assessed in the clinical setting,

and 7.0% (20) of participants did not recall being assessed in a simulation. The frequency of assessment for each method is shown in Figure 4.



**Figure 4. Frequency of assessment out of a possible score of 4.**

The overall frequency of HH assessment was significantly higher for university B than universities A and C, chi-square (2,  $n = 285$ ) = 13.59,  $p = .001$ . The frequency of assessment by university is shown in Table 14.

**Table 14. Frequency of Assessment by University**

University	N		M	SD	Minimum	Maximum
	Valid	Missing				
A	98	0	8.20	4.19	1	16
B	82	0	9.68	4.91	1	16
C	105	0	7.22	4.13	0	16

*Note.* Mean scores are out of a total possible score of 16.

**Importance Given to Hand Hygiene**

Data for the last independent variable were collected on the HH Importance Scale, measured on a 5–point Likert scale, with a strongly disagree to strongly agree response continuum. Participants were asked to rate the importance given to HH in the curriculum, in the facilities where they completed clinical practice, and by clinical instructors. The mean score on the HH Importance Scale was 12.20 ( $SD = 2.10$ ) and ranged from 6 to 15. Mean scores on each of the scale items are shown in Table 15.

**Table 15. Importance Given to Hand Hygiene by Statement**

		HH is an Important Part of Curriculum	Facilities Emphasize HH	Clinical Instructors Emphasize HH
<i>N</i>	Valid	285	285	285
	Missing	0	0	0
Mean		4.21	3.96	4.04
<i>SD</i>		0.84	0.91	0.89
Range		1-5	1-5	1-5

*Note.* Mean scores are out of a total possible score of 5.

There were no significant differences among universities on the perceived importance given to HH during nursing education, chi-square (2,  $n = 285$ ) = .363,  $p = .834$ . Scores on the HH Importance Scale for each university are shown in Table 16.

**Table 16. Hand Hygiene Importance Scale by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	98	0	12.10	2.17	6	15
B	82	0	12.13	2.21	6	15
C	105	0	12.34	1.96	6	15

*Note.* Mean scores are out of a total possible score of 15.

**Social Desirability Responding**

Data on social desirability responding were collected on the 11-item short form of the Marlowe-Crowne Social Desirability Scale, developed by Reynolds (1982). The mean score on the scale was 6.45 (*SD* = 2.42) and scores ranged from 0 to 11. A total of 11 (3.9%) participants had scores of 11 (1.88 standard deviations above the mean), and 13 (4.6%) participants had scores of 10 (1.47 standard deviations of the mean). Scores on the Social Desirability Scale were significantly lower for university A than for universities B and C, chi-square (2, *n* = 274) = 9.723, *p* = .008. Scores on the Social Desirability Scale, by university, are presented in Table 17.

**Table 17. Social Desirability Responding by University**

University	<i>N</i>		<i>M</i>	<i>SD</i>	Minimum	Maximum
	Valid	Missing				
A	97	1	5.77	2.46	0	10
B	79	3	6.73	2.42	1	11
C	98	7	6.89	2.25	1	11

**Employment in Health Care**

Two additional questions were included in the HHQ: one asking respondents to indicate if they had worked as a paid employee in health care, the other to specify the type of position held. Within the province of Alberta, nursing students enrolled in an approved educational program, and who have completed 450 hours of clinical practice, are eligible for employment as an Undergraduate Nurse Employee (AHS, 2015). Students who worked in a health care setting likely would have, depending on the type of employment, participated in HH education as a condition of employment and, thus, been exposed to training beyond that received in their nursing program. Overall, 61.8% of respondents indicated they had worked as a paid employee in health care; of those, 2.9% did not indicate the type of employment, 47.7% indicated they had worked as an undergraduate nurse, and 22.7% as a nursing assistant. The remaining 26.7% worked in a variety of other positions not directly involved in patient care, such as clerical work, and were grouped together under “other”. There were no significant differences among the universities with regard to the number of participants who worked in health care, chi-square (2,  $n = 284$ ) = 4.45,  $p = .108$ . The frequency of employment in health care by university is shown in Table 18.

**Table 18. *Employment in Health Care by University***

University	<i>N</i>		Frequency	
	Valid	Missing	Yes	No
A	97	1	33	64
B	82	0	39	43
C	105	0	37	68

**Infection Control Projects**

The third question added to the survey asked participants to indicate if they had worked on an individual or group project related to infection control or HH during the nursing program. The question was added to examine if there were any relationships between additional work on infection control projects and the dependent variables. Close to half (48.4%) of participants indicated they had worked on such a project. There were no significant differences among universities on the numbers of participants who worked on projects, chi-square (4, 282) = 2.250,  $p = .690$ . The frequency of participation on an infection control project, by university, is shown in Table 19.

**Table 19. Participation on Infection Control Project by University**

University	N		Frequency	
	Valid	Missing	Yes	No
A	97	1	46.9%	52.0%
B	81	1	48.8%	50.0%
C	104	1	48.6%	50.5%

**RQ 6: Are There Any Associations between Students’ HH Knowledge, Beliefs, and Practice and the Methods and Frequency of HH Education and Assessment?**

Analysis to assess the degree of relationships between variables was conducted using multiple regression. Multiple regression was performed for each of the dependent variables to examine associations among participants’ HH knowledge, beliefs, and practice, and the methods and frequency of HH education and assessment. All dependent variables

were checked for normality, and mathematical transformations were performed, where necessary, to achieve a distribution that approximated normality. Specific transformations are discussed in this section, with the analyses in which they were performed. Analyses were conducted excluding all cases with missing values on any of the variables in the analyses and repeated with missing values imputed with the series mean; statistical significance was unchanged. Results of analyses are presented with missing values replaced with the series mean.

Pearson *r* correlations were conducted to examine relationships between employment in health care and the dependent variables—nursing students’ HH knowledge, beliefs, and practices. There were no significant associations between being employed in health care and: knowledge,  $r = .024, p = .692$ ; beliefs,  $r = .078, p = .194$ ; or practices,  $r = .025, p = .681$ .

Although the mean scores on knowledge, beliefs, and practices were higher for participants who worked in undergraduate nurse positions, as compared to those who worked as nursing assistants, or in “other” positions, as shown in Table 20, the differences were not statistically significant. That is, there were no significant differences between the types of employment and the distribution of: knowledge scores, chi-square (3,  $n = 267$ ) = 7.64,  $p = .054$ ; beliefs, chi-square (3,  $n = 276$ ) = 5.41,  $p = .144$ , and practices, chi-square (3,  $n = 279$ ) = 1.40,  $p = .705$ . Given the lack of statistically significant differences between the types of employment and the lack of associations between employment in health care with any of the dependent variables, employment in health care was not included in further

analyses. The distribution of knowledge, beliefs, and practice scores by type of employment in health care is shown in Table 20.

**Table 20. Distribution of Knowledge, Beliefs, and Practice Scores by Type of Employment in Health Care**

	Knowledge		Beliefs		Practices	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Undergraduate Nurse	74.6%	11.26	65.27	6.43	93.9%	5.83
Nursing Assistant	72.9%	11.85	64.51	6.62	92.9%	7.69
Other	68.2%	12.35	63.40	6.58	92.8%	6.58
Not employed	72.2%	12.16	63.58	6.75	93.2%	5.78

Pearson *r* correlations were conducted to examine relationships between infection control projects and each of the dependent variables. There were no significant associations between projects and: knowledge,  $r = .023, p = .707$ ; beliefs,  $r = .063, p = .292$ ; or practices,  $r = .083, p = .167$ . Again, given the lack of association with the dependent variables, work on infection control related projects was not included in further analyses.

Pearson *r* correlations were also conducted to examine the relationships between scores on the Social Desirability Scale, the HH Beliefs Scale, and the HH Practices Inventory. A significant positive correlation between the social desirability and HH beliefs scales was obtained,  $r = .107, p = .014$  (two-tailed) indicating a very small association. A significant positive correlation between the Social Desirability Scale and participants' self-reported HH practice,  $r = .168, p < .001$  (two-tailed), was also obtained. Although both correlations were significant, the strength of the associations was small, accounting for

only 1% of the variance of beliefs and less than 3% of the variance of HH practices.

However, Pearson  $r$  correlations were rerun excluding those cases with scores greater than 9 ( $n = 24$ ) on the Social Desirability Scale; scores on the Social Desirability scale were no longer correlated with the HH Beliefs Scale,  $r = .060$ ,  $p = .236$ , nor with the HH Practices Inventory,  $r = .099$ ,  $p = .054$ . To reduce the possibility that results were biased due to socially desirable responses, cases with scores greater than 9 on the Social Desirability Scale were not included in analyses on the dependent variables.

### **Multiple Regression Analyses: Knowledge**

An SPSS multiple regression was performed, with knowledge as the dependent variable and teaching effectiveness, number of teaching methods, frequency of assessment, and the HH Importance Scale as the independent variables. Entry of the independent variables was simultaneous. No univariate or multivariate outliers were observed. Missing values were imputed with the series means, leaving a total of 285 cases available for analysis.

None of the variables made a significant contribution to the prediction of knowledge,  $F(4,280) = .828$ ,  $p = .508$ . The unstandardized regression coefficients ( $B$ ); the standardized regression coefficients ( $\beta$ ), the semi-partial correlations ( $sr_i^2$ ), and adjusted  $R^2$  are displayed in Table 21.

**Table 21. Regression Coefficients and Squared Semi-Partial Correlations**

	Regression Coefficients ( <i>B</i> )	Standardized Regression coefficients ( $\beta$ )	Squared Semi-Partial Correlations ( $sr_i^2$ )
Teaching Effectiveness	-.145	.097	-.0040
# of teaching methods	-.014	-.002	-.0000
Assessment	-.080	-.030	-.0006
HH Importance Scale	.116	.021	.0003
CONSTANT	76.18		

$R = .108$ ; adjusted  $R^2 = -.002$ ; \*\*  $p < .001$ ; \*  $p < .05$

**Multiple Regression Analyses: Beliefs**

An SPSS multiple regression was performed with beliefs as the dependent variable and teaching effectiveness, number of teaching methods, frequency of assessment, the HH Importance Scale, and knowledge as the independent variables. Entry of the independent variables was simultaneous. Missing values on the independent variables were imputed with the series means. Twenty-four cases with social desirability scores greater than 9 were deleted, leaving a total of 250 cases available for analysis. No univariate or multivariate outliers were observed.

The unstandardized regression coefficients (*B*), the standardized regression coefficients ( $\beta$ ), the semi-partial correlations ( $sr_i^2$ ), and adjusted  $R^2$  are displayed in Table 22.  $R$  was significantly different from zero,  $F(5,244) = 3.84$ ,  $p = .002$ . Two variables contributed significantly to the prediction of HH beliefs: (a) teaching effectiveness ( $sr_i^2 =$

.08), and (b) the number of teaching methods used to deliver HH education ( $sr_i^2 = .03$ ). Altogether, 5.4% of the variability in beliefs was predicted by knowing the scores on all independent variables.

**Table 22. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with Beliefs**

	Regression Coefficients ( <i>B</i> )	Standardized Regression coefficients ( $\beta$ )	Squared Semi-Partial Correlations ( $sr_i^2$ )
Teaching Effectiveness	.187*	.212	.022
# of teaching methods	-.577*	-.172	.014
Assessment	.150	.097	.007
HH Importance Scale	.321	.100	.008
Knowledge	.059	.104	.011
CONSTANT	55.33**		

$R = .270^{**}$ ; adjusted  $R^2 = .054$ ;  $** p < .001$ ;  $* p < .05$

An SPSS multiple regression was performed with the HH Importance Scale as the dependent variable, and frequency of assessment, number of teaching methods, and teaching effectiveness entered as the independent variables. Entry of the independent variables was simultaneous. Twenty-four cases with social desirability scores greater than 9 were deleted. Missing values were imputed with the series means, leaving a total of 250 cases available for analysis. The negative skew of the dependent variable was corrected

with reflect and inverse transformation. No univariate or multivariate outliers were observed.

The unstandardized regression coefficients ( $B$ ), the standardized regression coefficients ( $\beta$ ), the semi-partial correlations ( $sr_i^2$ ), and adjusted  $R^2$  are displayed in Table 22.  $R$  was significantly different from zero,  $F(3,246) = 30.64, p < .001$ . Three variables contributed significantly to the prediction of the perceived importance given to HH: (a) teaching effectiveness ( $sr_i^2 = .04$ ), (b) the number of teaching methods ( $sr_i^2 = .04$ ), and (c) frequency of assessment ( $sr_i^2 = .19$ ). Altogether, 26.3% of the variability in HH Importance Scale was predicted by knowing the scores on all independent variables.

**Table 23. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with HH Importance Scale**

	Regression Coefficients ( $B$ )	Standardized Regression coefficients ( $\beta$ )	Squared Semi-Partial Correlations ( $sr_i^2$ )
Teaching Effectiveness	.001**	.281	.040
# of teaching methods	-.005**	-.284	.042
Assessment	.004**	.465	.189
CONSTANT	.120**		

$R = .522^{**}$ ; adjusted  $R^2 = .263$ ;  $** p < .001$ ;

### Multiple Regression Analyses: Practices

An SPSS multiple regression was performed with practices as the dependent variable and teaching effectiveness, number of teaching methods, frequency of assessment, knowledge, beliefs, and the HH Importance Scale as the independent variables. Entry of the

independent variables was simultaneous. Twenty-four cases with social desirability scores greater than 9 were deleted. Missing values were imputed with the series means on the independent variables, leaving a total of 261 cases available for analysis. The negative skew of the dependent variable was corrected with reflect and inverse transformation. No univariate or multivariate outliers were observed.

The unstandardized regression coefficients ( $B$ ); the standardized regression coefficients ( $\beta$ ); the semi-partial correlations ( $sr_i^2$ ); and adjusted  $R^2$  are displayed in Table 23.  $R$  was significantly different from zero,  $F(6,254) = 9.33, p < .001$ . Two variables contributed significantly to the prediction of HH practices: beliefs ( $sr_i^2 = .12$ ), and the importance given to HH ( $sr_i^2 = .02$ ). Altogether, 16% of the variability in practices was predicted by knowing the scores on all the independent variables.

**Table 24. Regression Coefficients and Squared Semi-Partial Correlations of the Predictors with Practices**

	Regression Coefficients ( $B$ )	Standardized Regression coefficients ( $\beta$ )	Squared Semi-Partial Correlations ( $sr_i^2$ )
Teaching Effectiveness	.032	.041	.0008
# of teaching methods	-.077	-.025	.0003
Assessment	.016	-.012	.0001
HH Importance Scale	.501*	0.171	.0210
Knowledge	.040	-0.076	.0056
Beliefs	.325**	0.352	.1162
CONSTANT	69.06**		

$R = .43^{**}$ ; adjusted  $R^2 = .16$ ;  $** p < .001$ ;  $* p < .05$

### **Summary**

In this chapter, the results of the analysis of nursing students' HH knowledge, beliefs, and practices, and the methods and frequency that HH was taught and assessed during nursing education was presented. The results of analysis conducted to examine relationships among variables were also provided. Discussion of the results of the data analysis, conclusions drawn from the findings, limitations of the research, implications for nursing education, and recommendations for future research are presented in Chapter 5.

## CHAPTER FIVE: DISCUSSION

I begin this chapter with a summary of the research questions, purpose, and design. Interpretation and discussion of the results of the data analysis in relation to the research questions and previous research are presented, followed by the limitations of the research and recommendations for future research and nursing education.

Nursing students must be prepared to demonstrate professional accountability and safe practice (College and Association of Registered Nurses of Alberta, 2013). HH is a core skill, and as the leading measure in the prevention of HAI, a key component of patient safety that has enormous impact on the morbidity and mortality of clients in all health care settings (PHAC, 2012). Nursing students are also actively engaged in direct patient care in their clinical practice rotations and, thus, have an important role in infection control during their education. In addition, habits developed by nursing students during their clinical rotations will affect their future practice (Nicol et al., 2009). Therefore, it is of utmost importance that nursing students recognize the importance of HH in the prevention of HIAs, know when and how HH should be performed, and follow recommended practice. While extensive research has gone into investigating the HH knowledge, beliefs, and practices of HCPs (WHO, 2009a), there has been limited research on nursing students' HH practices and no studies conducted in Canada. The results of studies conducted in other countries suggest a lack of emphasis on HH in undergraduate nursing curricula.

The purpose of this research was to investigate the HH knowledge, beliefs, and practices of nursing students and the methods and frequency used to teach and assess HH during baccalaureate nursing education, with the goal of providing information useful for undergraduate nursing curriculum development in the area of HH. Using the theory of

planned behaviour (Ajzen, 1991) as a theoretical framework, the study was designed to answer the following research questions:

1. What level of knowledge about HH do senior nursing students have?
2. To what extent do senior nursing students have positive beliefs about HH?
3. What are the self-reported HH practices of senior nursing students?
4. What methods of HH education do nursing students find most effective?
5. How frequently is HH assessed and what methods are used for assessment?
6. Are there any associations between students' HH knowledge, beliefs, and practice, and the methods and frequency of HH education and assessment?

### **Research Findings**

The research was conducted within a cross-sectional design using the HH Questionnaire developed by van de Mortel (2009). A total of 285 respondents submitted completed questionnaires, giving a response rate of 69%. Interpretation and discussion of the results of the data analysis in relation to the research questions follows.

#### **What Level of Knowledge about HH do Senior Nursing Students Have?**

The mean score, 72.5%, on the knowledge questionnaire was within what is typically graded as a C at universities in Alberta (University of Lethbridge, 2015), which is generally considered a satisfactory grade with “basic understanding of the subject matter” (University of Calgary, 2015, Figure 2, Line C). However, given the frequency that HH is required (indeed, there is no other single task performed more often), the relative simplicity of the requisite knowledge, and the importance of HH in the prevention of HAI, it is questionable if a “basic understanding” is satisfactory, particularly given the context of identified knowledge deficits.

While the vast majority of participants correctly answered questions related to glove use and to the indications for HH, demonstrating excellent knowledge of when HH should be performed, more than one in five incorrectly answered that HH is not required following contact with bed linen of a patient with MRSA. The growing spread of multidrug resistant organisms, and the diminishing means of treating them, makes this finding worrisome, as it suggests nursing students could unknowingly be spreading these dangerous microorganisms.

In addition, participants did not score well on questions related to the use of ABHR or HH technique. Misconceptions about the use of ABHR, resulting in a reluctance to use it, undermines its promotion as the primary method of performing HH (WHO, 2009b). Less than half the participants correctly answered that ABHR is still effective if applied for less than 60 seconds. One of the reasons for promoting ABHR is to reduce the amount of time required to perform HH (WHO, 2009b), with lack of time being a frequently cited barrier to adherence to recommended practice. Hand washing requires at least one to two minutes, while ABHR can be effectively applied in less than 30 seconds (Trampuz & Widmer, 2004). Additional reasons for the promotion of ABHR are that it is associated with better condition of the skin, and it is more effective than hand washing, unless the hands are visibly soiled (WHO, 2009b). Close to half the participants did not know ABHR is more effective than soap and water in reducing bacterial counts on hands, and almost a fifth were not aware that ABHR should not be used when hands are visibly soiled.

Mean scores on the question related to skin care were also low. Less than half of participants knew that the use of hand creams and lotions is a recommended component of HH, close to a third failed to identify that washing hands with hot water is not correct

practice, and 22.8% responded that ABHRs cause more skin irritation and dryness than hand washing. Dry hands and skin irritation are common among HCPs and comprise another frequently reported barrier to HH (WHO, 2009b). ABHRs have been demonstrated as less irritating than hand washing, particularly with hot water, and the regular use of lotions and creams is recommended to prevent the drying effects of frequent HH (WHO, 2009b). Unfortunately, many HCPs prefer hand washing over the use of ABHR (Forrester, Bryce, & Mediaa, 2010). Lee (2013, p. 99) reported student nurses also have a preference for hand washing over ABHR, noting their statement that ABHR “doesn’t feel clean.” However, Trampuz and Widmer (2004) contend that once HCPs become familiar with ABHR, they prefer that method over hand washing. Additional education to ensure nursing students know the advantages of ABHR is needed to encourage them to use ABHR. Although many participants incorrectly answered the questions related to the incidence of HAI, and the cost associated with treating them, the majority overestimated both, demonstrating a recognition that HAI are a common and costly complication.

Compared to previous research assessing nursing students’ HH knowledge, participants in this study scored either marginally lower or higher. Waltman, Schenk, Martin, and Walker (2011, p. 220) reported a “strong knowledge base of hand hygiene principles” for 75 junior level nursing students in the United States. Students in that study had received additional HH education and training sessions and had participated in observations of HCPs’ HH practices. Similar to the current study, participants scored lower on questions related to the effectiveness of ABHR, and many also believed ABHR cause excessive skin irritation and dryness. Nasirudeen et al. (2012, p. e242) reported good levels of knowledge among final-year nursing students in Singapore. The reported average score

on a multiple-choice quiz used to assess knowledge was 75%, slightly better than in this study. The number and types of questions were not described in the report, thus it was not possible to make comparisons of participants' knowledge in specific areas such as indications or technique for HH. With a translated version of the same questionnaire used in the current study, van de Mortel et al. (2010) reported marginally better scores on the knowledge questions for final-year nursing students from the University of Athens. Scores on each of the questions were not included in the report; so again, it was not possible to make further comparisons with this study.

However, van de Mortel et al. (2011) included a breakdown of the scores on individual knowledge questions in another study using the same questionnaire to survey nursing and medical students, this time from a large university in Rome. The mean scores on the knowledge questionnaire for both second- and third-year nursing students was 5.25/12, with only 22.4% of nursing students scoring above 50%, considerably lower than the findings of both her 2010 study and the current one. Similar to this study, scores on questions related to the use of ABHR and to skin care were the lowest. It is important to note that unlike this study, van de Mortel et al. included both second- and third-year students from a 3-year nursing program. The authors reported that HH knowledge scores improved the longer students had been in the program. Similarly, Kennedy and Burnett (2011) found that third-year nursing students had more knowledge than second-year students. Kelčíkova et al. (2011) reported very low levels of knowledge among final-year students in Slovakia, particularly in the area of HH technique.

Although participants in the current study had good knowledge of when HH should be performed and achieved a satisfactory score on the knowledge questionnaire, the results

showed deficits in their knowledge, most notably in the areas of HH technique, the appropriate use of ABHR, and knowledge on maintaining skin integrity of the hands, similar to previous research conducted in other countries. The WHO (2009b, p. 93) reported “a lack of knowledge about the appropriateness, efficacy and use of hand hygiene and skin care protection agents determine poor hand hygiene performance.” Deficits in knowledge have the potential to create barriers to HH, such as skin breakdown, thus reducing the motivation to perform HH. Loffler and Kampf (2008) reported that an intervention group of nursing students who received regular teaching on skin care had, at the end of the 3-year study, significantly better skin condition of the hands and fewer morphological skin changes than did the control group who received no additional training. Based on the results of this large-scale longitudinal study, Loffler and Kampf strongly recommended regular teaching of skin care and skin protection in nursing curriculum to substantially reduce skin damage over the long term.

In addition to having the necessary knowledge about why, when, and how HH should be performed, nursing students must also be motivated to perform HH. Ajzen, Joyce, Sheikh, and Cote (2011) proposed that knowledge alone is insufficient, and indeed, not necessarily a prerequisite for a given behaviour, but that beliefs constitute the informational foundation that ultimately determines that behaviour.

### **To What Extent do Senior Nursing Students Have Positive Beliefs about HH?**

The mean score on the HH Beliefs Scale (3.78/5) indicated participants had, overall, moderately positive beliefs about HH, but there were considerable differences among the scores on statements related to behavioural beliefs, normative beliefs, and control beliefs. The mean scores on statements related to behavioural beliefs were all above four,

indicating participants had positive beliefs about the outcomes of performing HH. Beliefs about the importance of HH in reducing patient mortality, in reducing medical costs, and the belief that preventing HCAI is a valuable part of the health care workers role were the most positive with mean scores greater than 4.5. Normative beliefs were also positive, but generally less so than behavioural beliefs, with mean scores on statements related to beliefs about the expectations of others ranging from 4.17 to 4.4. The majority of participants believed that they have a duty to act as a role model, and the failure to perform HH could be considered negligence.

Scores on statements related to control beliefs, the presence of factors leading to the ability to perform HH, were inconsistent and, overall, less positive. While almost all believed that they could effectively apply their HH knowledge to the clinical setting and nearly as many believed their personal HH was a habit, over half agreed or strongly agreed that it was an effort to remember to perform HH as recommended. Over a third of the participants believed dirty sinks or a lack of acceptable soap were reasons for not cleansing their hands and that they could not always perform HH in recommended situations because their patients' needs came first. In a similar statement, the majority believed that when they were busy, it was more important to complete tasks than perform HH; these beliefs appeared to be inconsistent with the participants' beliefs about the outcomes of performing HH, specifically, that HH reduces patient mortality. There was a seeming lack of congruence between prioritizing the completion of patient care tasks over performing HH, with the belief that HH reduces patient mortality. Possible explanations are that participants did not associate their own failure to perform HH with the risk of their patients developing an HAI, they failed to identify the prevention of HAI as a patient need or priority, or,

similar to other HCPs, they considered HAI less of a threat than other patient safety issues, such as medication errors and falls prevention, and therefore, HH was perceived to be less important than other tasks (Gardam, Lemieux, Reason, van Dijk, & Goel, 2009).

In the study using the same questionnaire as that used in the current study, in which van de Mortel et al. (2010) found higher mean scores on the knowledge questions, the mean score on the HH Belief Scale (3.92) was also higher than that found in this study (3.78). Yet in 2011, van de Mortel et al., again using the same scales, found a lower mean score (3.27) on the HH Beliefs Scale for nursing students and lower knowledge scores.

Although participants in the current study had overall positive beliefs about the importance of HH, other beliefs were less positive. Of particular importance is the belief that when busy, completing other tasks becomes more important than HH. This finding suggests that rather than following guidelines on when HH should be performed, participants were prioritising HH against other tasks without considering the prevention of HAI as a priority, as a patient need, or the ethical imperative to provide safe care through adherence to recommended HH practices.

### **What are the Self-Reported HH Practices of Senior Nursing Students?**

The overall mean on the HH Practices Inventory (93.4%) indicates that participants reported very high HH practices. Self-reported HH practices were highest after contact with blood and body fluids, after contact with a patient's secretions, after inserting an invasive device, and after caring for a wound, with mean scores of almost 100%. The next highest HH practices reported were for when the hands looked or felt dirty and then after using the toilet. Practices were lowest before entering a room and before contact with the patient.

In comparison to other studies describing the self-reported HH practices of nursing students, Çelik and Koçaşlı (2008), Kelčíkova et al. (2012), and van de Mortel et al. (2011) all reported lower levels of HH than those found in this study. Nasirudeen et al. (2012), van de Mortel et al. (2010), and Waltman et al. (2011) found higher rates of self-reported HH practices, along with higher scores on the knowledge questionnaires. Similarities among the studies were that participants reported the highest levels of HH after contact with blood and body fluids and the lowest after contact with objects in the patient's room.

Higher compliance rates after contact, or risk of contact, with body fluids have been extensively documented. Based on a review of 35 studies measuring HCPs compliance rates, Erasmus et al. (2010, p. 285) reported large differences between compliance rates before and after patient contact, with the highest compliance rates after "dirty tasks." Whitby et al. (2006, p. 490) posited that HH is "performed mainly for self-protection against infection with harmful microorganisms." That participants in this study reported performing HH less often after using the toilet than any of the indications where there was a risk of exposure to a patient's microorganisms appears to support the proposition that HH is inherently self-protective in nature. If students' HH practices are largely driven by self-protection, an increased emphasis on the ethical duty to provide safe care is needed in education programs.

Mortell (2012) presented a concept termed the theory-practice-ethics gap, extending the notion of the theory-practice gap to include the ethical considerations of not providing evidence-informed care because it is considered idealistic, impractical, or inconvenient. Mortell recommended that education and training on HH should include an emphasis on its moral and ethical implications. Although it is essential to promote HH based on the ethical

imperative to provide safe care, using the inherent need for self-protection could also be used to motivate HH when the risk of transmission is less obvious. O'Boyle et al. (2001) observed nurses touching their faces, hair, eyes, noses, and mouth with contaminated hands, and that for some participants in their study, face touching appeared to be habitual. O'Boyle et al. also observed nurses touching objects with contaminated gloves, in and outside the patient environment, and the same objects were later touched by other HCPs who may not have been aware of the potential contamination. Kwok, Gralton, and McLaws (2015) observed medical students touching their faces on average 23 times per hour and suggested that an increased awareness of habitual face-touching as a source of self-inoculation and route of transmission might help improve HH compliance. Although the self-reported HH practices in this study were already very high, it is important to consider the accuracy of the reports.

During the period of time when the participants in this study were completing clinical rotations, the average compliance rates for nurses on the Alberta provincial HH audits were 66.4% in 2012 and 68.6% in 2013 (Henderson, 2015). The provincial HH audits are reported by type of employee, with nursing students included in the nurse category. Although the provincial audit reports do not provide an analysis of results for nurses and nursing students, some local and zone audits collect data on both. Audits conducted in the zone where approximately one-third of the sample for the current study completed clinical assignments have consistently shown nursing students perform HH less often than do Registered Nurses (Alberta Health Services South Zone, 2012). The disparity between AHS-observed HH compliance rates for all categories of nurses and the results

found in this study calls into question the accuracy of the participants' self-reported HH practices.

There have been mixed results among studies that compared self-reported HH practices with observed compliance, but the majority have shown HCPs most often overestimate the frequency they perform HH. For example, Larson, Aiello, and Cimiotti (2004) reported significant differences between self-reported and observed HH practices of nurses, but noted that the effect size was small. Self-report in that study was conducted through the use of diary cards to limit the amount of recall bias. Jenner et al. (2006) reported no correlation between the observed and self-reported HH practices of physicians, nurses, therapists, and health care assistants. In contrast, Moret, Tequi, and Lombrail (2004) reported that the observed HH rates of physicians, nurses, and nursing assistants during a 1-day period of observation were similar to self-reported HH rates collected the following week, but that there was a statistically significant difference between nurses' observed and self-reported HH rates, with some observed rates higher than the self-reported.

Only one study was found that directly compared the observed and self-reported HH practices of nursing students. Snow et al. (2006) reported an observed compliance rate of 51%, compared to self-reported compliance rates ranging from 80% to 93%. Although Cole (2009, p. 386) did not conduct observations of nursing students' HH practice, based on interviews with 14 of 147 students who had completed a HH questionnaire, he concluded that nursing students were not making an accurate assessment of their practices. Cole postulated that the "flawed self-assessments were not the result of dishonesty but the consequence of an inability to objectively self-assess." Based on the findings, Cole

suggested using self-assessment of HH practices during nursing education as a method of teaching students to reflect on their HH practices, in order to develop the ability to accurately assess.

### **What Methods of HH Education do Nursing Students Find Most Effective?**

The mean number of teaching methods participants recalled (10.73) indicates that HH education and training had been delivered by multiple methods. Almost all participants had received education in the clinical setting and by demonstration, and participants rated these two methods as the most effective. More than half of participants rated both demonstrations and clinical as highly effective, and close to a third rated both as moderately effective. Teaching in a laboratory was another of the most commonly used teaching methods and was rated as highly or moderately effective. Videos, posters, tutorials, and lectures were predominantly rated as moderately effective, but a large percentage of participants considered lectures only mildly effective. Teaching methods rated as the least effective were websites, lecture notes, and textbooks. Over 20% of participants rated textbooks and lecture notes as not effective, and over 30% considered lectures only mildly effective.

Van de Mortel et al. (2010) also found that participants in their study rated clinical and demonstrations as the most effective methods and lecture notes and textbooks among the least effective. The mean number of teaching strategies van de Mortel et al. reported was lower than found in this study, but mean scores on the effectiveness of each of the methods were higher, with the exception of demonstrations. Similarly, Nasirudeen et al. (2012) reported the nursing students in their study found clinical and laboratory sessions as the most effective methods and videos moderately effective. Based on previous research

and the results of the current study, it is concluded that students prefer experiential learning opportunities as opposed to didactic methods.

### **How Frequently is HH Assessed and What Methods Are Used for Assessment?**

Participants reported that assessment of HH was done least frequently by written exam and verbal exam. Many (34%) did not recall ever having their HH knowledge assessed by written exam, and 24% recalled only one exam. Assessments by verbal exam were reported slightly more often. The mean number of teaching methods used was close to 11, and although some of the teaching methods could have been used together, it does not appear assessment consistently followed. As part of the multimodal HH improvement strategy, the WHO (2009a) recommends ongoing evaluation of knowledge on, and perceptions of, HAI and HH.

Assessments in the clinical setting were reported, on average, fewer than three times over the course of the 4-year programs. More than half the participants recalled being assessed fewer than four times during their clinical rotations, and 12.6% did not recall ever being assessed. Participants in this study all completed a clinical rotation in all semesters except the first year. This translates into assessments being done in the clinical setting less than once a semester and, for most, less than once a year.

Almost all participants recalled being assessed in a simulation setting at least once. Nursing students spend considerably less time in simulation than in clinical practice, but the frequency of assessment in the two areas was similar. This may be explained by the fact that simulated health care environments are often used to teach and assess skills through the use of objective structured clinical examinations. It is possible that clinical instructors assume fundamental skills such as HH have been taught and evaluated in a simulation

setting, or the classroom, and therefore, no further follow-up is required. It is also possible that nursing instructors, similar to other HCPs, perceive HH to be less important than other tasks, particularly those that can result in immediate adverse events such as medication errors (Gardam et al., 2009). However, participants' scores on the HH Importance Scale suggest otherwise. Over 80% of participants believed that HH was an important part of the curriculum and that the importance of HH was emphasized by clinical instructors, suggesting that although students may not have been assessed, the importance of HH was stressed. In addition, it is plausible that students were assessed without being aware. However, an essential component of multimodal HH improvement strategies is not only evaluation, but also feedback on performance (WHO, 2009a).

### **Are There Any Associations between Students' HH Knowledge, Beliefs, and Practice, and the Methods and Frequency of HH Education and Assessment?**

There were no significant associations between knowledge scores and either the number of teaching methods or the perceived effectiveness of those methods; thus, the proposition that more frequent education would result in greater knowledge was not supported. Possible explanations are that students may have received conflicting information, or they simply did not retain what they were taught. A limitation of the survey, for the purposes of this study, was that it did not permit precise identification of when education occurred during the students' programs. If HH education was delivered in the first year of the nursing program, without review in later years, students may have forgotten some of what they were taught. Given the volume of material students are required to learn and the fact that basic skills are taught in the first year, this situation is conceivable. It is also possible that after a certain point, students lost interest and were no

longer engaged in what was being taught, particularly if the same information was repeatedly presented in a similar way.

A significant positive association was found between the HH Beliefs Scale and teaching effectiveness. Interestingly, there was a significant, but very small, negative association between beliefs and the number of teaching methods used; therefore, the proposition that repetitive education would be associated with positive beliefs was also not supported. A possible explanation is that the association is a spurious relationship due to the presence of an unknown confounding variable. Conceivably, if participants were receiving inconsistent or conflicting information from different instructors, it could affect not only their knowledge, but also their beliefs about HH. A very small, but significant, negative association between the HH Importance Scale and the number of teaching methods was again demonstrated, but positive associations were found between the HH Importance Scale and the perceived effectiveness of teaching and the frequency of assessment. Over 26% of the variability in HH Importance Scale was predicted by the variables entered into the analysis. The strongest association was between the frequency of assessment and the belief that HH was emphasized during participants' nursing education.

A significant positive association was also found between the HH Practice Inventory and the HH Beliefs Scale and the HH Importance Scale. The strongest association with practices was beliefs. To summarize, the frequency of assessment and the perceived effectiveness of teaching were associated with positive beliefs, and positive beliefs were associated with higher HH practices. These findings are consistent with the constructs of the theory of planned behaviour and similar to previous research conducted investigating the knowledge beliefs and *self-reported* HH practices of HCPs.

Sax, Uckay, et al. (2007) also found that the self-reported HH practices of physicians, nurses, and nursing assistants were associated with positive beliefs. Another similarity to the current study was that Sax, Uckay, et al. found HCPs overestimated the frequency, severity, and impact of HAI. Also similar to the current study, they found a lack of association between the perception of HAI as a serious concern and the perceived role of HH in preventing HAI with self-reported practices. They concluded that HCPs' HH practices were driven more by perceived social pressure and the perceived easiness of the task than by beliefs about HAI and their prevention. Tai et al. (2009, p. 320) also reported "perceived behavioral control and subjective norms were the most important factors associated with the nurses and physicians' self-reported hand hygiene performance." However, it is important to note that these studies used self-reported HH practices.

Although O' Boyle et al. (2001) also found the variables of the theory of planned behaviour were associated with the intention to perform HH and self-reported HH adherence, the variables did not predict observed HH. O' Boyle et al. (p. 357) did find a significant negative association between the "intensity of activity" in the nursing unit with observed HH, and they noted that "a theoretical perspective on HCW hand hygiene behavior must be expanded from a focus on the individual to a focus on the individual in situational context." The differences in the associations among the variables, between observed and self-reported HH practices, reported by O'Boyle et al. underscore the limitations of using self-reported HH practices and the caution that must be exercised in interpreting results when such measures are used.

### **Limitations and Recommendations for Future Research**

A limitation of the cross-sectional survey was that it does not provide exact measurements, but only estimates, of population characteristics. In addition, although it was possible to identify associations between variables, it was not possible to establish causation (Bryman et al., 2009). Another limitation was collection of data on the frequency and methods used to teach and assess HH through the use of a survey. A detailed review of course syllabi or collection of data from faculty to compare to students' reports could provide a more accurate estimation of how often HH is taught and the methods used.

Additional limitations included the use of a volunteer sample, which can result in systematic biases inherent to nonprobability samples, and most importantly, the use of self-reported HH practices. Students who volunteered may have had better knowledge of HH or stronger beliefs about its importance than those who chose not to participate. Inaccuracies in self-reported HH practices may have occurred as a result of intentional or unintentional misreporting related to poor recall, difficulty accurately assessing HH practices, or as a result of socially desirability responding. The Marlowe-Crowne Social Desirability Scale and subsets of items from it, such as the Reynolds short form used in this study, are frequently used to investigate social desirability response bias in surveys (Barger, 2010). However, there is no standard method of interpreting the results, and controversy exists over whether the scales measure a propensity to distort responses in a socially acceptable direction or if they reflect a tendency to conform to socially desirable behavior (Johnson, Fendrich, & Mackesy-Amiti, 2012).

Nederhof (1985, p. 264), contending that social desirability reflects the tendency of some individuals to “deny socially undesirable traits and to claim socially desirable ones,”

offered three methods to deal with social desirability bias: (a) reject the data of high-scoring participants; (b) correct the data, that is, replace high scoring cases with low or medium scores; or (c) merely register the impact of social desirability bias. In this study, because there was a positive correlation with two of the dependent variables, HH beliefs and HH practices, both believed to be susceptible to social desirability response bias, the decision was made not to include those cases with high scores on the Social Desirability Scale in the analysis of those dependent variables. The determination of what was considered a high score was based on the finding that there were no correlations between beliefs or practices with scores below 9 on the Social Desirability Scale. Interestingly, the mean score on the HH Practices Inventory remained high (92%), even when all cases with scores greater than 6 on the Social Desirability Scale were excluded from the analysis, suggesting that social desirability response bias was not a major contributing factor to the high levels of self-reported HH practice. Cole (2009, p. 386) suggested “flawed self-assessments” contributed to the high rates of HH reported by students in his study. The possibility that participants overestimated their HH practices in the current research cannot be ruled out.

Direct observation of HH practices using a validated tool and trained observers, although not without limitations such as the Hawthorne effect, has been shown to be a more reliable method of assessing HH practices than self-report (WHO, 2009b). Direct observation would also permit the collection of data on the frequency that hand washing is performed in relation to the use of ABHR, as well as assessment of technique. The majority of research on HH among HCPs and students has focused on when HH should be performed, with few studies on how it is done (Pittet, 2008). Laustsen, Bibby, Kristensen,

Thulstrup, and Møller (2008) reported HH with ABHR was performed correctly only 56% of the time before procedures and 58% of the time after procedures. When ABHR was applied incorrectly, Laustsen et al. found the number of colony-forming units on the hands were only reduced by 54% to 60%, compared to an 82% to 90% reduction with the correct use of ABHR. Based on these findings, additional research on HH technique is warranted.

The WHO (2009b) recommended that when planning interventions in health care, it is essential to first understand the HH practices of HCPs; similarly, understanding the HH practices of nursing students is important to planning their HH education. The limited amount of research investigating nursing students' HH practices, and the inability to generalize the results of this or similar research to different populations, warrants further study using research designs that enable generalization.

### **Conclusions and Recommendations for Education**

Since the WHO launched the *Save Lives: Clean Your Hands* campaign in 2009, extensive multimodal HH improvement strategies have been implemented by local and national health care agencies. It is unclear if nursing education has kept pace, but the current research and the results of previous studies suggest there are a number of areas that require attention. Existing guides to implementing multimodal HH improvement strategies, such as those published by the WHO (2009a), would serve as a valuable framework when planning HH education in nursing programs. Key components of multimodal interventions include training and education, evaluation and feedback, the creation of a safety culture, system change, and reminders in the workplace.

The results of this study indicate that although the participants received frequent training and education on HH, there were gaps in their knowledge, most notably in the

areas of HH technique, the appropriate use of ABHR, and knowledge on maintaining skin integrity of the hands. These findings suggest that the education on HH focused predominantly on when it should be performed, with less emphasis on how. To ensure nursing students recognise the importance of HH, when *and* how HH should be performed, as well as methods of preventing dry hands and skin breakdown, it is recommended that education and training during nursing programs include:

- The definition, impact, and burden of HAI;
- Major patterns of transmission of HAI;
- The critical role of hand hygiene in the prevention of HAI;
- Indications for hand hygiene;
- Correct technique for hand washing and the correct use of ABHR;
- Promotion of ABHR as the primary method of HH, except when hands are visibly soiled or when caring for patients with known or suspected norovirus or *Clostridium difficile* infections; and
- Methods of preventing dry skin and damage.

The finding that participants in the current study and in previous research, reported demonstrations and experiential learning opportunities to be the most effective teaching strategies should be considered when planning the methods of delivering HH education and training. Although the current study did not permit investigation of when HH education occurred during nursing programs, based on the WHO recommendation that HCW receive education and training at the commencement of employment and on an annual basis, it is recommended that nursing students receive HH education and training at the beginning of

nursing programs, prior to clinical placements, and at least annually thereafter. The *WHO Guidelines on HH in Health Care* (WHO, 2009b), based on a comprehensive review of scientific data on HH, would serve as an excellent resource for ensuring evidence-informed practice is consistently taught by all faculty and instructors.

An additional important finding in the current study was that assessment of HH knowledge by written exam was infrequent and assessment of HH practices in clinical settings was inconsistent, with some participants reporting frequent assessment and others none. Frequent assessments would help identify knowledge and practice gaps, such as performing HH prior to patient care, and additional education or emphasis could be implemented. The results showing that frequent assessment was associated with positive beliefs about HH, and positive beliefs were associated with better HH practices, further support the importance of both assessment and feedback. Evaluation of nursing students' knowledge of HAI and HH at least annually, and observation of HH practices followed by immediate feedback, in each of the clinical environments where students practice would help to ensure they have the necessary knowledge, put that knowledge into practice, and also serve to strengthen their beliefs about HH.

The common belief that when busy, HH becomes less important than competing tasks, suggests the implementation of strategies aimed at developing a safety culture are also important considerations in curriculum planning within nursing programs. Emerging from the finding that competing tasks are commonly perceived as more important than HH, is the recommendation that an increased emphasis be placed on HAI as one of the leading patient safety concerns, and an emphasis on adherence to recommended HH practices as the leading measure in reducing HAI. As previously noted, although participants in the

current study reported very high levels of HH, this finding has to be viewed cautiously, as it is possible that the participants overestimated their HH practices as a result of difficulties accurately assessing their own HH practice. The inclusion of HH practices as part of students' clinical reflections, as suggested by Cole (2009), is worth consideration in nursing education as a means of promoting accurate self-assessment and identification of where improvement is needed.

The recommendations that multimodal HH improvement strategies include system change and reminders in the workplace are also important considerations in the simulated health care environments that have become an integral part of nursing education. Ensuring sinks with soap and single-use towels are accessible and ABHR is available at “point of care”—each point where students practice care or participate in simulated patient care scenarios—enables students to practice HH in the same way it is required in health care. Posters explaining the indications for HH, the correct use of ABHR, and correct hand washing technique should also be prominently displayed throughout practice environments.

In conclusion, HH education and frequent assessment with feedback throughout nursing education, combined with an emphasis on patient safety including HAI and their prevention, and the provision of the necessary infrastructure and reminders in simulated practice environments are recommended. An increased emphasis on HH during education may help to ensure nursing students develop HH habits consistent with what is required to reduce the incidence and impact of HAI and would help create a safety culture within nursing education.

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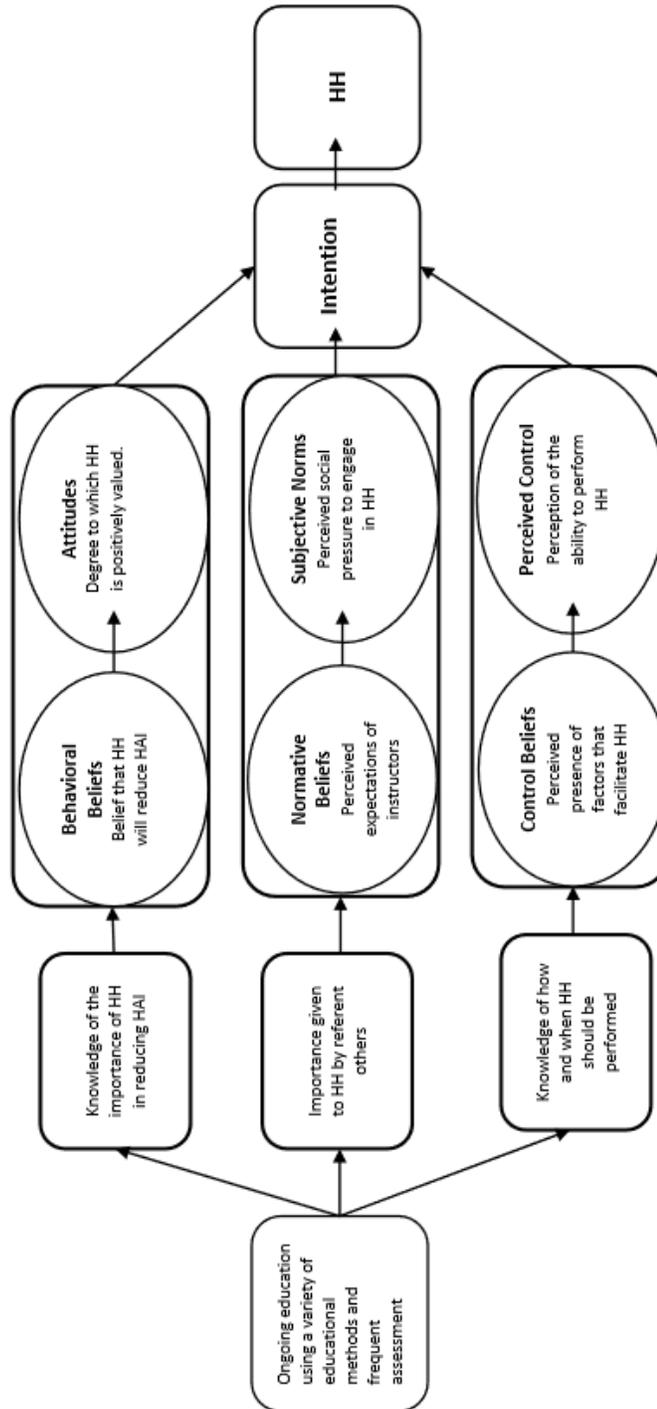
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APPENDICES

Appendix A: Expanded Model of the Theory of Planned Behaviour



### **Appendix B: Survey Information Letter**

You are invited to participate in a research study on hand hygiene in nursing education. This form details the purpose of the research, a description of your involvement and your rights as a participant.

The purpose of this research is to gain insight into nursing students' education on hand hygiene, knowledge and beliefs about hand hygiene, and hand hygiene practices.

If you decide to participate your involvement will be limited to completion of the attached survey. The survey asks questions about hand hygiene practices and what you remember about education on hand hygiene during your nursing education. The survey will take approximately 15 minutes to complete.

There are no anticipated risks or direct benefits to you from your participation in the survey.

The survey is completely anonymous. There are no personal identifiers on the survey and no records will be collected on who did, or did not complete it. The completed surveys will be kept in locked filing cabinet in my office at the University of Lethbridge, which only my thesis supervisor and I will have access to. The information will be used only for the purposes of the research and will be destroyed after 5 years' time.

The results from this research will be reported in general terms, responses will be aggregated and described in summary, in the form of my thesis, and possibly writings that may be presented in manuscripts, submitted for publication in scientific journals, or oral and/or poster presentations at scientific meetings, seminars, and/or conferences. The results may also be used for the development of teaching resources.

Your participation in this research is completely voluntary and refusal to participate will not initiate any prejudice, penalty or loss of benefits to which you might otherwise be entitled. You have the right to quit the survey at any time, for any reason, and without risk of prejudice, penalty or loss of benefits to which you might otherwise be entitled. If you choose to withdraw all information you provided will be destroyed immediately. You also have the right to skip any question(s), but continue to complete the rest of the survey.

If you require any information about this study, wish to receive a copy of the results from this study, would like to speak to me, or have any questions or please call *Sharon Dersch* at [phone #] at the University of Lethbridge.

If you have any other questions regarding your rights as a participant in this research, you may also contact the Office of Research Services at the University of Lethbridge at [phone #] or [email address], or you may contact my thesis supervisor Dr. Jean Harrowing by phone at [phone #] or [email address].

**Please keep this page for your future reference.**

**Appendix C: Hand Hygiene Questionnaire<sup>1</sup>**

**Hand Hygiene Questionnaire**

Age in years: \_\_\_\_\_

Gender: female  male

Have you worked in a health care related position as a paid employee? No  Yes

If yes what type of position (e.g. Nursing Assistant, Licensed Practical Nurse, Undergraduate Nurse)

\_\_\_\_\_

**Please check one box per question to indicate your response.**

Alcohol-based hand rubs should **not** be used:

- when hands are visibly soiled.
- during preoperative cleaning of hands by surgical personnel.
- before inserting invasive devices such as urinary catheters.
- after removing gloves.

Which of the following statements about alcohol-based hand rubs is **incorrect**?

- Alcohol-based hand rubs reduce bacterial counts on the hands of health care workers more effectively than plain soaps.
- Alcohol-based hand rubs can be more accessible than hand washing facilities.
- Alcohol-based hand rubs require less time to use than traditional hand washing.
- Alcohol-based hand rubs are only effective if they are applied for  $\geq 60$  seconds.

Which of the following statements regarding hand hygiene is **incorrect**?

- Poor adherence to hand hygiene practice is a primary contributor to hospital acquired infection and transmission of antimicrobial-resistant pathogens.
- Rings, watches and bracelets should be removed before beginning a surgical hand scrub.
- Hand hygiene is not necessary if gloves are worn during patient contact.

Which of the following methods is/are acceptable for drying hands in patient care areas?

- a) Single use cloth towels.
- b) Paper towels.
- c) Multiple use cloth towels of the hanging or roll type.
- d) all of the above.
- e) a and b only.

Hand hygiene must be performed:

- a) before patient contact.
- b) following emptying of a drainage reservoir (e.g. a urinary catheter bag).
- c) prior to and following venipuncture.
- d) all of the above.
- e) b and c only.

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<sup>1</sup> Used with permission T. F. van de Mortel

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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When using an alcohol-based hand rub to decontaminate hands:

- Hands should be rubbed together for 15 seconds.
- Hands should be rubbed together for 60 seconds.
- Hands should be rubbed together until they are dry.

Hand hygiene is **not** required:

- a) prior to administration of an injection.
- b) following handling of paper.
- c) following contact with a patient's dry skin.
- d) all of the above.
- e) b and c only.

Which of the following statements is **incorrect**?

- Hand hygiene should be performed when entering or leaving an isolation room.
- Hand hygiene is not required following contact with the bed linen of a patient with a multi-drug resistant *Staphylococcus aureus* infection.
- Hospital pathogens can be recovered from areas of normal, intact patient skin.
- Cracked skin carries higher loads of pathogenic organisms than intact skin.

Which of the following statements is **incorrect**?

- Alcohol-based hand rubs cause less skin irritation and dryness than hand washing using soap and water.
- The use of hand creams and lotions is not recommended for health care workers because they increase the load of pathogens on the hands.
- Hot water should not be used in the health care setting to wash hands as it increases the risk of skin irritation.

Which of the following statements about glove use is **incorrect**?

- Gloves should be changed during patient care if moving from a contaminated to a clean body site.
- The same pair of gloves can be used when caring for different patients as long as they are washed between patients.
- Gloves should be worn when contact with blood, secretions, and mucous membranes could occur.

Which of the following amounts **most closely** represents the average cost of a hospital acquired infection in developed countries?

- \$100
- \$1000
- \$10,000
- \$100,000

Which of the following figures **most closely** represents the incidence (number of new cases) of hospital-acquired infections in the Intensive Care Unit in developed countries?

- 5%
- 10%
- 20%
- 50%

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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How effective did you find the following in teaching you about hand hygiene? (*Please circle "not applicable" if the teaching method was not used in your program*).

<b>Statement</b>	<b>Not applicable</b>	<b>Not effective</b>	<b>Mildly effective</b>	<b>Moderately effective</b>	<b>Highly effective</b>
Lectures	0	1	2	3	4
Tutorials	0	1	2	3	4
Clinical Practice	0	1	2	3	4
Demonstration	0	1	2	3	4
Laboratory	0	1	2	3	4
Videos	0	1	2	3	4
Textbooks	0	1	2	3	4
Lecture Notes	0	1	2	3	4
Simulations	0	1	2	3	4
Websites	0	1	2	3	4
Research	0	1	2	3	4
Articles	0	1	2	3	4
Posters	0	1	2	3	4

How **frequently** was hand hygiene **assessed** in your program by the following (*Please circle your responses*)?

<b>Statement</b>	<b>Never</b>	<b>Once</b>	<b>Twice</b>	<b>Three Times</b>	<b>Four or more times</b>
Written examination	0	1	2	3	4
Verbal examination	0	1	2	3	4
In a simulated clinical setting	0	1	2	3	4
In the clinical setting	0	1	2	3	4

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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Did you work on any individual or group projects related to infection control or hand hygiene during your nursing program? (*e.g. Do Bugs Need Drugs*)

No  Yes

Please estimate your percentage of compliance with hand hygiene guidelines during clinical rotations: \_\_\_\_\_%

Please rate the importance of hand hygiene as an infection control measure in the health-care setting

Least Important Most  
 Important  
 1      2      3      4      5      6      7      8      9      10

*Please circle a number to indicate your response*

Statement	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Hand hygiene is considered an important part of the curriculum.	1	2	3	4	5
The facilities in which I do clinical practice emphasize the importance of hand hygiene.	1	2	3	4	5
The importance of hand hygiene is emphasized by my clinical supervisors.	1	2	3	4	5

Listed below are some statements concerning personal attitudes. *Circle whether the statement is true or false.*

- T    F    I am sometimes irritated by people who ask favours of me.
- T    F    I have never deliberately said something that hurt someone's feelings.
- T    F    It is sometimes hard for me to go on with my work if I am not encouraged.
- T    F    I am always courteous, even to people who are disagreeable.
- T    F    I'm always willing to admit it if I make a mistake.
- T    F    I sometimes try to get even rather than forgive or forget.
- T    F    I sometimes feel resentful when I don't get my own way.
- T    F    There have been times when I was quite jealous of the good fortune of others.
- T    F    There have been occasions when I took advantage of someone.
- T    F    No matter who I'm talking to, I'm always a good listener.
- T    F    I have never been irked when people express ideas very different to my own.

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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*Please circle a number to indicate your response.*

Statement	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
I have a duty to act as a role model for other health care workers.	1	2	3	4	5
When busy it is more important to complete my tasks than to perform hand hygiene.	1	2	3	4	5
Performing hand hygiene in the recommended situations can reduce patient mortality.	1	2	3	4	5
Performing hand hygiene in the recommended situations can reduce medical costs associated with hospital-acquired infections.	1	2	3	4	5
I can't always perform hand hygiene in recommended situations because my patient's needs come first.	1	2	3	4	5
Prevention of hospital-acquired infection is a valuable part of a health care worker's role.	1	2	3	4	5
I follow the example of senior health care workers when deciding whether or not to perform hand hygiene.	1	2	3	4	5
An infectious disease contracted in the health care setting may threaten my life or my career.	1	2	3	4	5
I believe I have the power to change poor practices in the workplace.	1	2	3	4	5
Failure to perform hand hygiene in the recommended situations can be considered negligence.	1	2	3	4	5
Hand hygiene is a habit for me in my personal life.	1	2	3	4	5
I am confident I can effectively apply my knowledge of hand hygiene to my clinical practice.	1	2	3	4	5
It is an effort to remember to perform hand hygiene in the recommended situations.	1	2	3	4	5
I would feel uncomfortable reminding a health professional to handwash.	1	2	3	4	5
Performing hand hygiene slows down building immunity to disease.	1	2	3	4	5
Dirty sinks can be a reason for not washing hands.	1	2	3	4	5
Lack of an acceptable soap product can be a reason for not cleansing hands.	1	2	3	4	5

## HAND HYGIENE IN UNDERGRADUATE NURSING EDUCATION

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*Please circle a number to indicate your response*

<b>I cleanse my hands:</b>	<b>Never</b>	<b>Some of the time</b>	<b>Half of the time</b>	<b>Mostly Always</b>	<b>Always</b>
After going to the toilet	1	2	3	4	5
Before caring for a wound	1	2	3	4	5
After caring for a wound	1	2	3	4	5
After touching potentially contaminated objects	1	2	3	4	5
After contact with blood or body fluids	1	2	3	4	5
After inserting an invasive device	1	2	3	4	5
Before entering a room	1	2	3	4	5
After contact with a patient's skin	1	2	3	4	5
After exiting a room	1	2	3	4	5
After contact with a patient's secretions	1	2	3	4	5
Before patient contact	1	2	3	4	5
After removing gloves	1	2	3	4	5
If they look or feel dirty	1	2	3	4	5