2012

Determinants of Hand Hygiene among Registered Nurses Caring for Critically Ill Infants in the Neonatal Intensive Care Unit

Candace Ryan
University of Windsor

Determinants of Hand Hygiene among Registered Nurses Caring for Critically Ill Infants in the Neonatal Intensive Care Unit

by

Candace Elizabeth Ryan

A Thesis
Submitted to the Faculty of Graduate Studies
through Nursing
in Partial Fulfillment of the Requirements for
the Degree of Master of Science at the
University of Windsor

Windsor, Ontario, Canada

2011

Determinants of Hand Hygiene among Registered Nurses

Caring for Critically Ill Infants in the Neonatal Intensive Care Unit

by

Candace Elizabeth Ryan

APPROVED BY:

_____

T. Loughead
Deptartment of Kinesiology

_____

M. El-Masri
Faculty of Nursing

_____

S. Fox-Wasylyshyn, Advisor
Faculty of Nursing

_____

D. Kane, Chair of Defense
Faculty of Nursing

November 17, 2011

AUTHOR'S DECLARATION OF ORIGINALITY

I hereby certify that I am the sole author of this thesis and that no part of this thesis has been published or submitted for publication.

I certify that, to the best of my knowledge, my thesis does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations, or any other material from the work of other people included in my thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. Furthermore, to the extent that I have included copyrighted material that surpasses the bounds of fair dealing within the meaning of the Canada Copyright Act, I certify that I have obtained a written permission from the copyright owner(s) to include such material(s) in my thesis and have included copies of such copyright clearances to my appendix.

I declare that this is a true copy of my thesis, including any final revisions, as approved by my thesis committee and the Graduate Studies office, and that this thesis has not been submitted for a higher degree to any other University or Institution.

ABSTRACT

Health care associated infections (HAIs) are a significant cause of morbidity and mortality among neonates in neonatal intensive care units (NICUs). Hand hygiene (HH) is the most effective means of reducing HAIs. However, HH rates among NICU nurses are low and few studies have examined the factors that predict HH among these nurses. The purpose of this study was to examine self-reported HH compliance rates among NICU nurses and the extent to which the Theory of Planned Behaviour (TPB) concepts and demographic variables predict nurses HH compliance. An anonymous, self-administered questionnaire was distributed to nurses working in two South Western Ontario NICUs. Forward stepwise regression identified the following predictors of self-reported HH compliance: intentions, attitudes, perceived behavioural control, subjective norms, and age. This study suggests that efforts aimed at improving HH compliance among NICU nurses be focused on the TPB concepts and the older NICU nurses.

DEDICATION

To GOD be the glory great things HE has done

To my loving husband, Aaron Ryan, who encouraged and supported me every step of the way. You never stopped believing in me, and would not let me give up on myself. I am so happy that we have set and achieved our goals together. I love you and I am so proud of all you have accomplished.

To my darling son, Nathanael Ryan, you bring me so much joy to my life. Already at the tender age of two you are highly intelligent, verbal, and perceptive, yet you are so sensitive and loving. I have loved every precious minute of being your mother.

To my parents, and especially my mother, Sandra Martin, who instilled in me the value of education and encouraged me throughout this entire process.

To my siblings, Colbert (Jr.), Collette, and Catherine, you have paved the way for me and have taught me that "with God, all things are possible".

ACKNOWLEDGEMENTS

First and foremost, I thank my God and Father for walking with me through this long and arduous journey. For faithfully giving me the strength, guidance, endurance, and the capability of complete this task. I owe it all to Him.

I would like to thank Dr. S. Fox-Wasylyshyn for her role as my advisor. Her careful review of my thesis, and her detailed and timely feedback were very much appreciated.

I would like to thank Dr. M. El-Masri for serving on my thesis committee and for his support with the statistical analyses.

I would also like to thank Dr. T. Loughead for his willingness to serve on my thesis committee and for providing helpful feedback and suggestions.

Special thanks are owed to the NICU nurses at Windsor Regional Hospital. They have been an amazing source of encouragement and support. I would also like to thank the NICU nurses at St. Health Care, as well as Dan Edelstein for their support and participation in my research.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Healthcare associated infections (HAIs) in the Neonatal Intensive Care Unit (NICU) are the most significant cause of morbidity and mortality among critically ill neonates (Aziz et al., 2005; Stevens et al., 2007). An HAI is confirmed when the neonate manifests clinical symptoms of an infection and/or positive bacteriologic cultures 48 hours after admission to the NICU (Auriti et al., 2003; Aziz et al., 2005; Pessoa-Silva et al., 2006). The time frame of 48 hours post admission helps to distinguish primary infections that may be present at birth from infections that are newly acquired in the hospital (Auriti et al., 2003).

Extensive exposure to medical treatments and invasive procedures, coupled with developmental and immunological immaturity puts infants in the NICU at an increased risk of developing HAIs (Brady, 2005; Saiman, 2002). Several studies by the Canadian Neonatal Network (CNN) have determined that the prevalence of HAIs in Canadian NICUs is approximately 16%, ranging from 7% - 75% for very low birth weight (VLWB, <1500g) infants and from 0.1% to 17.0% for higher birth weight (HBW, >1500g) infants (Aziz et al., 2005; Stevens et al., 2007). The CNN has also determined that the neonatal mortality rate due to HAIs ranges from 4% to 8% (Aziz et al., 2005; Sankaran et al., 2002).

The hand hygiene (HH) literature indicates that HAIs are associated with the transmission of pathogens from the hands of health care professionals (HCPs) to hospitalized individuals (Lewis & Thompson, 2009; Raskind, Worley, Vinski, & Goldfrab, 2007; Won et al., 2004). As far back as 1846, Ignaz Semmelweis recognized

HH as the single most effective means of reducing HAIs and their detrimental sequelae (CDC, 2002). The Canadian Adverse Events study (Baker et al., 2004) asserted that approximately 37% of HAIs are preventable, and the United Kingdom Department of Health (Rickard, 2004) reported that 10% of HAIs are attributed to low compliance with HH guidelines. Despite these facts, the Ontario Ministry of Health and Long Term Care (MOHLTC) has reported that HH compliance among Ontario HCPs remain unacceptably low (2010).

Background and Significance of the Problem

HAIs can significantly increase the morbidity, length of stay, cost to the health care system, mortality, and pain and suffering of critically ill newborns and their parents (Aziz et al., 2005; Banerjee, Grohskopf, Sinkowitz-Cochran, & Jarvis, 2006; Bloom et al., 2003; Raskind et al., 2007). Studies indicate that critically ill newborns may suffer numerous, yet distinct episodes of HAIs throughout their hospital stay (Aziz et al., 2005). A Canadian study conducted by the National Institute of Child Health and Human Development Neonatal Research Network (Aziz et al., 2005) assessed the HAI rates among 17 NICUs. The 16,538 neonates that comprised the sample population represented approximately 75% of the neonates admitted to Canadian NICUs that year. The study found that 78.7% of VLWB infants in NICUs developed at least one HAI, while 16.2% experienced two HAIs, and 5.1% experienced three or more HAIs (Aziz et al., 2005). Similarly, 87.9% of HBW infants experienced at least one HAI, while 9.3% experienced two HAIs, and 2.8% experienced three or more HAIs (Aziz et al., 2005). As morbidity rates increase among neonates, mortality, length of hospital stay, and economic costs also increase. A study based in Canadian NICUs (Sankaran et al., 2002) reported

that the mortality rate of neonates due to HAIs increased by 4% over a 22 month period. Additionally, an Italian study (Auriti et al., 2003) reported that the neonatal mortality rate due to HAIs increased by 7.1% over a one year period. Studies have also found that the length of hospital stay was increased by 5.2 to 19.2 days among neonates who had developed a HAI (Auriti et al., 2003; Leroyer et al., 1997; Sheng et al., 2005). Based on an additional 5.2 day (length of) stay in the NICU, Leroyer et al. (1997) estimated that it would cost an additional $10, 440 (United States Dollars) to treat a neonate with an HAI. In addition to economic costs, the psychological costs to parents with neonates in the NICU has been well documented (Jenner, Watson, Miller, Jones, & Scott, 2002; Docherty, Miles, & Holditch-Davis, 2002; Holditch-Davis & Miles, 2000).

HH is an important aspect of the care provided to infants hospitalized in the NICU. HH is an umbrella term that refers to hand-washing with soap and water, or hand antisepsis using an antiseptic soap or alcohol-based handrub (ABHr) (CDC, 2002). HH is an effective, cost efficient means of reducing the number of microorganisms on the hands, thereby minimizing the transfer of microorganisms to hospitalized patients and reducing the total number of HAIs (Aiello, Cimiotti, Della-Latta & Larson, 2003; Pessoa-Silva et al., 2004; Pittet et al., 2006; Polak, Ringler & Daughterty, 2004; Chudleigh, 2005; Raskin et al., 2007; Won et al., 2004). HAI rates may be reduced by approximately one-third when HCPs follow HH guidelines (Baker et al., 2004; Pittet et al., 2000). For the neonate, Won et al. (2004) and Pessoa-Silva et al. (2006) reported that an increase in HH by NICU nurses can significantly decrease HAIs and their detrimental sequelae. However, compliance with HH recommendations by NICU nurses is

persistently low, ranging from approximately 40% (Lam, Lee & Lau, 2004; Pessoa-Silva et al., 2008; Won et al., 2004) to 59.3% (Raju & Kobler, 1991).

Nurses are well positioned to help lower the rates of HAIs in the neonatal population. NICU nurses who work closely with the neonates should be well aware that critically ill and premature neonates have a reduced immunological capacity with which to combat infections (Auriti et al., 2003; Brady, 2005). Indeed most NICU nurses agree that infections are a particular problem in the NICU, and that hand washing and infection control practices should be an important part of nursing care (Chudleigh et al., 2005; Kennedy, Elward & Fraser, 2004). Despite this reported understanding, HH rates among nurses remains low (Larson et al., 1992; Pessoa-Silva et al., 2004; Korniewick & El-Masri, 2010). NICU nurses should be champions of the message that "hand washing is the single most important measure to prevent the transmission of microorganisms and reduce morbidity and mortality due to HAIs" (Pessoa-Silva et al., 2004, p.192). NICU nurses must exhibit careful and consistent compliance with all HH guidelines. They must also work to reduce HAIs through consistent role modeling of HH to colleagues and visitors, as well as providing bold and timely HH education to those who come in contact with critically ill neonates.

Problem Statement and Purpose of the Study

The contaminated hands of NICU nurses are a known vector in the transmission of potentially pathogenic organisms to hospitalized infants (Pessoa-Silva et al., 2004) who are especially vulnerable to the development of HAIs (Brady, 2005; Saiman, 2002). The need for careful HH among NICU nurses is clear, and the vulnerability of the

neonatal population is evident. However it is still unclear why some NICU nurses perform conscientious HH, while others fail to consistently comply with HH guidelines.

An extensive body of literature has described the potential predictors of HH compliance among HCPs. Some of the variables that have been examined include, but are not limited to motivational factors, workload and intensity of the nursing unit, and attitudes toward HH guidelines. The Theory of Planned Behavior (TPB) (Ajzen, 1985), which purports to explain how cognitive variables (attitude, subjective norms, perceived behavioral control, and intentions) can predict HH practices, offers a promising approach to the study of HH behaviors among HCPs. However, results of studies based on this theory have been conflicting (see literature review), and none were conducted with Canadian nurses working in the NICU. In addition, research examining demographic factors as predictors of HH compliance among NICU nurses in Canada is limited. Due to this paucity of knowledge, the purpose of this study is to examine how selected demographic characteristics and cognitive variables from the TPB predict HH compliance among the Canadian nurses working in a community based NICU.

Research Questions

This study will attempt to answer the following research questions:

1. What are the self-reported HH compliance rates among nurses working in a community based NICU?
2. To what extent do demographic characteristics (gender, age, education, formal HH education, exposure to HH campaign) and cognitive factors (intentions, attitude, subjective norms, and perceived behavioural control) of NICU nurses influence their compliance with HH guidelines?

Conceptual Framework

The TPB (Ajzen, 1985) has been selected as the conceptual framework for this study. It is an extension of the Theory of Reasoned Action (TRA) that was developed by Ajzen and Fishbein (1967). Originally developed for use in social psychology, these theories have been used in nursing to describe and explain "health promoting and health protecting behaviors" (Pender, 2002, p.38). The TBP has also been used in the HH literature to predict and understand the HH practices of HCPs (O'Boyle, Henly, Larson, 2001; O'Boyle, Henly, Duckett, 2001; Nicol, Watkins, Donovan, Wynaden & Cadwallader, 2009; Whitby, McLaws & Ross, 2006). In the following text, both the TRA and the TPB are described in general, and within the context of HH.

The Theory of Reasoned Action

Developed to predict and explain volitional behaviours (Ajzen, 1985; Pessoa-Silva et al., 2005), the TRA postulates that an individual's behavior is a function of their intent to perform that behavior. Behavioral intent is a function of two determinants: attitude and subjective norms. Defined as a feeling or affective regard for a behaviour (O'Boyle, Henly, & Larson, 2001), attitude is determined by an individual's belief or evaluation about the outcomes of performing the behavior. If the outcomes are deemed desirable, a positive attitude toward the behaviour may result (Ajzen, 1985). Conversely, if the outcomes are deemed undesirable, a negative attitude toward the behaviour may result. Subjective norms are defined as the individual's perception of the social pressure that relevant others exert to perform or not perform a behavior (O'Boyle, Henly & Larson, 2001). Subjective norms are determined by normative beliefs, which are one's overall evaluation of relevant others' expectations (O'Boyle, Henly & Larson, 2001). An

individual may comply with the social pressure to perform a given behavior if relevant others expect its performance. Similarly, the individual may avoid behaviors to which relevant others object. In general, individuals are likely to perform a behavior that they evaluate positively, when relevant others expect it, and if they are motivated to comply with the expectations placed on them (Azjen, 1985).

The TRA can be applied to the volitional behaviour of HH among HCPs. In the context of HH, the theory postulates that compliance with HH guidelines is a function of the HCP's intent to perform HH. The theory suggests that HCPs` intent to perform HH is a function of attitudes and subjective norms toward HH. That is, if the HCP believes that the outcomes of HH are desirable, such as a decrease in HAIs or protection of self from infection (Erasmus et al., 2009), a positive attitude toward HH may result. Conversely, if the outcomes are assessed as undesirable, such as damaged or dry hands (O'Boyle, Henly, & Duckett, 2001), a negative attitude toward HH may result. HCPs who hold positive attitudes toward HH may be more inclined to perform it. To continue, subjective norms represent the HCPs' belief about the social pressure that relevant others exert to perform or not perform HH. For example, if the HCP believes that their charge nurse, colleagues, or a family member of the neonate expect good HH (Sax, Uckay, Richet, Allegranzi, & Pittet, 2007), the HCP may chose to practice in that way. On the contrary, if relevant others neither practice good HH, nor believe it can prevents cross infection (Erasmus et al., 2009), the HCP may choose not to practice HH as recommended by HH guidelines.

The Theory of Planned Behavior

Developed in 1988, the TPB (Figure 1) it is an extension of the TRA (Ajzen, 1988). It was developed by Ajzen to satisfy his own critique of the original 1967 TRA (Ajzen, 1988). The TPB incorporates the idea that behavior is not always under one's volitional control. In fact, persons may have a strong intent, a positive attitude, and motivation to comply with social pressures, but external factors may prevent them from performing that behavior (Ajzen,1988). Thus a new concept labeled perceived behavioral control was added to the original predictors of attitude and subjective norms. Perceived behavioral control is determined by the individual's belief about the ease or difficulty, and resources or obstacles associated with performance of a given behaviour (O'Boyle, Henly& Larson, 2001). Thus, the TPB differs from the TRA in that it accounts for perceived as well as actual control over a given behavior (Ajzen, 1988).

In the context of HH, perceived behavioural control refers to the HCP's perceptions about the external factors that may limit their ability to practice good HH. These external factors may supersede the HCP's positive intentions, attitudes, and motivation to conform to HH guidelines, ultimately resulting in poor HH. The HCP may perceive that they have little control over external factors such as availability of sinks, time constraints, patient condition, or a heavy workload (Lankford, Zembower, Trick, Hacek, Noskin, & Peterson, 2003), which may lead them to believe that they have little control over their HH practices.

Modified Model of the Theory of Planned Behaviour

The present study employed a modified version of the TPB (see Figure 2). In the modified version of the TPB, the constructs, attitude, subjective norms, and perceived

behavioural control were used along with intentions as direct, rather than indirect, predictors of HH behaviour. As described earlier, the original TPB model postulates that attitude, subjective norms, and perceived behavioural control predict intentions to perform a given behaviour. The model further postulates that intention is the one direct predictor of behaviour (see Figure 1). However, several recent HH studies have been able to demonstrate that the concepts of attitude, subjective norms, and perceived behavioural control are also direct predictors of HH behaviour (Pittet, Simon, Hugonnet, Pessoa-Silva, Sauvan & Perneger, 2004; Sax et al., 2007; Tai, Mok, Ching, Set & Pittet, 2009). For this reason, the theoretical framework that was used to guide this study used intentions, attitude, subjective norms, and perceived behavioural control as direct predictors of HH behaviour (see Figure 2). According to the TPB, beliefs about outcomes, normative beliefs, and control beliefs are the antecedents of attitude, subjective norms, and perceived behavioural control respectively, and do not play a direct role in predicting behaviour (Azjen, 1985). Therefore these three concepts were not used in the current study as direct predictors of HH behaviour.

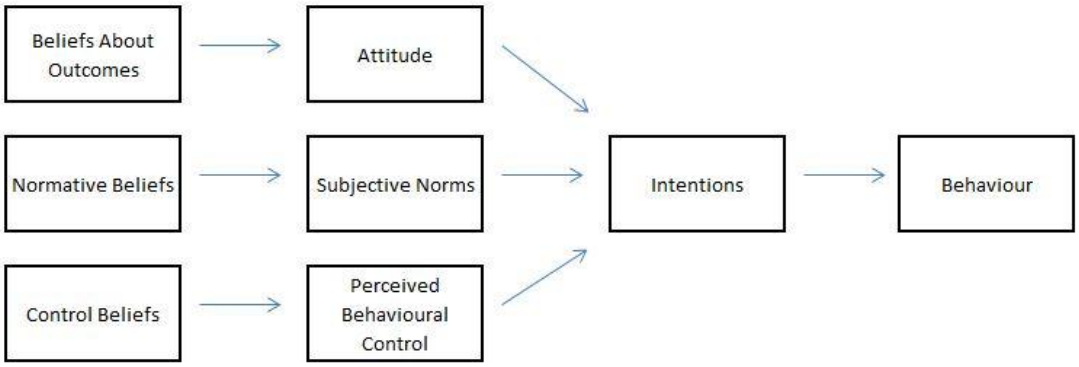

Figure 1. Theory of planned behavioural model

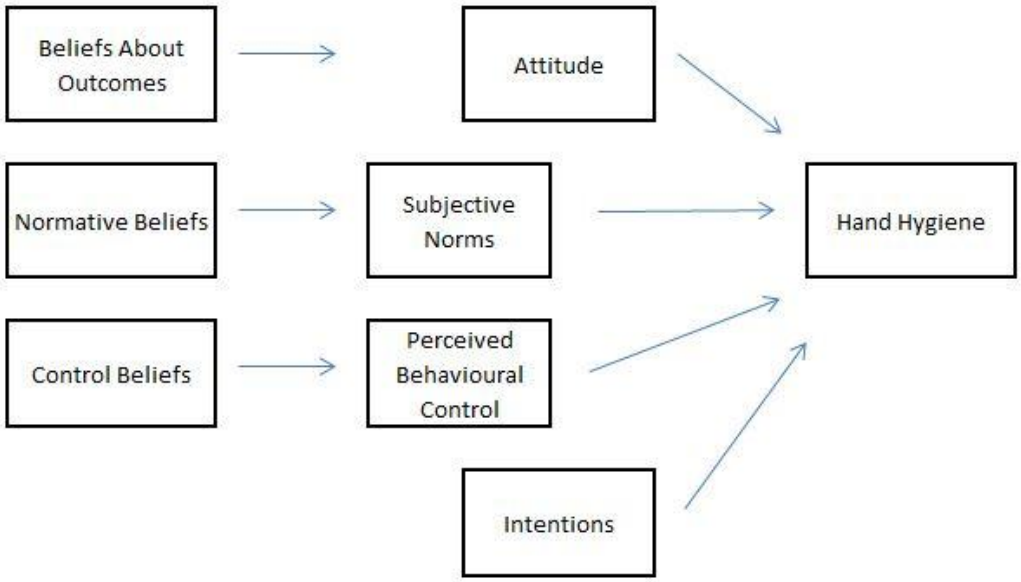

Figure 2. Modified theory of planned behavior model

CHAPTER II

LITERATURE REVIEW

Search Strategies

The following literature review presents peer-reviewed studies that pertain to factors associated with HH compliance among HCPs. The proposed study will focus on how selected demographic variables (gender, age, education, formal HH education, exposure to HH campaigns) and concepts from the TPB (attitude, subjective norms, perceived behavioural control, and intentions) are related to HH compliance. Therefore, the review that follows is limited to literature pertaining to the above concepts. Relevant HH studies were obtained using electronic databases accessed through the University of Windsor's Leddy Library website: PubMed, Medline @ Scholars Portal, and Cumulative Index to Nursing and Allied Health Literature through EBSCO. The keywords used in the search included various combinations of the following terms: hand hygiene, alcohol based handrub, handwashing, hand decontamination, guidelines, recommendations, compliance, adherence, Theory of Planned Behavior, neonatal intensive care unit, health care associated infection, hospital acquired infection, nosocomial, health care professional, healthcare worker, nurses, predictor, determinants, attitudes, subjective norms, perceived behavioural control, intentions, perception, beliefs, and Canada or Canadian. The reference lists of pertinent articles were also scanned for additional relevant articles. Studies were retained for inclusion in the literature review if: (a) the sample included HCPs working in a hospital setting; (b) the study examined the associations of HH compliance with TPB concepts and/or demographic factors (c) HH compliance was measured by self-report or direct observation by expert observers (as

opposed to direct observation by patients or video surveillance, consumption of HH products, or electronic monitoring of automated sinks and ABHr dispensers), and (d) the study was published between the years 1991 to 2010.

The literature review begins with an overview of the vulnerability of hospitalized neonates to HAIs. HH guidelines established for HCPs in a healthcare setting are presented next. A discussion of the selected demographic and TPB predictors listed above, and their association with HH follows. Finally, the review concludes with a summary of the research findings and indications for the present research study.

The Vulnerability of Neonates in the NICU

Several factors help to explain why neonates are especially vulnerable to HAIs. HAIs are typically seen in neonates who are born more prematurely (i.e., <32 weeks gestation) (Auriti et al., 2003; Nagata, Brito, Matsuo, 2002), with lower birth weights (Nagata et al., 2002), and immature immune systems (Brady, 2005; Saiman, 2002). Neonates typically acquire passive immunity through transplacental transfusion of immunoglobulin G (IgG) during the third trimester of gestation (Brady, 2005). However, neonates born before term acquire lower levels of IgG (Saiman, 2002). In addition, the immunity that they receive protects against only those organisms to which the mother has been exposed (Brady, 2005). Thus the newborn is virtually defenseless against the spectrum of pathogens that may be resident in the NICU environment or on the hands of caregivers (Brady, 2005). The ill newborns of the NICU may also be developmentally immature. Premature newborns often possess thin skin, resulting in an ineffective barrier against pathogenic microorganisms (Brady 2005; CDC, 2002; Saiman, 2002). Potentially pathogenic microorganisms may be transferred to the newborn's skin during contact with

HCPs, family members, or visitors. These pathogens may then permeate the neonate's thin skin, significantly increasing the newborn's risk of acquiring an HAI (Brady, 2005).

Hospitalized infants in the NICU often experience numerous medical treatments and invasive procedures that may increase their risk for HAIs (Brady, 2005; Saiman, 2002). Mechanical ventilation and surgical interventions have been independently associated with HAIs in the neonatal population (Auriti et al., 2003). Central venous access, peripheral intravenous access (IV), the use of antibiotics, and parenteral nutrition (IV fat and IV amino acids) have all been associated with neonatal HAIs (Auriti et al., 2003; Aziz et al., 2005; Saiman, 2002). Neonates may also experience frequent blood drawing for medical testing. The frequent needle sticks increase the number of entry sites in the skin that may serve as portals of entry for microorganisms, thereby reducing the thin skin's already limited capacity to protect the neonate (Brady, 2005). Numerous blood draws may also cause iatrogenic hypogammaglobinemia in the newborn. Hypogammaglobinemia is a condition in which maternally derived antibodies are reduced to a low level before the neonate is capable of producing sufficient antibodies for immunologic protection (Brady, 2005). These examples illustrate that critically ill newborns face significant risk for infection due to a combination of factors that include developmental and immunologic immaturity, invasive procedures, environmental pathogens, and their extended length of stay in the NICU (Carey, Saiman, & Polin, 2008). The vulnerability of neonates to HAIs underscores the importance of studying HH practices in the NICU setting.

Acquisition of Infections from HCPs

The role of the NICU nurse is to provide the care necessary to optimize the survivability of critically ill newborns. However, nurses and other HCPs may inadvertently place newborns at risk for HAIs, by transmitting potentially pathogenic microorganisms to newborns or their immediate environment (Saiman, 2002). One prominent neonatal research study (Pessoa-Silva et al., 2004) found that the hands of nurses can become laden with potentially pathogenic microorganisms. Pessoa-Silva et al. (2004) studied bacterial counts, measured as colony forming units (CFUs), on the fingertips of nurses during routine neonatal care. The authors found a significant increase in bacteria on the fingertips of nurses shortly after the initiation of care. Within 2 minutes of contact with the neonate's skin, soiled diapers, or respiratory secretions, the bacterial counts on the fingertips of nurses were increased by 100 CFUs or greater (Pessoa-Silva., 2004). Bacterial counts were also significantly increased after contact with neonates' equipment and after manipulation of vascular access devices. The authors found that the microorganisms isolated on the caregivers' fingertips included the nurses' own skin flora, and many of the microorganisms that have been implicated with HAIs (Aziz et al., 2005; Carey, Saiman & Polin, 2008).

The findings of Pessoa-Silva et al. (2004) and others may help explain how nurses contribute to the development of HAIs in neonates. Pessoa-Silva et al. (2004) have shown that nurses acquire bacteria from multiple sources. The primary source is the resident flora that lives on nurses' hands. Additional bacteria are then added to the hands when nurses touch previously contaminated objects such as thermometers, incubator doors, stethoscopes, or other equipment or inanimate objects in the neonate's

environment prior to hands-on care of the neonate (Bhalla et al., 2004; Larson et al., 1992; Pessoa-Silva et al., 2004). If these microorganisms are capable of surviving for more than several minutes on the hands (Pittet et al., 2006) and the nurse does not perform HH before patient contact, potentially pathogenic microorganisms may be transferred to the neonate, thus contributing to the development of HAIs (Saiman, 2002).

There are two other significant means by which nurses contribute to the development of HAIs in neonates. First, nurses may cause cross transmission of pathogens from one body site of the neonate to another. Nurses who fail to cleanse their hands between different care activities for the same neonate may contaminate a clean body site with microorganisms from a soiled body site (Pessoa-Silva et al., 2004). For example, pathogens may be passed from the gastrointestinal tract to the urinary tract or blood stream if a nurse orally suctions a neonate and performs a diaper change in the absence of HH. Second, nurses may contribute to bacterial loading of the environment if they use soiled gloves or hands to touch inanimate objects within the neonate's environment (Pessoa-Silva et al., 2004). The contamination of the neonate's environment creates a reservoir for infectious pathogens, contributing to a cycle in which the nurses' hands may become re-contaminated and transmission of pathogens to the neonate becomes possible (Larson et al., 1992; Pessoa-Silva et al., 2004).

Hand Hygiene Policies for Staff at the Research Settings

Overview of HH policies. In March 2010, St. Joseph's Health Care (SJHC) published a revised HH policy that is to be used by its employees (see Appendix A). Similarly, in June 2010, Windsor Regional Hospital (WRH) revised and published a HH policy for use by its employees (see Appendix B). The two HH policies are very similar.

Both recognize HH as an important measure in patient safety and the single most important practice in the prevention and control of disease transmission (SJHC, 2010; WRH, 2010). Both policies are based on: (a) the Ontario Ministry of Health and Long Term Care (2010) *Just Clean Your Hands (JCYH) Program*, and (b) MOHLTC Provincial Infectious Diseases Advisory Committee's (2008) *Best Practices for HH in all Health Care Settings*. In addition, the policies in both settings closely follow the 2009 international World Health Organization (WHO) Guidelines on Hand Hygiene in Health Care.

The WRH and the SJHC policies document support of HH compliance among HCPs. The WRH policy advocates that HCPs receive basic HH training with periodic review of HH procedures. The WRH policy also recommends that monitoring of HH compliance and timely feedback should be used to promote HH among HCPs. According to the policy, HH products (liquid and antimicrobial soaps, paper towels, hot and cold running water) and a sufficient number of sinks must be placed in convenient and accessible locations to promote HH. Similarly, the SJHC HH policy indicates that all staff are required to complete training modules on HH, and review the documents pertaining to patient and visitor HH. The WRH and the SJHC policies encourage HCPs to maintain their skin integrity by providing appropriate hand moisturizes. When skin integrity problems develop, hospital administrators are directed to refer HCPs to the appropriate employee health departments (SJHC, 2010; WRH, 2010).

HH guidelines. In clinical situations, HCPs of WRH and SJCH must practice the following *Four Moments of Hand Hygiene*:

1. Before initial contact with a patient or items in the patient's environment.

2. Before putting on gloves for the purpose of performing an invasive/aseptic procedure, and when moving from a contaminated body site to a clean body site during care.
3. After care involving contact with body fluids; if gloves are worn, after removing gloves but before moving to another activity.
4. After contact with the patient or items in their immediate environment, and when leaving the patient area, even if the patient hasn't been touched.

Above all, the HCP should perform HH wherever there is any doubt about its necessity (JCHC, 2010; WRH, 2010).

WRH and JCHC staff members are expected to practice, and encourage family and visitors to practice HH in the situations outlined below. HH must occur when hands become contaminated, even when contamination is not visible. HH must occur upon entering and exiting the hospital, and/or entering a patients' room. It is necessary to cleanse hands before eating, and after coughing, sneezing, blowing one's nose, smoking, using the restroom, or other activity in which hands may become contaminated with one's own secretions or excretions. HH must also be performed before preparing, handling, or serving food or medication (SJHC, 2010; WRH, 2010).

Alcohol-based handrub (ABHr). HH using ABHr is the preferred method of HH, and should be the first choice for HH in clinical situations when hands are not visibly soiled (SJHC, 2010; WRH, 2010). The approved technique for AHBr is based on the JCYH program (MOHLTC, 2010). Posters describing and illustrating the correct technique are prominently displayed beside many of the ABHr dispensers around the two hospitals. The technique includes use of 1-2 pumps (approximately 35 ml) of an ABHr

that has an alcohol concentration of 60-90%. The ABHr is to be placed in the palm and rubbed over all surfaces of the hands for 15 – 20 seconds until the product is dry. The guidelines encourage HCPs to focus on cleansing the fingertips, the thumbs, between the fingers, and the back of each hand (SJHC, 2010; WRH, 2010).

Handwashing with soap. The technique for washing with soap is also based on the JCYH program (MOHLTC, 2010). Descriptions and illustrations of the technique are located beside many of the sinks in the hospitals. The procedure for washing hands with soap begins with the removal of all hand and arm jewelry. Hands are to be wet with warm water and a liquid soap is to be applied to the hands. The hands should then be rubbed together vigorously for a minimum of 15 seconds, paying attention to the fingertips, each thumb, between the fingers, and the back of the hands. Hands should be thoroughly rinsed under running water and dried with paper towels using a patting action. Re-contamination should be avoided by using a paper towel to turn off the taps (SJHC, 2010; WRH, 2010).

Gloves. Gloves must also be considered in the context of appropriate HH. Gloves are not to be worn in place of appropriate HH. It is also inappropriate to wash and re-use gloves. Gloves should be worn if the HCP anticipates that their hands will contact mucous membranes, non-intact skin, or bodily fluids. Gloves must be removed and discarded immediately after an activity that contaminates them. HH should then be performed. A new pair of gloves should be donned (after HH) when moving to a clean site after touching a contaminated body site. Gloves must be changed between patients (WRH, 2010). The SJCH (2010) policy includes recommendations about glove use along with its recommendations for jewellery.

Nails and other considerations. Both policies address several factors to which HCPs must adhere in order for HH to be effective. Nails must be kept natural, clean and short. Nails should not extend beyond the end of the finger. Nail polish is discouraged. However, if it is worn, it should be fresh, and should not be chipped. Artificial nails and nail enhancements are not to be worn by HCPs who provide direct patient care. Hand and arm jewelry such as rings, watches, and bracelets, are also discouraged in the hospital setting. Finally, long sleeved clothing should not impede, or become wet during HH (SJHC, 2010; WRH, 2010).

Neonatal Intensive Care Unit hand hygiene guidelines. According to the clinical practice coordinator of the NICU (S. Woolcock), there is not a written HH policy that is specific to the NICU at WRH. However, the NICU's infection control committee has created a unit specific HH campaign called T.R.U.S.T. The acronym stands for "Talk it up, Remove all jewelry, Up to the elbow wash, Short sleeves only, True clean nails." The campaign is based on the recommendations of the Provincial Maternal-Newborn Advisory Committee Infection Prevention and Control Work Group (2008). The HH guidelines are posted throughout the unit and are actively enforced among nurses and other HCPs who come to the unit (S. Woolcock, Personal Communication, August 9, 2010). The NICU at St. Joseph's Health Care have provided the NICU staff with a written HH policy. The policy builds on the hospital-wide HH policy, and re-iterates in greater detail the *four moments for HH* (see Appendix C).

Predictors of Hand Hygiene Compliance

Demographic Variables

Gender. Three studies were reviewed that assessed the relationship between gender and HH practices among HCPs providing patient care in hospital settings (Nobile,

Montuori, Diaco & Villari, 2002; Sax, Uckay, Richet, Allegranzi & Pittet, 2007; Van de Mortel, Bourke, Mcloughlin, Nonu & Reis, 2001). Van de Mortel et al. (2001) used direct observation to assess the hand washing rates of an unknown number of HCPs of various types working in a critical care unit (CCU). The authors found that female physicians and staff tended to wash their hands after patient care more frequently than did male physicians and staff (p =.047 and p <.001, respectively, no statistic reported with p values). However, the authors found no difference in HH rates between male and female registered nurses. Nobile et al. (2002) and Sax et al. (2007) used anonymous questionnaires to assess the effect of gender on self-reported HH rates among medical and nursing staff. Sax et al. (N = 413) found that male staff tend to cleanse their hands less often than female staff (OR = 0.6, CI = 0.4 - 0.98, p = .041), while Nobile et al. (N = 1,042) found no gender difference in HH rates.

Age. Five studies in this literature review examined the relationship between age and HH as determined by self report (Quiros, Lin, & Larson, 2007; Sax et al., 2007; Tai et al., 2009) or direct observation (Pittet et al., 2004; Snow, White, Alder & Stanford, 2006). Sample sizes ranged from 60 (Snow et al., 2006) to 1042 (Sax et al., 2007), and included nurses (Snow et al., 2006), physicians (Pittet et al., 2004) and interdisciplinary HCPs (Quiros et al., 2007; Sax et al., 2007; Tai et al., 2009) as participants. The results of these five studies reported no relationship between age and HH compliance.

Education. The relationship between HH and level of education, and previous experience in a healthcare setting were examined in studies using survey (Nobile et al., 2002; Sax et al., 2007; Tai et al., 2009) and prospective quasi-experimental (Snow et al., 2006) designs. Nobile et al. (2002) found no difference in the HH behaviour of HCPs

who had obtained a high school diploma compared to those who had obtained a college degree. However, Snow et al. (2006) demonstrated that previous experience in a healthcare setting was associated with improved HH adherence ($\beta = .13$, $p < .03$). Both Tai et al. (2009) and Sax et al. (2007) found that neither years since completion of basic training, nor years of employment were significant predictors of HH behaviour.

Formal HH Education. Formal HH education and its relationship to HH behaviour was examined in two studies. Tai et al. (2009) found that formal HH education had no effect on the HH practices of HCPs (statistics not reported). In contrast, Sax et al. (2007) found that those who had received formal HH education and those who had past exposure to a HH campaign were more likely to report higher rates of HH behaviour (*OR* = 1.7, *CI* = 1.1 - 2.7, $p = .02$ and *OR* = 1.7, *C I* = 1.1-2.7; $p = .04$, respectively).

Variables from the Theory of Planned Behaviour

Attitude. Attitude is one of the variables outlined in the TPB that may influence HH. Several studies (Creedon, 2005; Pittet et al., 2004; Quiros et al., 2007; Snow et al., 2006) have described positive attitudes toward HH among HCPs. A number of studies examined the extent to which positive attitudes predicted either observed (O'Boyle, Henly, & Larson, 2001) or self-reported (Jenner et al., 2006; Nobile et al., 2002; Pittet, et al., 2004; Quiros et al., 2007) HH behaviour among HCPs. Quiros et al. (2007) surveyed 1,359 critical care physicians, nurses, and allied HCPs in 39 U.S. hospitals regarding their attitudes toward the CDC HH guideline. They found that HCPs with positives attitude toward the guideline were more likely to report its implementation (*OR* = 1.11, *CI* = 1.06 -1.16, $p < .001$). Pittet et al. (2004) found similar results with respect to attitude and observed HH behaviour among Swiss physicians ($N = 163$). Specifically, physicians who

held positive attitudes toward performing HH after patient contact were five times more likely to practice hand decontamination after patient contact (*OR* = 5.19, *CI* = 2.17-12.4, $p < .001$). Jenner et al. (2006) assessed the attitudes of various categories of HCPs (*N* = 71) using a survey tool. They found attitude to be a significant predictor of self-reported HH (no statistics provided). By contrast, Nobile et al. (2002) found that attitude was not significantly associated with self-reported HH compliance among 413 interdisciplinary HCPs in Italy. Finally, O'Boyle, Henly & Larson (2001) found that a positive attitude was not predictive of the observed HH behaviour of 120 critical care nurses. Again, the authors did not report the statistical results to support their conclusions.

Subjective Norms. Subjective norms are defined as the individual's perception of the social pressure exerted by others, both superiors and peers, to perform a given behaviour (Ajzen, 1985). Four studies (Jenner et al., 2006; O'Boyle, Henly & Larson, 2001; Sax et al., 2007; Tai et al., 2009) were found that examined subjective norms as a predictor of HH behaviour. Two of these studies (Sax et al., 2007; Tai et al., 2009) administered anonymous questionnaires among interdisciplinary groups of HCPs. Using logistic regression, Sax et al. (2007) found that HCPs (*N* = 1042) were 1.8 times (*CI* = 1.0-3.2, $p = .042$) more likely to report higher rates of HH adherence when they perceived that their colleagues expected good HH adherence. Tai et al. (2009) reported that the expectations of a superior significantly predicted improved HH ($\beta = .258$, *CI* = .288-.493, $p < .001$) among HCPs (*N* = 1022). By contrast, Jenner et al. (2006) and O'Boyle, Henly & Larson (2001) reported that subjective norms did not predict HH behaviour. Neither of these two studies reported the statistical results to support their findings.

The behavior of a role model or mentor may influence the beliefs and HH practices of a mentee. Three studies (Lankford et al., 2003; Muto, Sistrom, & Farr, 2000; Snow et al., 2006) used direct observation, and two studies (Erasmus et al., 2009; Nicol, Watkins, Donovan, Wynaden, & Cadwallader, 2009) used qualitative methods to assess the impact of a role model or mentor's HH practice on a mentee's HH compliance. Snow et al. (2006) observed the HH behavior of 60 student nursing assistants who were assigned to mentors in unspecified clinical settings. The investigators found that good HH practices among mentors was the strongest predictor of good HH among students ($\beta = .70$, $p < .05$). Nicol et al. (2009) used semi-structured interviews with a mixed group of HCPs ($N = 46$) working on two medical and surgical wards. The authors found that role models; particularly senior staff, nurse preceptors, and peers; influenced HCPs' beliefs about HH. Lankford et al. (2003) observed an unspecified number of interdisciplinary HCPs in a hematology/oncology unit, a medical intensive care unit (MICU) and surgical intensive care unit. Logistic regression analyses suggested that when a peer, or higher ranking HCP (physician or nurse) failed to wash their hands, the lower ranking HCPs were less likely to practice hand decontamination ($OR = 0.2$, $CI = 0.1\text{- }0.5$, $p < 0.001$). Two studies used focus group interviews with interdisciplinary groups of HCPs in Canada (Jang et al., 2010) and the Netherlands (Erasmus et al., 2009). Both the Canadian HCPs ($N = 153$) and Dutch HCPs ($N = 65$) reported that their poor HH practices were influenced by negative role models who were non-compliant with HH guidelines. Muto et al. (2000) followed a mixed group of 126 HCPs working in a MICU and its step down unit. Results of the study suggested that when the highest ranking physician practiced hand decontamination, lower ranking physicians were more likely to do the same. The

authors did not note if this effect held true among other types of HCPs, nor did they provide statistical results to support their finding. Pittet et al. (2004) used direct observation and a self-report questionnaire to examine physicians' (N = 126) perceptions of being a role model. The investigators found that beliefs about being a role model to other physicians was independently associated with HH compliance (OR = 1.89, CI = 1.03-3.47, $p < .001$). However, physicians' beliefs about being a role model for other professional categories was not associated with HH compliance.

Perceived behavioural control. Perceived behavioural control refers to the individual's perception about whether the appropriate resources are available to engage in a given behaviour (Ajzen, 1985). Nine studies (Erasmus et al., 2009; Jang et al., 2010; Jenner, Watson, Miller, Jones & Scott, 2002; Jenner et al., 2006; Nicol et al., 2009; O'Boyle, Henly, & Larson, 2001; Pittet et al., 2004; Sax et al., 2007; Tai et al., 2009) were found that examined the relationship between HH compliance and perceived behavioural control, which was operationalized in most studies as the ease with which HCPs perceive they can perform HH. Seven of the reviewed studies (Erasmus et al., 2009; Jang et al., 2010; Jenner et al., 2002, Jenner et al., 2006; Nicol et al., 2009; Sax et al., 2007; Tai et al., 2009) found that perceived behavioural control influenced HH behaviour among HCPs, while two of the studies found that it did not (O'Boyle, Henly, & Larson, 2007; Pittet et al., 2004). Sax et al. (2007) and Tai et al. (2009) administered anonymous questionnaires to interdisciplinary groups of HCPs. Sax et al. (2007) found that HCPs (N = 1, 042) were 7.1 times (CI = 4.5-11.0, $p < .001$) more likely to report high rates of HH adherence when they perceived that HH was easy to perform. Tai et al. (N = 1,022) similarly found that perceived behavioural control was significantly associated

with nurses' (β = .256; *CI* = .287-.514 $p < .05$) and physicians' (β = .266, *CI* = .076-.605, $p < .05$) self-reported HH performance. In a 2002 study, Jenner et al. found that perceived behaviour control significantly predicted observed HH compliance (β = -2.58; Wald test (97) = 6.10; $p < .05$) among a mixed group of HCPs (N = 104). In a later study, Jenner et al. (2006) found perceived behavioural control to be a predictor of observed HH behaviour among HPCs (N = 71), however they did not report their statistical results. In a qualitative study (Erasmus et al., 2009), an interdisciplinary sample of HCPs reported that perceived barriers such as emergency situations, lack of time and access to HH materials, and forgetfulness decreased HH practices. In another qualitative study (Jang et al., 2010) an interdisciplinary group of HCPs (N = 153) reported that perceived barriers to HH such as poor access to ABHr and skin damage negatively impacted HH. In contrast to the aforementioned results, two of the studies that were reviewed found that perceived behavioural control was not associated with observed (O'Boyle, Henly, and Larson, 2001) or self-reported (Pittet et al., 2001) HH compliance among 120 critical care nurses (O'Boyle, Henly, and Larson, 2001) or 163 physicians (Pittet et al., 2001).

Intentions. In the context of HH, an individual's compliance with HH guidelines may be a direct result of their intentions to perform it. Eight studies (Erasmus et al., 2009; Jenner et al., 2002; O'Boyle, Henly & Larson, 2001; Pessoa-Silva et al., 2005; Pittet et al., 2004; Sax et al., 2007; Tai et al., 2009; Whitby et al., 2006) were found that examined HCPs' behavioural intentions in the context of HH. Only three of these studies (Jenner et al., 2002; O'Boyle, Henly & Larson, 2001; Pittet et al., 2004) examined the extent to which intentions predicted HH behaviour. Jenner et al. (2002) administered anonymous questionnaires to an interdisciplinary group of HCPs (N = 104). Using hierarchical

logistic regression, the authors found intentions to be a strong predictor of HH (β = -4.53, *SE* = 1.15, $p < .001$). Two studies (O'Boyle, Henly & Larson, 2001; Pittet et al., 2004) used both observational methods and self-report questionnaires among physicians (Pittet et al., 2004) and registered nurses (O'Boyle, Henly & Larson, 2001) to assess the impact of intentions on HH. Neither study found intentions to be a significant predictor of HH behaviour. Five additional studies (Erasmus et al., 2009; Pessoa-Silva et al., 2005; Sax et al., 2007; Tai et al., 2009; Whitby et al., 2006) were found that examined the impact of the TPB variables on HH. However, none of these studies attempted to examine intentions as a possible predictor of HH.

Summary of the Literature

The reviewed literature contains substantial information about attitude and HH. In general, HCPs report a positive attitude toward HH guidelines (Creedon, 2005; Pittet et al., 2004; Quiros et al., 2007; Snow et al., 2006). The relationship between HCP's attitudes toward HH, and HH behaviour has also been reviewed, however the results of the reviewed studies are conflicting. Three of the five studies included in this literature review found that positive attitudes toward HH were predictive of both observed (Pittet et al., 2004) and self-reported (Jenner et al., 2006; Quiros et al., 2007) HH behaviour. The remaining two studies found that positive attitudes did not predict observed (Nobile et al., 2002) or self-reported (O'Boyle, Henyl & Larson, 2001) HH behaviour. Of the nine studies that examined the relationship between subjective norms (social expectations or a mentor's influence) and HH behaviour, seven (Erasmus et al., 2009; Jang et al., 2010; Lankford et al., 2003; Muto et al., 2000; Sax et al., 2007; Snow et al., 2006; Tai et al., 2009) found a positive relationship between the variables, while two (Jenner et al., 2006;

O'Boyle, Henly & Larson, 2001) found no relationship. Eight studies were found that examined perceived behavioural control as a predictor of HH among HCPs. Six of the reviewed studies (Erasmus et al., 2009; Jang et al., 2010; Jenner et al., 2002, 2006; Nicol et al., 2009; Sax et al., 2007; Tai et al., 2009) found that perceived behavioural control influenced HH behaviour among HCPs, while two studies found that it did not (O'Boyle, Henly, & Larson, 2001; Pittet et al., 2004). Finally, three studies were found that examined intention as a predictor of HH among HCPs. One study (Jenner et al., 2006) found that intention predicted HH behaviour, while two studies found that it did not (O'Boyle, Henly, & Larson, 2001; Pittet et al., 2004).

The literature provides limited and conflicting information about the demographic factors that predict HH in HCPs. With regard to gender, Nobile et al. (2002) and Van de Mortel et al. (2001) found no difference between male and female HH practices, while Sax et al. (2007) found that females had better HH practices than males. No association has been noted between HH and HCPs' age (Pittet et al., 2004; Quiros et al., 2007; Sax et al., 2007; Snow et al., 2006; Tai et al., 2009), level of education (Nobile et al., 2002), years since completion of basic training, or years of employment (Sax et al., 2007; Tai et al., 2009). However, previous experience in a h healthcare setting (Snow et al., 2006), and previous exposure to a HH campaign (Sax et al., 2007) have all been associated with higher rates of HH compliance.

Of the 20 studies that met the criteria for inclusion in this literature review, none of the studies were conducted in an NICU and only one was conducted in Canada (Jang et al., 2010). Most studies sampled either physicians (Pittet et al., 2004) or interdisciplinary groups of HCPs (Creedon, 2005; Erasmus et al., 2009; Harris et al.,

2000; Jang et al., 2010; Jenner et al., 2002, 2006; Lankford et al., 2003; Nicol et al., 2009; Nobile et al., 2002; Muto et al., 2000; Quiros et al., 2007; Tai et al., 2009; Van de Mortel., 2001). Only two studies (O'Boyle, Henly & Larson, 2001; Snow et al., 2006) sampled nurses exclusively. Finally, three additional studies (Jenner et al., 2006; Muto et al., 2000; O'Boyle, Henly & Larson, 2001) omitted some of their statistical results, thus their written conclusions cannot be verified.

It is important to study the HH behaviour of nurses in the NICU. NICU nurses have the most physical contact with neonates, and are therefore well positioned to help decrease HAI rates among the members of this vulnerable population. Furthermore, it is important to study HH behaviour in NICUs due to the vulnerability of the neonatal population. Hence, there is a need to conduct a HH study based on Canadian nurses working with critically ill neonates in the NICU. This important study will help to increase our understanding of the demographic and TPB cognitive predictors of Canadian NICU nurses who comply with HH guidelines.

CHAPTER III

METHODOLOGY

Study Design

Design

A descriptive, observational, cross-sectional survey design was implemented in which data were collected by means of an anonymous self-administered questionnaire.

Setting and Sample

Setting. The study was conducted in two Canadian NICUs located in Southwestern Ontario: WRH in Windsor, and SJHC in London. WRH is a modified level III unit that provides intensive and intermediate care to approximately 550 term and preterm neonates annually (approximately 4600 patient days). It is a 20-bed facility that serves Windsor and the surrounding region. However, critically ill neonates may also be transferred to the NICU from various regions throughout the province of Ontario. Nursing care is provided by approximately 47 registered nurses who work either 8 or 12 hour shifts. In general, the neonate-to-nurse ratio is 3:1, but may be 1:1 or 2:1 for critically ill neonates. The average length of stay for neonates admitted to the unit was reported as 17.5 days in 2009 (L. St Aubin, personal communication, June 18, 2010).

The NICU in WRH is divided into five pods, each of which has four beds. There are also three care-by-parent rooms in which families reside with stable, preterm infants for several days prior to discharge from the unit. Six hands-free sinks are conveniently located throughout the unit. Alcohol-based handrub is also available at each bedside. Each care-by-parent room contains a sink and alcohol-based handrub. Upon entry into the central administration area, parents, visitors, and staff are required to cleanse their

hands before entering the area in which neonates are hospitalized. Staff and visitors of the NICU are frequently exposed to communications that are part of the hospital-wide JCYH campaign (OMHLTC, 2010) such as posters, video announcements played on televisions screens throughout the hospital, and HH audits conducted by infection control practitioners.

The NICU at St. Joseph's Health Care is the larger of the two NICUs. It is a 42-bed level III NICU that is part of a tertiary care perinatal program. It provides intensive care to approximately 660 critically ill and premature newborns each year (approximately 13,100 patient days). The nursing staff is comprised of approximately 105 registered nurses who work 12 hours shifts. The neonate-to-nurse ratio may range from 1:1 to 4:1 depending on the acuity of the neonate. The reported length of stay in the unit for 2009 was 23 days (J. Marcheson, personal communication, October 1, 2010).

The physical layout of the NICU consists of three patient care areas containing 26 neonatal beds, an additional 16-bed step down unit, an isolation room, and 5 care-by-parent rooms. Although sinks and liquid soap are available throughout the unit, ABHr, is the preferred method of hand cleansing, except in cases when hands are visibly soiled. Therefore ABHr is readily available throughout the unit and ABHr dispensers are attached to each neonatal isolette. The AHBr on each isolette serves as a strong reminder to practice HH. The JCYH campaign posters throughout the NICU and hospital also serve to remind staff to practice HH. Parents, visitors, and staff are required to wash their hands upon entry into the unit. ABHr and a designated room for hand cleansing are available immediately upon entry into the NICU (J. Marcheson, personal communication, October 1, 2010).

Sample. Individuals were eligible to participate in the study if they met the following inclusion criteria: (a) worked as a Registered Nurse, (b) provided direct patient care, (c) worked in the NICU at one of the research settings, and (d) were willing to participate in the study and complete the questionnaire. One hundred and thirteen registered nurses from the two sites were recruited for participation in this study. Given the sample size, number of predictors that met the ($p \leq 0.25$) criteria for inclusion in multivariate analysis, the observed R^2, and a two-tailed alpha of 0.5, the power of this analysis to find an effect was equal to 0.99. When the power level was calculated using the number of significant ($p < .05$) predictors in the final model, the power of this analysis to find an effect was equal to 1.0. All power calculations were obtained using the online power calculator by Soper (2011).

Procedure. The procedure varied slightly between sites. At WRH, the 10 minute self-report questionnaire (Appendix D) was delivered to the mailbox of each nurse by a research assistant. The questionnaire directed nurses to return their completed questionnaires to a locked drop box that was located behind the nurses' station. To increase response rates, the researcher conducted short presentations with the nursing staff to outline the study's purpose and aims. At SJHC, privacy policies prevented both the researcher and research assistant from placing questionnaires in the nurses' mailboxes. Therefore, the questionnaires were made available in approved areas around the NICU, and in the nurses' lunch room. At SJHC, the locked drop box for completed questionnaires was also placed in the nurses' lunch room. Because questionnaires were not delivered to each mailbox, several methods were used to increase response rates including: approved posters placed throughout the unit, presentations about the study

were conducted with the nursing staff and a $5 coffee card was offered as an incentive. The utilization of an anonymous questionnaire and locked drop at both sites helped ensure anonymity as nurses were not required to record their names on the questionnaires, or return completed questionnaires directly to the researcher or research assistant.

Variable Definitions and Validity of Instrumentation

This study utilized a modified version of the 65-item HH questionnaire (Appendix F) that was originally administered by Tai et al. (2009). (See Appendix E for permission to use the questionnaire). The original questionnaire, which also takes approximately 10 minutes to complete, was originally administered to HCPs in Hong Kong. The authors reported very good internal consistency for the overall questionnaire (Cronbach's alpha = 0.95). Tai et al. (2009) did not specify the alpha coefficient for each sub-scale in the questionnaire; instead they indicated that the coefficients for the scales ranged from 0.84 to 0.91 (Tai et al., 2009). It is important to note that the authors did not report on the validity of the scales.

Due to the fact that the original questionnaire was modified for use in this study (described below in detail), the adapted questionnaire was assessed for reliability and validity (Tabachnick & Fidell, 2001). While it appeared that Tai et al. (2009) used their questionnaire in its entirety as a scale to measure self-reported HH, the modified questionnaire used five scales as independent measures of the concepts of interest (attitudes, perceived behavioural control, subjective norms, intentions, and self-reported HH). All of the five scales had very good internal consistency, exceeding the generally

Table 1

Cronbach's alphas and factor loading for the questionnaire scales

Attitude		Percieved Behavioural Control		Subjective Norms		Intentions		Self-reported HH Compliance	
α = .783		α = .837		α = .772		α = .903		α = .864	
Item	Loading		Loading		Loading		Loading		Loading
1	.716	1	.791	1	Deleted	1	.942	1	.890
2	.758	2	.863	2	Deleted	2	.909	2	.821
3	.476	3	.717	3	.790	3	.722	3	.711
4	.674	4	.847	4	Deleted	4	.929	4	.908
5	.781	5	.862	5	.471	5	.798	5	.697
6	.717	6	.529	6	.946	6	.658	6	.658
7	.648	7	.673	7	Deleted	7	.918	7	.906
8	.600	8	.624	8	.803	8	.669	8	.577

acceptable criteria of a Cronbach's alpha value of 0.70 or greater (Field, 2005). Factor analysis revealed that all five scales effectively measured their intended uni-dimensional concepts. That is, the 8 items (or questions) that comprised each scale substantively loaded (0.4 or greater) onto the correct factor (Field, 2005). For example, the factor loadings for the 8 items that comprised the attitude scale are greater than 0.4. The same is true for the other scales, with the exception of the subjective norms scale (see table 1). Four items in the subjective norms scale were deleted due to a lack of variability in those items. However the new 4-item subjective norms scale still met the criteria to be considered a reliable and valid scale (outlined above).

Modifications to Questionnaire

Demographic variables. Section A of the original questionnaire consisted of 8 questions that were used to elicit information pertaining to respondents' age, gender, nursing education, formal HH education, exposure to HH campaigns, professional category (i.e., nurse, physician, allied HCP), and hospital department (eg. medicine, surgery, intensive care unit). The two questions pertaining to the respondents' professional category and hospital department were deleted from the modified questionnaire (Appendix D) because only nurses who work in the NICU were sampled in this study. One question was added to the modified questionnaire that elicited data pertaining to respondents' highest level of education. Three questions (items 4, 5, and 6) were moved from Section C in the original questionnaire and placed in Section A of the modified questionnaire. These questions were used to elicit data pertaining to the respondents' perceptions of how highly the institution, the NICU, and the participant ranked HH in terms of its importance. Another question was added that pertains to how highly other HCPs rank HH.

Attitude. Attitude is conceptually defined as an individual's positive or negative evaluation of performing a given behaviour (Ajzen, 1985), which is HH in this study. Attitude was operationalized in the HH questionnaire using 8 questions (See Section B, Appendix D) that elicit information pertaining to respondents' perceptions of the effectiveness of HH in reducing HAIs during specified clinical situations. Responses were rated on a likert scale ranging from 1 (not effective) to 7 (highly effective).

Perceived behavioral control. Perceived behavioral control refers to the individual's belief about the ease or difficulty, and resources or obstacles associated with

performing a given behaviour (O'Boyle, Henly & Larson, 2001), which is HH for the present study. This concept was operationalized using 8 questions from the HH questionnaire that elicit HCPs' perceptions of the difficulty or ease of performing HH during specified clinical situations (See Section C, Appendix D). Perceived behavioural control was measured on a likert scale ranging from 1 to 7. A response of 1 reflects the belief that HH is extremely difficult to perform, while 7 represents the belief that HH is extremely easy to perform during the specified clinical situations.

Subjective norms. Subjective norms is defined as individuals' perceptions of the social pressure that relevant others exert on them to perform or not perform a specific behavior (O'Boyle, Henly & Larson, 2001). Within the context of this study, subjective norms referred to one's perception of the environmental pressure (from their manager and their colleagues) to comply with HH guidelines. Section D of the HH questionnaire includes 8 questions that measured this concept (Appendix D). The 8 questions elicited information regarding the respondents' perceptions of the how much their manager wanted them to cleanse their hands. However, as mentioned above, four items (items 1, 2, 4, and 7) were deleted from multivariate analysis due to absence of variability. For the remaining four items, measured on a 7- point likert scale ranging from 1 to 7, a response of 1 indicated the belief that their manager did not care at all if HH was performed, while a response of 7 reflected the belief that their manager expected HH to be performed during the specified clinical situations. An additional question (Final Section, Appendix D) was used to measure nurses' perception of how often (10% to 100% in 10% increments) they perceived that their colleagues complied with HH guidelines. This single item question was used to measure the pressure nurses' felt to comply with HH

guidelines based on how often they perceived that their colleagues complied with the HH guidelines.

Intentions. The TPB postulates that the precipitating cause of volitional behaviour is one's intention toward the specified behaviour (O'Boyle, Henly & Duckett, 2001). This concept was not included in the original questionnaire by Tai et al. (2009). However, it was added to the modified questionnaire because Azjen's (1985) theory postulates that an individual's behaviour is directly predicted by their intent to perform the behaviour. Therefore, for the purpose of this study, the concept of intentions was added and defined as nurses' thoughtful deliberation, or plan to engage in HH behaviour. Nurses' intentions toward HH was determined via self-report, operationalized by eight items (Section E, Appendix D) that asked participants to identify the frequency (0% to 100% in 10% increments) with which they intend to perform HH during 8 specified clinical situations.

Self-reported HH compliance. HH compliance is defined as the performance of effective HH with soap and water or ABHr as indicated by HH guidelines (MOHLTC, 2010). According to the HH guidelines developed by the MOHLTC, there are four indications for HH. These include: (a) before initial contact with the patient/patient environment, (b) before aseptic procedures, (c) after body fluid exposure risk, and (d) after contact with the patient or patient environment (OMHLTC, 2010). For the purpose of this study, HH compliance was defined as the nurses' perception of how often they perform HH as recommended by HH guidelines. HH compliance was determined via self-report by individual nurse respondents. This concept was operationalized by eight items (Section F, Appendix D) that asked participants to identify the frequency (0% to

100% in 10% increments) with which they believed they perform HH during the specified clinical situations.

Additional modifications to the original questionnaire. Two sections (B and D) from the original questionnaire (Appendix F) were not included in the modified questionnaire, as they were not pertinent to the research questions of this study. In the original questionnaire, Section B contained 4 questions that tested respondents' knowledge about: (a) the financial costs of treating HAIs, (b) the percentage of patients who developed HAIs, (c) the percentage of patients who died as a result of HAIs, and (d) the length of stay associated with HAIs. Section D of the original questionnaire, which asked respondents to rate the effectiveness of 11 different interventions to increase HH rates, was also deleted. Throughout the original questionnaire the phrases "your department," "the patient," and "training" were replaced with the terms "NICU," "neonate," and "education," respectively. Although none of the items in the five scales (attitude, subjective norms, perceived behavioural control, intentions, and HH compliance) were changed, the examples were adapted to reflect the NICU setting. For example, in the original questionnaire, the last clinical situation in each section was "before touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia)." The author changed the clinical situation to "before touching a patient's groin (femoral pulse) and subsequently examining stomach contents with a naso-gastric tube" based on previous experience in the research setting with the physical assessments of neonates.

A section entitled "Final questions" (Appendix D) was added to the modified questionnaire. One question was used to elicit the overall frequency (0% to 100% in 10%

increments) with which participants' intended to cleanse their hands. A second question was used to elicit participant's overall HH compliance on a scale from 10% to 100%, in 10% increments. The third question asked nurses' perception of their colleague's HH compliance a scale from 10% to 100% in 10% increments (described above), while the fourth question asked nurses to estimate the time it takes them to cleanse their hands.

Scoring. The TPB concept scales (attitude, subjective norms, and perceived behavioural control) were measured on a 7-point likert scale, ranging from 1 to 7. These three scales were scored by summing the item responses and then dividing the sum by the number of items to which the participant responded, to yield a scale score that ranged from 1 to 7. Intentions and self-reported HH compliance were measured on a scale from 10% to 100% in 10% increments. These two scales were scored by summing the 8 item responses and then dividing the sum by the number of items to which the participant responded. This calculation yielded a result that ranged from 10% to 100%.

Statistical Analysis

Descriptive statistics was used to describe the study sample, and to summarize the self-reported HH compliance rates. Specifically, frequencies of the discrete and categorical variables, as well as means, standard deviations (SD), and standard errors (SE) of continuous variables were used. Student's *t* tests and Pearson correlations were also performed to identify unadjusted associations between each of the IVs and the DV, HH compliance (Field, 2005). A significance level of $p \leq .25$ was used to determine which variables were included in the multivariate analysis (discussed below). This liberal *p* value was used to avoid the unnecessary deletion of potentially significant IV from the final multivariate analysis (Hosmer & Lemshow, 2000).

Forward stepwise linear regression analysis was then performed to examine the predictors of HH compliance. In forward linear regression analysis, the IVs with the largest correlation with the DV are entered into the model first. The order in which subsequent IVs are entered into the model is based on their respective correlations with the DV, such that those with the largest correlations are entered into the model first (Field, 2005).

Protection of Human Participants

Approval to conduct the study was obtained from the Research Ethics Boards at the University of Windsor, WRH, the University of Western Ontario, and the Lawson Health Research Institute at SJHC. As noted above, information letters and questionnaires were distributed to all potential participants via the internal mailing system at WRH, but were posted in designated areas throughout the NICU at St. Joseph's Health Care, as per the unit's manager's requirement. The information letter provided information about: (a) the investigator (name and affiliation), (b) the purpose of the study, (c) potential risks and benefits, (d) assurance of confidentiality, (e) time requirement, (f) the right to omit any questions, (g) voluntary nature of participation and the right to withdraw from the study without penalty at any time. The letter also indicated that the researcher would have no knowledge of the identity of individual respondents and that individual responses would not be submitted to the administration of their institution. Nurses were assured that their participation or non-participation in the study would in no way jeopardize their employment or be used to penalize them for past or current HH practices. Respondents were also assured that the study results would be reported in a scholarly journal as aggregate data. Participants indicated their consent by

completion and submission of the anonymous questionnaire. The completed questionnaires were stored in a locked cabinet in the Research Office at the University of Windsor. Only the author and immediate advisors had access to the questionnaires. The electronic database in which all collected data has been stored will be destroyed after 5 years.

Conflict of Interest

The author is an employee of WRH, and has worked in the NICU as a staff nurse and colleague of the nurses at WRH who participated in this study. As a staff nurse, the author held no position of authority over the participants of the NICU at WRH. It is also noteworthy that the author worked an average of six 12-hour shifts per month during the study period. Therefore, the author's limited presence in the unit was unlikely to result in participation due to a sense of obligation toward a well-known friend or colleague. The author also attempted to minimize the risks to her colleagues by the following: (a) questionnaires were complete anonymously, (b) individual responses were not reported to hospital administration, and (c) results will be reported as aggregate data to a scholarly journal.

CHAPTER IV

RESULTS

Data Entry

Accuracy of Input

Upon completion of data collection and data entry, the entire database was reviewed for accuracy of data entry. Accuracy of data entry was checked by searching for out-of-range values for each variable, and then comparing those data points with the corresponding questionnaires. All errors were corrected. The entire database was then reviewed a second time to ensure there were no remaining errors.

Deleted Variables

Several variables were excluded from analysis due to lack of variability. Two variables (gender and overall intention to perform HH [Final Questions, Appendix D]) had no variability, as all respondents were female, and all respondents indicated that their overall intention to perform HH was 100%. In addition, four items (#s 1, 2, 4, and 7) on the subjective norms scale, had no variability and were therefore excluded from inferential analyses. One item in the questionnaire asked participants if they had received formal HH education. Given that more than 90% of participants indicated that they had received formal HH education, this variable was also deleted. According to Tabachnick and Fidell (2001), dichotomous variables with severe ($\geq$ 90:10) splits such as this one should be deleted, as the categories with the smaller number of cases tend to be more influential than the category with the larger number of cases.

Screening for Missing Data

Data were also screened for missingness. One participant did not respond to 20 items (36.4%) of the 55-item HH questionnaire. This participant was excluded from the sample because data were missing for all items on the outcome variable, self-reported HH compliance (Section F, Appendix D). The text that follows provides a summary of how missing data were handled, excluding the aforementioned participant, and the deleted variables.

Table 2 provides an overview of the variables with missing data, the extent of missingness, and the imputation techniques that were used to replace the missing data. To begin, the variables age and experience (i.e. years since completion of nursing education) contained less than 5% missingness. Sample mean substitution was used to replace these missing data points due to the fact that the pattern of missingness was deemed to be non-systematic as determined by Little`s MCAR Test (p =.298) (El-Masri & Fox-Wasylyshyn, 2005). Missing data for the categorical variables level of education, and whether or not the respondent had ever experienced a HH campaign also contained less than 5% missingness. These missing data points were replaced using the sample mode. A small amount of data was missing from each of the five uni-dimensional 8 item scales. As described above, 4 items of the subjective norms scale were deleted from analysis. The remaining 36 items (of the five scales) had a total of 16 missing data points (n = 0.39 %) on this component of the questionnaire. Case mean substitution was used to impute the missing data on the five TPB scales. This method was used because it can be assumed that the score for any individual item on a psychometric scale should be closely related to the participants' scores on the other items on the scale (El-Masri & Fox-

Table 2

Summary of Variable Missingness for Hand Hygiene Questionnaire

Variable	Count	% Missing	Replacement
Age	2	1.8	sample mean
Experience	1	0.9	sample mean
Education	5	4.4	sample mode
Campaign	1	0.9	sample mode
Attitude			
Item #8	1	0.9	case mean
Perceived Behavioural Control			
Item #1	1	0.9	case mean
Item #2	2	1.8	case mean
Item #6	1	0.9	case mean
Item #8	1	0.9	case mean
Subjective Norms			
Item #1	deleted*		
Item #2	deleted*		
Item #3	1	0.9	case mean
Item #4	deleted*		
Item #5	1	0.9	case mean
Item #6	2	1.8	case mean
Item #7	deleted*		
Item #8	2	1.8	case mean
Intentions			
Item #8	1	0.9	case mean
Self-reported HH			
Item #6	1	0.9	case mean
Item #8	2	1.8	case mean

*****item deleted from analysis due to lack of variability in responses

Wasylyshyn, 2005). Overall there were 25 missing data points for the entire questionnaire (excluding the deleted variables), yielding an overall proportion of 0.46%.

Univariate Analysis

Outliers. Outliers are out of range data points that can bias the mean, inflate the standard deviation, and have a disproportionate influence that distorts statistical findings (Field, 2005; Tabachnick & Fidell, 2001). Outliers were identified among variables using a z-score cut-off point of ± 3.29 (Field, 2005). Six variables had data points with one or more z-scores that were greater than or equal to ± 3.29: attitude, perceived behavioural control, subjective norms, intentions, self-reported HH compliance, and HH duration. For each of these variables, the outliers were treated by substituting the outlying raw data point with a new value equal to the next most extreme value in the data set plus one unit (Tabachnick & Fidell, 2001).

Normality. Continuous variables were examined for normality using histograms and skewness and kurtosis values (Field, 2005). Table 3 displays the absolute skewness (S) and kurtosis (K) values for each continuous variable. According to Kline (2011), the distribution of continuous variables can be considered normal if the absolute skewness value is less than 3, and the absolute kurtosis value is less than 10. Most of the variables met these criteria. However, three variables (subjective norms, intentions, and self-reported HH compliance [the DV]) exceeded the acceptable skewness and/or kurtosis values of 3 and 10, respectively. The variables intentions and subjective norms were dichotomized such that participants who chose the extreme values (‘100% intention for HH’ and ‘manager always wants HH’ respectively) were placed in one category and all other participants were place in the second category. Several attempts were made to

transform self-reported HH compliance into a normal distribution using log, square root, and natural log transformations (Tabachnick & Fidell, 2001). The square root transformation was the only transformation that reduced the skewness of the DV distribution. However the decision was made not to use this transformation because it greatly altered the relationship between the original variables in the model, making interpretation quite difficult (Osborne & Overbay, 2004). In addition, it failed to deal with the outlying data points, which were the underlying cause for the skewed distribution (Wilcox & Keselman, 2004). Wilcox and Keselman (2004) suggest using a robust procedure such as the trimmed or windsorized mean to deal directly with outliers and eliminate their deleterious effects. Therefore, the windsorized mean of the DV was calculated, in which 5% of the upper values and 5% of lower values of the DV were temporarily eliminated, the mean of the remaining values was calculated, and then the temporarily eliminated values were replaced with the value of the windsorized mean (Osborne & Overbay, 2004). The absolute skewness and kurtosis values for the new distribution of the DV met the criterion for normality (skewness = 1.33, kurtosis = 1.77).

Table 3

Normality Statistics for Continuous Variables

Variable	M ± SD	Skewness (< 3*)	Kurtosis (< 10*)	Normal Distribution	Treatment
Age	44.91 ± 9.09	0.40	0.29	Yes	
Years since Nursing Education	21.84 ± 9.28	0.44	0.32	Yes	
Years at Current Institution	18.54 ± 8.89	0.38	1.12	Yes	
Attitude	6.69 ± 0.40	1.76	3.66	Yes	
Perceived Behavioural Control	6.71 ± 0.46	2.30	6.86	Yes	
Subjective Norms	6.95 ± 0.17	3.92	17.44	No	Dichotomized
Intention	96.73 ± 8.35	7.23	64.57	No	Dichotomized
Nurses' HH compliance	94.48 ± 8.88	5.64	44.10	No	Transformed (Windsorized mean)
Colleague Compliance	88.98 ± 7.20	1.64	7.12	Yes	
HH Duration	23.22 ± 15.00	1.26	1.57	Yes	

S = Absolute skewness value; K = Absolute kurtosis value; * = criteria used to judge normality

Questionnaire Results

Sample Characteristics

Participants recruited for this study were 113 NICU registered nurses employed in two South Western Ontario hospitals who provided direct care to hospitalized neonates. This represents an overall response rate of 73%. The response rate was slightly lower for the Windsor site (66%, 31 of 47) compared with the London site (76%, 82 of 108). Twenty-seven percent (n = 31) of the participants were employed in Windsor, while 73% (n = 82) were employed in London. As previously noted, all participants were female, as males were not employed as NICU nurses in either hospital. The mean age of participants was 45 years (SD = 9.09), ranging from 22 to 64 years. The number of years since completion of nursing education ranged from 1 to 41 years, with a mean of 22 years (SD = 9.28). As well, the number of years employed at their current institution ranged from 1 to 40 years, with the mean of 19 years (SD = 8.88). With regard to education, the majority (59%, n = 67) of nurses reported their highest level of education as a college diploma, compared to 41% (n = 46) of the sample who had one or more university degrees.

HH Practices and Perceptions in the NICU

Table 4 summarizes HH practices and beliefs about HH as reported by NICU nurse respondents. Overall, nurses reported high rates of HH compliance for themselves and their colleagues. Nurses' scores for both attitude (M = 6.69; mdn = 6.75) and perceived behavioural control (M = 6.71; mdn = 7) were also high. The mean reported duration for HH was 23.22 seconds.

Table 4

Summary of nurses' responses to the self-reported HH compliance, attitude, and perceived behavioural control scales, colleague's compliance and HH duration

Variable	Mean ± SD	Median	Range
Overall (8-item) mean self-reported HH compliance (%)	94.96 ± 5.70	96.57	75 - 100
HH before direct contact with patient (%)	98.22 ± 8.26	100	20 – 100
HH after direct contact with patient (%)	97.21 ± 9.75	100	20 - 100
HH before touching clean site (%)	93.10 ± 13.23	100	20 - 100
HH after exposure to body fluids (%)	98.94 ± 7.72	100	20 - 100
HH after removing gloves used in patient care (%)	92.48 ± 13.18	100	20 - 100
HH after touching object in immediate vicinity of patient (%)	84.56 ± 15.83	90	20 - 100
HH between two patients (%)	98.67 ± 7.85	100	20 - 100
HH between femoral pulse and nasogastric tube (%)	92.65 ± 18.71	100	0 - 100
Colleague compliance (%)	88.98 ± 7.20	90	80 - 100
Attitude*	6.69 ± .40	6.75	4.88 - 7
Perceived Behavioural Control**	6.71 ± .46	7.00	4.25 - 7
HH duration (seconds)	23.22 ± 12.83	20.00	5 - 61

*Attitude 1 = not at all effective; 7 = extremely effective; ** Perceived behavioural control: 1 = extremely difficult; 7 = extremely easy

Research Question #1

This study sought to determine the self-reported HH compliance rates among nurses working in a community based NICU. Nurses were asked to report the frequency with which they performed HH during eight clinical situations. Table 4 provides an overview of how nurses responded to each of these items. The mean of all eight self-reported HH compliance items reveal an overall self-reported compliance rate of 94.96% (SD = 5.69). The highest reported rates of HH occurred after exposure to patient body fluids (98.9%), followed by HH between touching two patients sequentially (98.67%), and before direct contact with a patient (98.22%). The lowest HH rates occurred after touching an object within the patient's vicinity (84.56%, SD = 15.83).

Research Question #2

The aim of the second research question was to determine the cognitive (attitude, subjective norms, perceived behavioural control, intentions) and demographic (gender, age, education, formal HH education, exposure to HH campaigns) factors that are independently associated with compliance with HH guidelines. The text that follows describes the results of preliminary (univariate) and multivariate analyses that were performed to address this research question.

Preliminary Analysis

Prior to conducting multiple linear regression, Pearson's correlations and student's *t* tests were performed to determine the unadjusted associations between the IVs and DV, self-reported HH compliance. Unadjusted associations that achieved a significance level of $p \leq .25$ were included in the multivariate analysis. As indicated in Tables 5 and 6, nine variables met this criterion.

Table 5

Pearson's correlations of continuous variables with self-reported HH compliance

Variable	*R*	*P*
Age (years)	-.115	.23*
Years since completion of nursing education	-.060	.53
Years employed at current institution	-.074	.44
Attitude	.45	<.001*
Perceived Behavioural Control	.42	<.001*
Colleagues' HH Compliance	.25	<.01*

*Indicates $p \leq .25$ and inclusion in multivariate analysis (HH 90%)

Table 6

Student's t-test comparisons of categorical variables with self-reported HH compliance

Variable	n (%)	*M* ± *SD*	*t*	*p*
Education			1.72	.08*
University	46 (41)	96.35 ± 3.53		
College	67 (59)	95.13 ± 3.86		
Hospital Site			-1.1	.275
Windsor	31 (27)	95.08 ± 2.95		
London	82 (73)	95.84 ± 4.02		
Experienced HH Campaign			-.80	.42
Yes	95 (84)	95.05 ± 3.75		
No	18 (16)	96.28 ± 3.86		
Intentions			5.04	<.001*
100%	61 (54)	97.17 ± 2.48		
<100%	39 (46)	93.82 ± 4.21		
Subjective Norms			2.88	<.001*
Always wants HH	100 (89)	96.12 ± 3.25		
Not always	13 (11)	91.83 ± 5.24		
Rank by Top Management			.929	.35
Top Priority	86 (76)	95.81 ± 3.80		
Not Top Priority	27 (24)	95.04 ± 3.70		
Rank by NICU Manager			.25	.80
Top Priority	91 (81)	95.67 ± 3.80		
Not Top Priority	22 (19)	95.45 ± 3.75		
Rank by Respondent			2.00	.05*
Top Priority	94 (83)	95.94 ± 3.52		
Not Top Priority	19 (17)	94.07 ± 4.60		
Rank by NICU Nurses			2.10	.04*
Top Priority	90 (80)	96.00 ± 3.54		
Not Top Priority	23 (20)	94.18 ± 4.32		

*Indicates $p \leq .25$ and inclusion in multivariate analysis

The data were screened for the following assumptions of multiple linear regression: absence of outliers and multicollinearity, linearity, and homoscedasticity. Multivariate outliers were identified using Mahalanobis distances. Each Mahalanobis distance was evaluated against the critical value of the χ^2 distribution, and determined using $p < .001$ and *df* = number of independent variables. Seven Mahalanobis distances were greater than the specified critical value (32). However, the corresponding Cook's distances were <1, therefore the multivariate outliers were deemed non-influential and retained in the multivariate analysis (Field, 2005).

Inspection of the scatter plot of the standardized residuals against the standardized predicted values revealed a random array of the residuals that were evenly dispersed around zero (see Figure 2), indicating that the assumption of homoscedasticity was met. The normal probability plot of the observed versus predicted residuals was also inspected to examine linearity. This plot conformed relatively closely to a straight line (see Figure 3), suggesting that the assumption of normality was met (Field, 2005). Finally, inspection of the histogram (Figure 4) of the residuals was also examined, and indicated that the residuals were normally distributed, thus providing evidence that the set of independent predictors in the model met the assumption of multivariate normality. (Field, 2005).

Collinearity diagnostics (tolerance and variance inflation factor) were used to screen for multicollinearity among the nine IVs that were included in the multivariate analysis. Field (2005) indicates that a VIF greater than 10 and a tolerance below 0.1 may indicate a problem with multicollinearity. Table 7 provides a summary of the collinearity

diagnostics that were obtained from the regression model predicting the DV, self-reported HH compliance. These two indices suggest that multicollinearity was not an issue.

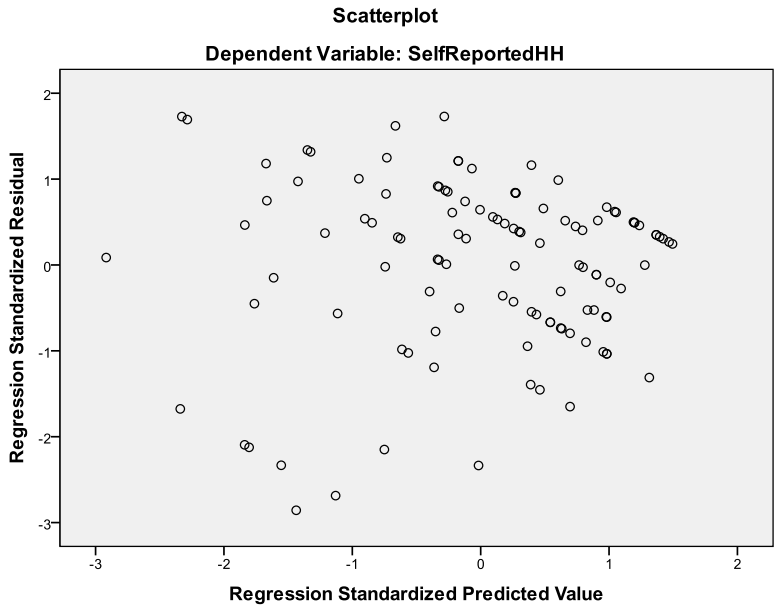

Figure 3. Scatterplot of standardized residuals against standardized predicted values

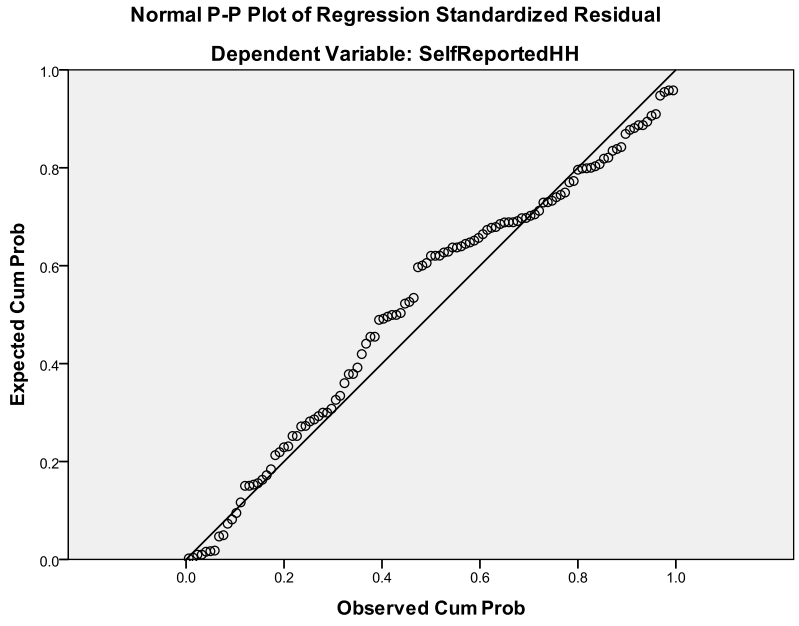

Figure 4. Normality plot of observed versus predicted residuals

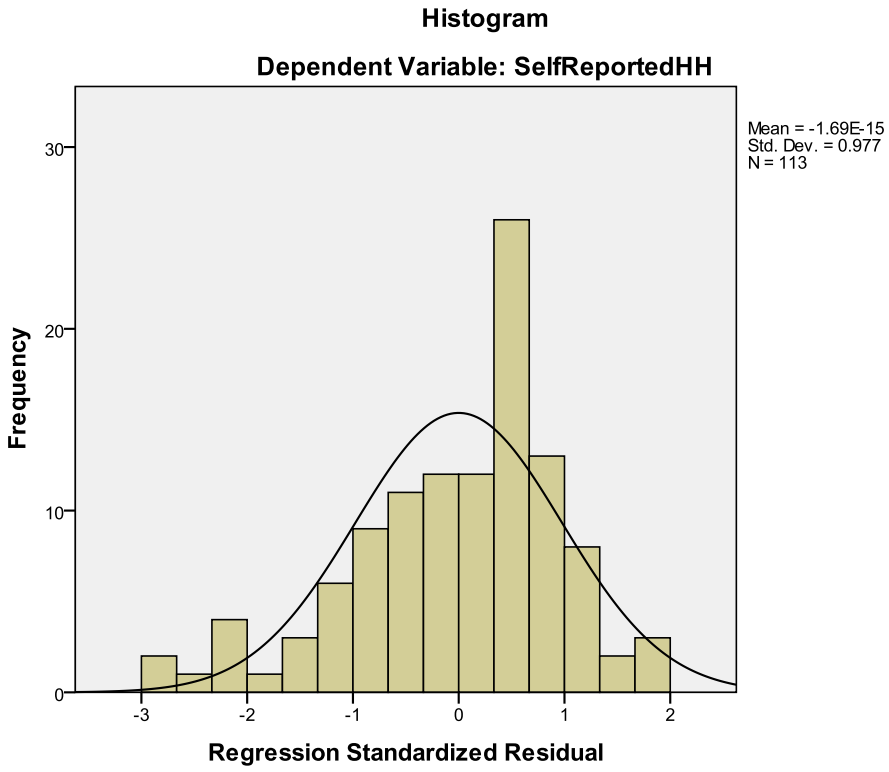

Figure 5. Histogram of standardized residuals

Table 7

Collinearity Diagnostics

Variable	Tolerance <.1*	VIF >10*
Age	.800	1.250
Attitude	.789	1.267
Perceived Behavioural Control	.793	1.261
Colleague's Compliance	.884	1.131
Education	.772	1.295
Intentions	.752	1.330
Subjective Norms	.738	1.355
Rank by Respondent	.456	2.192
Rank by NICU Nurses	.457	2.187

* = criteria used to judge multicollinearity

Linear Regression

Table 8 suggests that five variables were independently related to self-reported HH compliance. These variables include: attitude (β = .279; p < .001), perceived behavioural control (β = .298; p =.002), intentions (β = .253; p = .04), age (β = -.157; p = .038), and colleagues' compliance (β = .155; p = .04). Together, these predictors explain 42.2% of the variance in self-reported HH compliance among NICU nurses.

Table 8

Forward stepwise linear regression for self-reported HH compliance

Variable	*B*	*SE*	*β*	*t*	*p*
Attitude	2.632	.751	.279	3.50	<.001
Perceived Behavioural Control	2.415	.634	.298	3.811	.002
Intentions	1.905	.604	.253	3.151	.04
Age	-.066	.031	-.157	-2.103	.038
Colleague's Compliance	.081	.039	.155	2.081	.04

Constant = 56.536; R^2 = .422, p < .001

CHAPTER V

DISCUSSION

HAIs are the most significant cause of morbidity and mortality among neonates admitted to the NICU (Aziz et al., 2005; Stevens et al., 2007). HH has been declared the single most effective means of reducing HAIs among critically ill neonates (Pessoa-Silva et al., 2006; Won et al., 2004). However, past research has indicated that HH rates among NICU nurses are surprisingly low (Lam et al., 2004; Pessoa-Silva et al., 2008; Won et al., 2004), and few studies have been conducted to examine the factors that are predictive of HH among these nurses. Therefore the purposes of this study were to examine the self-reported HH compliance rates of NICU nurses in South Western Ontario, and to examine the extent to which cognitive (attitude, subjective norms, perceived behavioural control, and intentions) and demographic factors (including gender, age, education, nursing experience, HH education etc.) predict HH compliance among NICU nurses.

Research Question # 1: HH Compliance Rates

In the current study, NICU nurses reported high rates of HH compliance [*M* (of all 8 clinical situations) = 94.96%]. This is consistent with findings of other studies that used self-report measures of nurses' HH compliance. In these studies nurses' self-reported HH compliance rates ranged from 74%, (Moret, Tequil & Lombrail, 2004; O'Boyle, Henly & Larson, 2001; Tai et al., 2009) to 90% (Sax et al., 2007). However, HH compliance rates were substantially lower when measured using direct observation. Four studies (Lam et al., 2004; Pessoa-Silva et al., 2008; Raju & Kobler, 1991; Won et al., 2004) were found that measured HH compliance among NICU nurses via direct observation. The observed HH rates in these studies ranged from 40% (Lam et al., 2004; Pessoa-Silva et al., 2008; Won et

al., 2004) to 59.3% (Raju & Kobler,1991. Given the results of past research, and assertions by Pah Lavan (2005) that HCPs tend to overinflate estimates of their compliance rates, it is likely that the nurses in this study may have provided somewhat inflated estimates of their own HH behaviour.

It is important to note that self-reported behaviours are considered to be an acceptable surrogate for actual behaviours (Ajzen, 1988). Researchers who utilize self-report designs may easily and routinely obtain HH compliance estimates from a large number of HCPs (Moret et al., 2004). This study design also minimizes and/or eliminates issues related to cost, confidentiality, training personnel, and modification of behaviour that is associated with participants' knowledge of being observed (Larson et al., 2004; Maury, Lakermi, Barbut, Offenstadt, 2006; Moret et al., 2004). In addition, studies that have measured compliance using both self-report and direct observation have not provided sufficient evidence to nullify the use of self-report study designs. While some studies (Jenner, Fletcher, Watson et al.,2006; O'Boyle, Henly & Larson, 2001) have demonstrated a poor correlation between compliance rates measured via self-reported and direct observation, others (Larson et al., 2004; Moret et al.,2004) have provided evidence of overall consistency between the two methods. Moreover Jenner, Fletcher, Watson et al. (2006) highlighted an important distinction between the two study designs. Observational studies use a purportedly objective eye witness to measure nurses' HH compliance, while self-report studies offer nurses time to deliberate, and then report on their personal HH practices and/or their idyllic HH practices. This is an important distinction as it highlights the fact that self-reports offer nurses an opportunity to communicate their unique perspectives of the factors that may impact their HH practices. Because researchers and hospitals alike strive to identify and eliminate the factors

that may inhibit HH, self-reports are a logical means of measuring and ultimately understanding the HH practices of NICU nurses.

The results of this self-report study suggest that nurses cleansed their hands most consistently after exposure to body fluids (*M* = 98.94%). This finding is substantiated by both self- report (Tai et al., 2009) and observational studies (El-Masri & Korniewicz, 2009; O'Boyle, Henly, & Larson, 2001) that also found that compliance rates were highest when participants were exposed to body fluids. Blood in particular; as compared with other body fluids such as urine, saliva, sweat or feces; was found to be the greatest predictor of HH compliance (El-Masri & Korniewicz, 2009). Further comparison of the current study results with other self-report HH studies is difficult. Although studies often ask nurses to report their perceived HH compliance for a set of specified clinical situations, studies frequently differ with respect to the clinical situations they specify. However, HH studies tend to agree that higher rates of HH also occur after direct contact with patients, while compliance rates tend to be lower before patient contact. This finding tends to be consistent whether HH is measured via self-report (Sproat & Inglis, 1994, Tai et al., 2009) or direct observation (El-Masri & Korniewicz, 2009; Jenner, Fletcher et al., 2006; O`Boyle, Henly & Larson, 2001). Taken together, the finding that greater compliance rates occur after contact with patients, especially after contact with body fluids suggests that nurses may practice greater HH to protect themselves from risk rather than as a means of reducing HAIs (El-Masri & Korniewicz, 2009).

Research Question # 2: Predictors of HH Compliance

Theory Based Variables

Attitude. The linear regression analysis suggested that NICU nurses who reported more positive attitudes were more likely to report higher levels of HH compliance compared with those with less positive attitudes. This finding is consistent with those of several self-report HH studies (Jenner, Fletcher et al., 2006; Pittet, et al., 2004; Quiros et al., 2007) conducted among mixed groups of medical and nursing staff.

The current study findings conflict with those of Nobile et al. (2002) and O'Boyle, Henly, and Larson (2001), who reported that positive attitudes did not significantly predict HH behaviour. Differences in study results may be due to differences in how the investigators operationalized HH compliance. O'Boyle, Henly, and Larson (2001) operationalized HH compliance via direct observation, whereas the current study used self-report. Although Nobile et al. (2002) also used participants' self-reports of HH compliance, this variable was dichotomized. By contrast, the current study treated self-reported HH as a continuous variable. Dichotomization may have resulted in a loss of information, leading to a difference in study results. In addition, Nobile et al. (2002) used a sample comprised of physicians and nurses while this study sample was comprised of registered nurses only. Previous studies have demonstrated that nurses and physicians tend to differ in their HH practices (Sproat & Inglis, 1994), beliefs regarding HH (Tai et al., 2009), and in the factors that motivate them to perform HH (Jang et al., 2010; Lankford et al., 2003). Thus, the inherent differences in the populations may have contributed to the differences in study results.

Perceived Behavioural Control. This study found perceived behavioural control to be the strongest predictor of self-reported HH. Nurses who perceived that HH was easier to perform were more likely to report performing HH when compared with those who perceived that HH was more difficult to perform. These results are consistent with those of seven HH studies (Erasmus et al., 2009; Jang et al., 2010; Jenner, Fletcher et al., 2006; Jenner, Watson et al., 2006; Nicol et al., 2009; Sax et al., 2007; Tai et al., 2009). By contrast, the results conflict with the studies conducted by O'Boyle, Henly, & Larson (2007) and Pittet et al., (2004). As described above, results may differ due to the inherent differences in samples comprised of physicians (Pittet et al., (2004) versus nurses, and observational (O'Boyle, Henly, & Larson, 2007) versus self-report study designs.

Intentions toward HH. Intentions to perform HH was positively related to self-reported HH compliance. Thus, nurses who intended to perform HH were more likely to cleanse their hands as compared to nurses with lower intentions. This result is consistent with those of previous studies (Jenner, Fletcher et al., 2006; Jenner, Watson et al., 2006). However, this result contrasts with those of O'Boyle, Henly, and Larson (2001) and Pittet et al. (2004), who found no association between intentions and HH compliance. Again, results may differ due to differences in sample composition and study design.

Subjective Norms. In the context of HH, subjective norms refer to nurses' perceptions of the social pressure exerted by others, both superiors and peers, to perform HH. This concept was examined in the current study using questions regarding the respondents' perceptions of their managers' expectations for HH, and nurses' perceptions of their colleagues' HH compliance. The current study found that managers' expectations were not

related to self-reported HH compliance. However, there was a positive relationship between nurses' self-reported HH compliance and perceptions of their colleagues' HH behaviours.

The finding that the manager's expectation had no impact on self-reported HH compliance is consistent with the results of Sax et al. (2007), but contrasts with those of Tai et al. (2009). The Tai group found that perceived managerial expectations was associated with higher levels of self-reported HH compliance among nurses and physicians in Hong Kong hospitals. These results may conflict with the current study due to different perspectives of supervisory authority in Eastern versus the Western cultures. Tsui, Ho, and Lam (2005) suggested that in Hong Kong, supervisors hold the decision making power, and their authority is evident in the fact that they acquire passive consent from their employees. The authors further suggested that conventional practice (in Hong Kong) dictates that supervisees know the boundaries, respect their supervisors' authority, and follow instructions even in situations in which the supervisee may disagree with the supervisor (Tsui et al., 2005). Differences in perspectives pertaining to supervisory authority in Canadian NICU nurses as compared to nurses in Hong Kong may account for the differences in study results.

The finding of a positive relationship between self-reported HH compliance and perceptions of colleagues' HH compliance is consistent with the majority of HH studies that were reviewed. Studies agree that compliance rates tend to be higher if a mentor or colleague has good HH practices (Nicol et al., 2009; Muto et al., 2000; Sax et al., 2007; Snow et al., 2006; Tai et al., 2009), but tends to be lower with poor HH by a mentor or colleague (Erasmus et al., 2009; Jang et al., 2010; Lankford et al., 2003). Although two studies (Jenner, Fletcher et al., 2006; O'Boyle, Henly & Larson, 2001) found that subjective norms were not

an independent predictor of HH compliance, both of these studies measured HH compliance through direct observation as opposed to self-report, as in the present study.

There are several plausible explanations to further explain the finding that nurses' self-reported HH compliance was associated with perceptions of colleagues' behavior, but not with expectations of their manager. Nurses are influenced by their colleagues because they work more closely and more regularly with their colleagues as compared to the unit manager. By contrast, nurses may have greater respect for experienced front line care givers as compared to hospital administrators, who no longer provide bedside care. Finally nurses may believe managers are far removed from bedside care and therefore do not understand the numerous pressures exerted on the bedside nursing staff.

Finally, four separate questions asked nurses to report on how highly they ranked HH in terms of its priority; and how highly they believed it was ranked by their institution, NICU manager, and nurse colleagues. None of these variables were significantly associated with self-reported HH compliance in the multivariate analyses. These findings are consistent with research conducted by Tai et al. (2009) and Sax et al. (2007).

Demographic Variables

Age. The current study findings suggest that nurses of younger ages reported significantly higher rates of HH compliance. This result conflicts with those of five other studies (Pittet et al., 2004; Quiros et al., 2007; Sax et al., 2007; Snow et al., 2006; Tai et al., 2009) that found no relationship between age and HH compliance. However, the findings might be explained by the fact that younger nurses tend to be more recent graduates who may have received extensive HH education in their nursing programs. Therefore the younger

NICU nurse may be more keenly aware of the theoretical relationships been poor HH and HAIs.

Exposure to HH Campaigns. The study results indicate that exposure to a HH campaign did not significantly predict HH compliance. This contrasts with that of Sax et al. (2007) who found that HCPs were more likely to perform HH if they had previous exposure to a HH campaign. This difference in results may be related to the fact that Sax et al. (2007) dichotomized their DV. It is interesting to note that 16% of participants in the current study reported that they had not experienced a HH campaign. However, it became evident during data collection that both WRH and SJHC were actively engaged in the JCYH HH poster campaign established by the MOHLTC (2010). Although they may not have perceived the posters as a "campaign," it is unlikely that any of the study respondents did not experience this campaign. Jenner, Fletcher, Watson et al. (2006) provide an explanation for the nurses' seemingly inaccurate responses to the question of HH campaign exposure. The authors suggested that nurses who overestimate their HH compliance may be oblivious to HH campaigns aimed at increasing their HH behaviour. Therefore, although the data suggest that there was variability among the participants with regard to HH campaign exposure, it is unlikely that such variability actually existed; this may explain why the findings with regard to this variable were not significant.

Additional demographic factors. Consistent with previous research (Pittet et al., 2004; Quiros et al., 2007; Sax et al., 2007; Snow et al., 2006; Tai et al., 2009), neither experience (i.e. years since completion of nurse education), nor years at current institution were independent predictors of self-reported HH compliance. The results of this study also indicated that there was no difference in HH compliance among nurses who obtained a

college diploma compared with those who obtained a university degree. These findings are similar to those of Nobile et al. (2002), who reported no difference in HH compliance among HCPs who obtained a high school diploma compared with those who obtained a college degree. Together, these two studies seem to suggest that a higher level of education does not necessarily lead to improved HH compliance among HCPs. The impact of formal HH education and gender could not be examined in this study due to the 90:10 split in formal HH education, and the fact that the sample was comprised of only female NICU nurses. Interestingly, informal telephone inquiries of 11 of the 13 high acuity NICUs across Ontario suggest that the all-female staff composition found in this study is typical of Ontario NICUs, as only 5 male NICU nurses are currently employed in the 11 NICUs that were queried.

Implications and Recommendations

As described above, the NICU nurses who participated in this study reported high rates of HH compliance. To some, these high rates may offer a sense of relief and/or encouragement. However. one cannot be lulled into a sense of complacency with regard to HH in the NICU, especially in light of the devastating outcomes that can be associated with HAIs in the neonate. Instead, consistent efforts must be exerted in order to achieve the greatly desired, but rarely achieved 100% HH compliance rate. This study offers insight into the areas that may be targeted in order to improve HH rates among NICU nurses. Based on the current study findings, the following discussion provides recommendations for nursing practice, education, theory and research**.**

Practice and Education

Given that a positive attitude about the effectiveness of HH was found to be a significant predictor of compliance, every effort should be made to improve nurses' attitudes

toward HH. Jenner, Watson et al. (2002) suggested that because of the time lag between a lapse in HH compliance and the subsequent development of an HAI in a specific neonate, nurses may not be recognize their role in the transmission of pathogens. Thus nurses may not hold positive attitudes regarding the effectiveness of HH in reducing HAIs and may thus use their own judgment to determine whether or not HH is warranted (Boyce, as cited in Pah Lavan, 2005). This is neither an acceptable nor responsible practice. Therefore, it is recommended that nurses be taught the WHO's evidence-based model for hand transmission (of microorganisms) during patient care (Pittet et al., 2006). It is also recommended that nurses continue to receive formal education about the four indications for HH in a heath care setting (MOHLTC, 2010), and how to correctly cleanse their hands with soap and water or ABHr. NICUs should continue to urge nurses to use these four indications are the basis for their HH practices rather than their own risk assessment criteria, and to cleanse their hands effectively to reduce the transmission of microorganisms.

In addition to formal education, personal experience with HAIs may improve nurses' attitudes towards HH. Nicol et al. (2009) asserted that "individual experiences, particularly vivid episodes, may have a persistent positive influence in instilling sustained improvement in HH practices by strengthening attitudes and intentions as compared with formal HH education" (p.40). The authors suggest that experiential elements, especially emotion-arousing experiences (e.g. graphic videos and/or narratives), may be an important means of improving HH (Nicol et al., 2009). Jenner, Watson, Miller, et al. (2002) conducted an interesting study with students that may be explored as an experiential element with NICU nurses. Students who participated in the study performed fingertip impressions on separate culture plates before and after HH, and then compared the bacterial growth between the two

culture plates. A similar activity performed with NICU nurses may convey a stronger message regarding the necessity of appropriate HH, ultimately augmenting nurses' attitudes (and intentions) with respect to performing HH on a consistent basis. In relation to the specific behavior of lower HH rates after touching an object in the neonates' vicinity, it might be worthwhile to culture some of these objects and show nurses the resulting bacterial growth.

This study found that perceived behavioural control was a significant predictor of compliance in the NICU. Therefore it is highly recommended that hospital administrators work with front line NICU nurses to determine the factors that pose barriers to HH. Although some barriers to HH have been identified in the literature (Jang et al., 2010; Kennedy et al., 2004), it is necessary for administrators to understand unit-specific barriers to HH. Once specific barriers have been identified, administrators and nurses should work together to develop strategies aimed at minimizing these obstacles to HH. A joint endeavour to minimize barriers makes HH a shared priority between nurses and administrators, which may ultimately improve compliance with HH policies and/or guidelines.

Lack of time for HH is one barrier that is not unique to any particular NICU or group of HCPs, so it bears mentioning here. In fact, studies have commonly reported a lack of time (or heavy workload) as a barrier to HH among HCPs (Jenner et al., 2002; O'Boyle, Henly & Ducket, 2001; O'Boyle, Henly & Larson, 2001; Pessoa-Silva et al., 2005). Therefore, in addition to a multitude of conveniently located sinks with soap and paper towels, it is recommended that ABHr dispensers be mounted on each neonate's incubator or crib. (This is the current practice at SJCH, but not at WRH). Placement of ABHr on each incubator or bed substantially reduces the time required to leave the bedside to perform HH (Boyce et al.,

2002) prior to engaging in care of the neonate. It may also serve as a reminder to perform HH upon entering the patient environment, after contact with objects in the patient's environment (including incubator doors), and before contact with neonates (MOHLTC, 2010).

The study found nurses' perceptions of their colleagues' HH compliance to be a significant predictor of self-reported HH compliance. Given this finding, NICUs should work to establish a culture in which nurses can openly remind and encourage their colleagues to practice appropriate HH as indicated by the HH guidelines. NICU nurses should also be encouraged to model excellent HH practices to their peers and novice nurses, medical staff, and other HCPs who visit the NICU. It is also recommended that staff identified, well-respected leaders among the NICU nursing staff perform periodic on-the-spot feedback to their colleagues regarding HH practices. The HH campaign developed by MOHLTC (2010) includes the training, observation tool, and necessary documents to provide nurses with written on-the-spot feedback regarding: (a) the indication(s) for HH, (b) HH method employed, and (c) the extent to which nurses adhered to the HH guidelines.

Nurses' intentions to practice HH was also predictive of their self-reported HH compliance. Therefore every attempt should be made to ensure that nurses have a pre-determined plan to carry out HH in accordance with established guidelines. According to the TPB (Ajzen, 1988), intentions can be impacted by targeting an individual's attitudes, perceived behavioural control, and subjective norms. Therefore, it is suggested that interventions (such as those listed above) be focused on augmenting NICU nurses attitudes, perceived behavioural control, and subjective norms in order to improve their intentions to practice HH consistently and appropriately.

Finally, the results of this study suggest that younger age is associated with higher self-reported HH compliance. Although this finding needs to be verified in future research, it suggests that interventions aimed at improving HH should target older NICU nurses. Because this finding conflicts with other HH studies that have assessed the impact of age on HH compliance, the literature provides little indication about the best strategies that may be used to promote HH among older nurses. However, strategies that may promote improved HH among the older NICU nurses include: public recognition of nurses who practice good HH, identifying an older staff nurse leader to model and promote good HH among their peers, paid education days to re-educate nurses on HH, and support from colleagues and managers.

T**heory and Research**

The results of this study support the TPB by demonstrating that intentions, attitude, perceived behavioural control, and subjective norms were each associated with self-reported HH compliance. In this study attitude, perceived behavioural control, and subjective norms were not regarded as antecedents of intentions as postulated by the TPB. Instead, all four variables were analyzed as direct predictors of self-reported HH compliance. For this reason, future studies should examine whether attitude, perceived behavioural control, and subjective norms are stronger predictors of intentions (as postulated by the TPB), or HH behaviour.

This study is believed to be the first to examine HH compliance rates and its predictors among NICU nurses in South Western Ontario. This research is important because identification of the predictors of HH among NICU nurses can provide direction for interventions to improve HH practices among this group. However, it is recommended that study results be replicated in other Canadian NICUs. Future research may be used to substantiate the relationship between age and compliance, as this is the first known study to

determine that younger age is associated with higher self-reported HH compliance. Emphasis should be placed on determining the interventions that may best improve HH among the older NICU nurses. Future research should also re-examine the relationship between subjective norms and nurses' HH behaviour. Because colleagues' compliance was measured with a single item question in the current study, special attention should be paid to developing and measuring colleague's compliance using an eight item scale similar to those used in this study to measure attitude, subject norms, and perceived behavioral control. It would be beneficial to substantiate whether expectations from nurses' peers or from their managers plays a greater role in HH behaviour. Finally, future researchers should consider measuring nurses' HH compliance through direct observation rather than through self-reports. Direct observation of HH practices may provide: (a) a more objective estimate of nurses' compliance, (b) an understanding of the environmental factors that may predict or inhibit HH compliance, and (c) evidence to support or refute the current study results.

Limitations

Given the self-report nature of the questionnaire, it is likely that social desirability response bias resulted in over-estimation of nurses' self-reported HH compliance rates. This may be especially true among participants who were acquainted with the investigator. However, this possible limitation was minimized by the use of an anonymous questionnaire. Although the study results suggested that the four concepts from the TPB and age were predictive of self-reported HH, we cannot be sure that they would be similarly predictive if HH compliance was measured via direct observation. A second limitation pertains to the use of a single-item measure of subjective norms as it relates to colleagues' compliance. More information about nurses' perceptions of their colleagues' compliance would have been

obtained using an eight item scale similar to those that were used to measure subjective norms pertaining to managers' expectations.

Conclusion

In light of neonates' vulnerability to infection, HAIs remain an important issue for critically ill neonates and their parents. HH compliance among NICU nurses should be equally important, as it is the most effective means of minimizing the transfer of pathogens to neonates. This study is believed to be the first to examine HH compliance rates and its predictors among NICU nurses in South Western Ontario. The results of the study suggest that the TPB provides a useful framework for conceptualizing HH among NICU nurses, as four of its concepts were found to be predictive of self-reported HH compliance. This study also found age to be a predictor of self-reported HH compliance. Thus the findings suggest that efforts aimed at improving HH compliance among NICU nurses be focused on the four TPB concepts and the older nurses working in that area. Given that this was the first study of its kind conducted among nurses in Ontario, and that compliance was measured by nurses' self-report, additional studies using direct observation should be conducted to verify the study results before generalizations can be made of the greater population of NICU nurses. However, one cannot ignore the results of this study as they are consistent with many previous HH studies conducted among HCPs in other settings.

APPENDIX A

ST JOSEPH'S HEALTH CARE

Policy Administration Console

Policy:	Hand Hygiene		
Policy Owner:	Manager, Infection Prevention and Control		
SLT Sponsor:	IVP, Medical Education and Medical Affairs		
Approval By:	City Wide Infection Control Committee	**Date:**	2008-03-01
Effective Date: 2008-04-01	**Reviewed Date:** 2010-02-01	**Revised Date:** 2010-03-30	

This policy applies to: SJH Parkwood Mount Hope RMHC S & L

Similar policy at LHSC: **Policy Name:** Hand Hygiene
Policy Owner(s): Manager, Infection Prevention and Control

POLICY

Hand hygiene is considered the most important and effective measure to prevent the spread of health-care associated infections. Hand hygiene is the responsibility of all individuals involved in health care.

There are two methods of killing/removing microorganisms on the hands:
- Hand sanitizing with alcohol-based hand rub (ABHR)
- Hand washing with soap and water

Alcohol-based hand rub is the preferred method for hand hygiene in clinical situations if hands are not visibly soiled.

Washing hands with **soap and water** is required if there is visible soiling with dirt, blood, body fluids or other body substances.

If hands are visibly soiled and running water is not available, a moistened towelette can be used to remove visible soiling followed by ABHR.

Hand hygiene indications during care include:
- Before initial contact with each patient or items in their environment
- Before putting on gloves when performing an aseptic/invasive procedure
- Before preparing, handling or serving food or medications to a patient
- After care involving contact with body fluids, even if gloves are worn (e.g., wound care, contact with secretions, excretions, blood, urine), after removing gloves and before moving to another activity
- After contact with a patient or items in their immediate surroundings
- When moving from a contaminated body site to a clean body site during care
- Whenever a health care provider is in doubt about the necessity for doing so

The indications for hand hygiene can be simplified into **4 key indications**.

4 Key Indications/Moments for Hand Hygiene:

1. BEFORE initial patient/patient environmental contact

2. BEFORE aseptic procedure
3. AFTER body fluid exposure risk
4. AFTER patient/patient environment contact

Refer to Your 4 Hand Hygiene Moments for detailed information.

Patient hand hygiene:

- Patients should be instructed and encouraged in hand hygiene practices
- Patients may require assistance in performing hand hygiene before eating, after toileting and before leaving their room
- In ambulatory/clinic settings patients should be encouraged to perform hand hygiene upon arrival and before leaving

Personal hand hygiene indications:

- Before preparing, handling, serving or eating food
- After personal body functions

PROCEDURE

1. Techniques for Hand Hygiene

1.1. Soap and Water

a. Remove hand and arm jewellery or push up above wrist
b. Wet hands with warm water
c. Apply 1 or 2 pumps of soap
d. Rub hands together vigorously for 15 seconds to lather the soap and cover all surfaces of hands
e. Pay attention to finger tips, between fingers, backs of hands and base of thumbs
f. Thoroughly rinse soap from hands
g. Blot hands gently with paper towel
h. Dry thoroughly
i. Use paper towel to turn off faucet

1.2. Alcohol-based Hand Rub

a. Remove hand and arm jewellery or push up above wrist
b. Ensure hands are visibly clean (if soiled, use soap and water)
c. Apply 1 or 2 full pumps of product to palm of hand
d. Spread over all surfaces of hands and fingers
e. Pay attention to finger tips, between fingers, backs of hands and base of thumbs
f. Rub hands together until product is dry. This will take 15-20 seconds if sufficient product is used.
g. Hands must be fully dry before touching the patient or patient's equipment/environment to be effective and to eliminate the extremely rare risk of flammability in the presence of an O2-enriched environment or static electricity from carpets

2. Factors That Influence the Effectiveness of Hand Hygiene

2.1. **Nails:** Long nails are difficult to clean, and can pierce gloves and harbour more microorganisms than short nails. Nails should be kept clean and trimmed.

2.2. **Nail Polish:** Chipped nail polish can harbour microorganisms that are not removed by hand washing. Nail polish, if worn, should be fresh and free of chips and cracks.

2.3. **Artificial nails or nail enhancements:** Artificial nails harbour more microorganisms and are more difficult to clean than natural nails. Artificial nails and nail enhancements have been implicated in the transfer of microorganisms such as pseudomonas and outbreaks particularly in neonatal nurseries. Artificial nails or nail enhancements are not to be worn by those giving patient care.

2.4. **Jewellery:** Hand and arm jewellery can hinder hand hygiene. Rings increase the number of microorganisms present on hands and increase the risk of tearing gloves. It is recommended that hand and arm jewellery not be worn by those providing direct patient care. Arm jewellery (if worn), including watches, should be removed or pushed up above the wrist before performing hand hygiene.

2.5. **Condition of Hands:** Lotion provided should be used as it is compatible with the antiseptic present in the hand soap. Dermatitis and skin breakdown should be reported to Occupational Health and Safety.

3. Education

3.1. Staff Education
- a. All staff are required to complete the Infection Prevention & Control Core Competency Training in Hand Hygiene.
- b. See Core Competency Training Modules Hand Hygiene

3.2. Information for Patients
- a. See Hand Hygiene "Just Ask Us"

3.3. Information for Visitors
- a. See Guidelines for Visitors How you can help prevent the spread of germs.

REFERENCES

Ministry of Health and Long Term Care Provincial Infectious Diseases Advisory Committee (PIDAC) Best Practices for Hand Hygiene in All Health Care Settings January 2009

Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force

Ministry of Health and Long Term Care Just Clean Your Hands

Ministry of Health and Long Term Care Provincial Infectious Diseases Advisory Committee (PIDAC) Hand Hygiene Fact Sheet for Health Care Settings

APPENDIX B

WINDSOR REGIONAL HOSPITAL

POLICY & PROCEDURE

MANUAL / INTRANET GROUP	CODE/NUMBER
Infection Control	IP 012
ISSUING AUTHORITY V.P. of Acute Medicine K. McCullough	PAGE Page 1 of 7
SIGNATURE	EFFECTIVE DATE February 2009
AUTHOR Corrinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
REFERENCE Page 6	

Universal Policy	x
Metropolitan Campus	0
Western Campus	0
Malden Park	0
RCC	0
WRCC	0

ONLY APPLIES TO: _____

Hand Hygiene for the Health Care Worker

Policy:

Windsor Regional Hospital recognizes the importance of Hand Hygiene as the single most important practice in the prevention and control of disease transmission and that it directly contributes to patient safety. Windsor Regional Hospital supports the measures that allow all staff, patients and visitors to adhere to hand hygiene recommendations.

Purpose:

To ensure that all staff understand the importance of hand hygiene as the single most important practice in the prevention and control of disease transmission and that it directly contributes to patient safety. To ensure that all staff understand and utilize the appropriate measures of hand hygiene and adhere to all hand hygiene recommendations.

Procedure:

INDICATIONS AND MOMENTS FOR HAND HYGIENE

1. A hand hygiene indication is the reason why hand hygiene is necessary at any given moment. For all staff in providing patient care, there may be several hand hygiene indication "moments" in a single care sequence or activity. The essential indications or "4 moments" are defined as follows:

    - Before initial contact with a patient or items in their environment. This should be done on entry to the room or bed space, even if the patient has not or will not be touched.
    - Before putting on gloves when performing an invasive/aseptic procedure. When moving from a contaminated body site to a clean body site during care.

WINDSOR REGIONAL HOSPITAL

POLICY & PROCEDURE

MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 2 of 7
SIGNATURE	EFFECTIVE DATE: February 2009
AUTHOR: Corinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
REFERENCE: Page 6	

Universal Policy x
Metropolitan Campus 0
Western Campus 0
Malden Park 0
RCC 0
WRCC 0

ONLY APPLIES TO: _____

- After care involving contact with the body fluids of the patient **even if gloves are worn** (such as (but not limited to) assisting with blowing the nose, toileting, doing wound care, contact with secretions, excretions, blood and urine), after removing the gloves and before moving to another activity
- After contact with the patient or items in their immediate surrounding when leaving even if the patient has not been touched

**** However, if the health care provider is ever in doubt about the necessity to perform hand hygiene, then the health care provider should.***

2. Hand hygiene for all staff of Windsor Regional Hospital should include (but is not limited to) the following:

   - Upon entry to all sites of Windsor Regional Hospital
   - After using the toilet or public washroom
   - Before preparing, handling or serving food or medication
   - Prior to eating
   - After coughing, sneezing, blowing of the nose, smoking or any other task where the hands may become contaminated with their own secretions or excretions.
   - At any time when the staff considers that their hands may be contaminated whether or not they are visibly soiled

3. Personal hygiene for the patients or the family/visitors of the patient is also important and often overlooked. Patients and their family/visitors should be encouraged or assisted to perform hand hygiene. Times of hand hygiene may include (but are not limited to):

   - Upon entry to all sites of Windsor Regional Hospital
   - Upon entering and exiting the patient room
   - After using the toilet or public washroom
   - Prior to eating

WINDSOR REGIONAL HOSPITAL	POLICY & PROCEDURE	MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
		ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 3 of 7
		SIGNATURE	EFFECTIVE DATE: February 2009
Universal Policy x Metropolitan Campus o Western Campus o Malden Park o RCC o WRCC o		AUTHOR: Corinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
ONLY APPLIES TO: _____		REFERENCE: Page 6	

- After coughing, sneezing, blowing of the nose, smoking or any other task where the hands may become contaminated with their own secretions or excretions

HAND CARE AND ADORNMENTS

4. A Hand Care Program is provided by Employee Health where by a hand care assessment is made for new staff if they present on hire with an hand/skin condition and any staff who have developed hand skin problems related to the use of hand hygiene products, workplace chemicals and gloves.

5. All Health Care Providers should strive to maintain their hand skin integrity to enable effective hand hygiene. This can be done by several methods including but not exclusive of:
   - Using hand washing products in the recommended techniques (see how to wash and how to sanitize in attached appendix (Techniques for Performing Hand Hygiene).
   - Use hand moisturizers regularly in order to prevent drying and cracking of the skin of the hand
   - Follow up with Employee Health to assess their skin integrity if they are developing hand skin problems.
   - Based on the Hand Care Program provided by Employee Health, follow the comprehensive recommendations by the Health Nurse to improve the hand skin integrity.

6. All managers and senior leadership provide appropriate hand moisturizing skin care products in their working environment and encourage staff to use frequently to minimize the occurrence of irritant contact dermatitis associated with hand hygiene.

7. All managers and senior leadership should refer individual staff to Employee Health if hand skin integrity is an issue for a hand care assessment.

8. To enable effective hand hygiene all Health Care Providers must adhere to the following:

WINDSOR REGIONAL HOSPITAL	POLICY & PROCEDURE	MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
		ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 4 of 7
		SIGNATURE	EFFECTIVE DATE: February 2009
Universal Policy x Metropolitan Campus 0 Western Campus 0 Malden Park 0 RCC 0 WRCC 0 ONLY APPLIES TO: _____		AUTHOR: Corinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
		REFERENCE: Page 6	

- **Natural nails must be kept clean and short (not to show past the end of the finger).** *Long nails are difficult to clean, can harbour higher levels of microorganisms (germs) than short nails and can pierce gloves.*
- **Fingernail polish is not recommended but if worn must be fresh and in good condition.** *Nail polish worn longer than 4 days can harbour microorganisms that are not removed by hand hygiene techniques even with surgical hand scrubs.*
- **Artificial nails and nail enhancements are not to be worn by those having direct patient contact.**
- **Hand and arm jewelry are not recommended as they impede on effective hand hygiene technique.** *Hand and arm jewelry (rings and watches) is hard to clean and hides microorganism from the action of the hand hygiene product as well as rings increase the risk of tears in gloves. If a ring is worn it must be limited to a smooth wedding band without projections or mounted stones and if a watch is worn on the wrist it must be removed or pushed up above the wrist before hand hygiene is performed.*
- **Long sleeves on clothing should not interfere with or become wet when performing hand hygiene.**

HAND HYGIENE PRODUCTS AND PLACEMENT

9. Alcohol-Based Hand Rub (ABHR) is the preferred method of hand hygiene supported by the Ministry of Health and Long Term Care and should be the first choice for hand hygiene in clinical situations when hands are not visibly soiled.

10. Hand washing with soap and water should be used if there is visible soiling on the hands with dirt, blood, body fluids or other body substances.

11. The use of ABHR with a concentration of from 60% to 90% is required and must be available at the point of care (which is the place where the following three elements occur together –the patient, the health care provider and the care or treatment involving patient/patient environment contact) for the use of all staff. *For a detailed guide around*

WINDSOR REGIONAL HOSPITAL	POLICY & PROCEDURE	MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
		ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 5 of 7
		SIGNATURE	EFFECTIVE DATE: February 2009
Universal Policy x Metropolitan Campus 0 Western Campus 0 Malden Park 0 RCC 0 WRCC 0 ONLY APPLIES TO: _____		AUTHOR: Corinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
		REFERENCE: Page 6	

placement of the product the Best Practices For Hand Hygiene document (referenced below) should be consulted.

12. All hand hygiene and hand care products provided must be dispensed in a disposable container that delivers an appropriate volume of the product to perform an adequate technique of hand hygiene. Refer to attached appendix (Techniques for Performing Hand Hygiene). Containers must not be "topped up" or refilled.

13. Liquid soap; paper towels and hot and cold running water must be placed at all sinks for the use of hand washing. *Antimicrobial soap may be used in critical care areas or in other areas where invasive procedures are regularly performed but are not routinely required in other areas.*

14. There must be sufficient hand wash sinks to encourage and assist staff to readily conform to proper hand hygiene. Sinks need to be convenient and accessible. *For detailed requirements and recommendations for placement of sinks, local building codes and the Best Practices For Hand Hygiene document (referenced below) should be consulted.*

15. Non-alcohol, waterless antiseptic agents should not be used as a hand hygiene agent within the hospital.

16. Bar soap for hand hygiene is not acceptable except for individual patient use.

17. Hand hygiene products must not interfere with glove integrity.

TECHNIQUES FOR PERFOMING HAND HYGIENE

18. When using an ABHR, first ensure that your hands are not visibly soiled. Apply a sufficient amount of product onto the palm of your hands (one or two pumps or a squirt about 35 mm in size – about the size of a loonie) and spread product over all surfaces of your hands and rub for a minimum of 15 seconds before the product becomes dry. **Refer to attached appendix (Techniques for Performing Hand Hygiene) for details of the methods in perform this task.**

WINDSOR REGIONAL HOSPITAL	POLICY & PROCEDURE	MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
		ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 6 of 7
Universal Policy x Metropolitan Campus 0 Western Campus 0 Malden Park 0 RCC 0 WRCC 0 ONLY APPLIES TO: _____		SIGNATURE	EFFECTIVE DATE: February 2009
		AUTHOR: Corrinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
		REFERENCE: Page 6	

19. When using soap and water, a minimum of 15 seconds of mechanical lathering is required before rinsing. **Refer to attached appendix (Techniques for Performing Hand Hygiene) for details of the methods in performing this task.**

20. Hands must be fully dry before touching the patient/patient environment and before donning gloves. Dry hands using a method that does not re-contaminate the hands.

21. When performing surgical Hand antisepsis use an antimicrobial soap ensuring it has a sustained activity before donning surgical gloves. ***It is important to note that all staff to whom this would apply must follow the appropriate policy and procedure related to surgical hand scrub that applies to Perioperative procedures.***

GLOVE CONSIDERATIONS

22. The use of gloves does not replace the need for hand hygiene.

23. Wear gloves when it is anticipated that the hands will be in contact with mucous membranes, non- intact skin or bodily fluids as required in the Policy on Routine Practices.

24. The same pair of gloves must not be used for the care of more than one patient.

25. Remove gloves immediately and discard after the activity for which they are used and then perform hand hygiene. Change or remove gloves if moving from a contaminated body site to a clean body site within the same care of one patient.

26. Do not wash or re-use gloves.

HAND HYGIENE EDUCATION, MONITORING AND FEEDBACK

27. All health care providers should receive basic training on hand hygiene and periodic retraining to reinforce the proper procedures which may include one or all of the following:

WINDSOR REGIONAL HOSPITAL	POLICY & PROCEDURE	MANUAL / INTRANET GROUP: Infection Control	CODE/NUMBER: IP 012
		ISSUING AUTHORITY: V.P. of Acute Medicine K. McCullough	PAGE: Page 7 of 7
Universal Policy x Metropolitan Campus 0 Western Campus 0 Malden Park 0 RCC 0 WRCC 0		SIGNATURE	EFFECTIVE DATE: February 2009
ONLY APPLIES TO: _____		AUTHOR: Corinna Brudner	LAST REVISION DATE: October, 2009 LAST REVIEW DATE: June, 2010 NEXT REVIEW DATE: June, 2011
		REFERENCE: Page 6	

- Indications for hand hygiene
- Factors that influence hand hygiene
- Hand hygiene techniques
- Hand care to promote skin integrity

28. All health care providers should promote and encourage patients, families and other visitors to the hospital to use hand hygiene by such methods such as but not limited to:
    - Informational fact sheets
    - Brochures and poster
    - Personal instruction on when and how to perform hand hygiene

29. Monitoring of hand hygiene compliance and timely feedback should be used to promote and improve motivation and compliance of hand hygiene practices.

HAND HYGIENE CONSIDERATION FOR FACILITY DESIGN

30. The department and/or senior leader in charge of any renovation or new construction to the hospital must consult with the Infection Prevention and Control Coordinator and/or Infection Control Practitioner before installing any hand sinks and ABHR dispenser in order to ensure that the plans conform to the recommendations laid out in *the Best Practices For Hand Hygiene document (referenced below)*.

References:

1. Provincial Infectious Diseases Advisory Committee (PIDAC), Best Practices for Hand Hygiene in All Health Care Settings; *Ministry of Health and Long Term Care* Published May 2008.

2. Ministry of Health and Long-Term Care. Just Clean Your Hands Program. Released 2008; Available from: http://www.justcleanyourhands.ca.

APPENDIX C

4 Moments for Hand Hygiene

Why Should We Be So Concerned About Hand Hygiene?

- One in six patients admitted to Canadian hospitals acquire an infection as a consequence of their stay
- Healthcare acquired infections are now the 4th leading cause of death
- Hand hygiene is the single most important means to prevent infections

Key Definitions:

- **Patient Environment:** The immediate space around the patient that may be touched by the patient or the health care worker, while providing care. In the NICU setting the patient care environment would consist of the area from the end of the incubator/crib back to the wall. Everything within that space including pumps, supplies under the incubator/crib and supplies on the back wall are within the patient environment. The table at the end of the incubator/crib is NOT within the patient environment.
- **Hospital Environment:** the environment outside of the patient's immediate environment

What are the clinical indications for hand hygiene?
There are 4 Key Moments for Hand Hygiene:

1. **Before the initial contact with the patient or the patient's environment,** to protect the patient/ patient environment from harmful organisms carried on your hands. It is one of the more commonly missed indications for hand hygiene. Clean your hands before touching the patient or their environment as described above

2. **Before performing an aseptic procedure,** to protect the patient against harmful organisms, including the patient's own flora, entering his or her body which can lead to infection. Before performing an aseptic procedure includes any action that will involve touching or manipulating a site that needs to be protected against organisms such as a wounds, mucous membranes such as the eyes or mouth, and invasive device sites. Perform hand hygiene immediately prior to performing the aseptic procedure including the following examples:
   - Inserting an IV catheter
   - Administering an IV medication
   - Administering a SC medication / injection
   - Changing / reinforcing a dressing
   - Discontinuing a peripheral IV
   - Suctioning
   - Oral / mouth care
   - Inserting a catheter / catheter care
   - Opening a drainage system
   - Accessing / opening a vascular access system
   - Instilling eye drops
   - Performing phlebotomy
   - Administering feeds

4 Moments for Hand Hygiene

3. **After exposure or potential exposure to body fluids and after glove removal,** to protect you and the health care environment from harmful patient organisms. If there is a risk that you may have contaminated your hands with body fluids like blood, urine, or nasal secretions, for example, you should perform hand hygiene afterwards. This includes if you have worn gloves when the exposure (or potential exposure) has occurred. For example, if you put on a pair of gloves to empty a catheter bag, once you have completed your task and removed your gloves, you should perform hand hygiene because you have had a potential exposure to body fluids, even if you are fairly certain you did not get urine on your hands. Common examples of exposure to body fluids include:
    - After obtaining a blood specimen
    - After obtaining specimens / swabs
    - After administering an injection
    - Discontinuing a peripheral IV
    - Emptying a Foley catheter bag
    - Emptying a drainage collection system
    - Intubation or extubation
    - Suctioning
    - Changing a dressing

4. **After you touch the patient,** to protect you and others from the spread of germs. Whenever you finish your care or leave one patient to move to another, you should **ALWAYS** perform hand hygiene.

Basic Principles for Hand Hygiene

- The MOHLTC has advised that in clinical situations alcohol based hand rub (ABHR) is the preferred method for hand hygiene.
- Washing hands **with soap and water** is required when there is visible soiling with dirt, blood or body fluids
- Placement of ABHR should be at the point-of-care which is defined as a site within reaching distance of the place where direct patient care is provided

APPENDIX D

Hand Hygiene and Healthcare Associated Infections in the Neonatal Intensive Care Unit

As a healthcare professional, you are in direct contact with critically ill neonates. For this reason we are interested in your opinion on Hand Hygiene and Healthcare associated infections. Your answers will be kept confidential. Please do not write your name of this questionnaire. The questionnaire should 5 - 10 minutes to complete. Please place the completed questionnaire in the locked drop box located behind the nursing desk. Email the researcher at ryanj@uwindsor.ca for your **FREE $5 Tim Horton's Card.** Thank you for your participation.

SECTION A

Please complete the following

Gender:	Age:	Level of Education:
_____	_____	_____

Years since completion of nursing education:	Number of years employed at your institution:	Have you experienced a hand hygiene promotional campaign in the last year?	Have you received formal hand hygiene education?
_____ years	_____ years	☐ Yes ☐ No	☐ Yes If yes, when _____(year) ☐ No
How highly ranked is hand hygiene by top management of your organization? ☐ Top priority ☐ Top 2-5 priorities ☐ Lower than 5th priority	**How highly ranked is hand hygiene by top management of the NICU?** ☐ Top priority ☐ Top 2-5 priorities ☐ Lower than 5th priority	**How highly ranked is hand hygiene by yourself?** ☐ Top priority ☐ Top 2-5 priorities ☐ Lower than 5th priority	**How highly ranked is hand hygiene by the nursing staff in the NICU?** ☐ Top priority ☐ Top 2-5 priorities ☐ Lower than 5th priority

SECTION B

Please indicate your **perception of the effectiveness** of cleansing your hands to reduce HAIs in the following clinical situations. Please circle one answer only.

		Not at all Effective						Extremely Effective
1.	Before direct contact with a patient	1	2	3	4	5	6	7
2.	After direct contact with a patient	1	2	3	4	5	6	7
3.	Immediately before touching a clean site during patient care (e.g. manipulating IV apparatus)	1	2	3	4	5	6	7
4.	After exposure to a patient's body fluids (e.g. diaper change)	1	2	3	4	5	6	7
5.	After removing gloves used for patient care	1	2	3	4	5	6	7
6.	After touching an object in the immediate vicinity of a patient (e.g. cardiorespiratory monitor)	1	2	3	4	5	6	7
7.	Between touching two patients sequentially	1	2	3	4	5	6	7
8.	Between touching a patient's groin (femoral pulse) and subsequently examining stomach contents (naso-gastric tube manipulation)	1	2	3	4	5	6	7

SECTION C

Please indicate your **perception of the difficulty or ease** of cleansing your hands in the following clinical situations. Please circle one answer only.

		Extremely Difficult						Extremely Easy
1.	Before direct contact with a patient	1	2	3	4	5	6	7
2.	After direct contact with a patient	1	2	3	4	5	6	7
3.	Immediately before touching a clean site during patient care (e.g. manipulating IV apparatus)	1	2	3	4	5	6	7
4.	After exposure to a patient's body fluids (e.g. diaper change)	1	2	3	4	5	6	7
5.	After removing gloves used for patient care	1	2	3	4	5	6	7
6.	After touching an object in the immediate vicinity of a patient (e.g. cardiorespiratory monitor)	1	2	3	4	5	6	7
7.	Between touching two patients sequentially	1	2	3	4	5	6	7
8.	Between touching a patient`s groin (femoral pulse) and subsequently examining stomach contents (naso-gastric tube manipulation)	1	2	3	4	5	6	7

SECTION D

Please indicate your **perception of how much your superiors want you** to cleanse your hands in the following clinical situations. Please circle one answer only.

		Do not care at all						Want me to do it
1.	Before direct contact with a patient	1	2	3	4	5	6	7
2.	After direct contact with a patient	1	2	3	4	5	6	7
3.	Immediately before touching a clean site during patient care (e.g. manipulating IV apparatus)	1	2	3	4	5	6	7
4.	After exposure to a patient's body fluids (e.g. diaper change)	1	2	3	4	5	6	7
5.	After removing gloves used for patient care	1	2	3	4	5	6	7
6.	After touching an object in the immediate vicinity of a patient (e.g. cardiorespiratory monitor)	1	2	3	4	5	6	7
7.	Between touching two patients sequentially	1	2	3	4	5	6	7
8.	Between touching a patient`s groin (femoral pulse) and subsequently examining stomach contents (naso-gastric tube manipulation)	1	2	3	4	5	6	7

SECTION E

Please indicate the percent of time (0 - 100%) **you intend to cleanse** your hands during the following clinical situations. Please circle one answer only.

1.	Before direct contact with a patient	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2.	After direct contact with a patient	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3.	Immediately before touching a clean site during patient care (e.g. manipulating IV apparatus)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4.	After exposure to a patient's body fluids (e.g. diaper change)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
5.	After removing gloves used for patient care	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
6.	After touching an object in the immediate vicinity of a patient (e.g. cardiorespiratory monitor)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
7.	Between touching two patients sequentially	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
8.	Between touching a patient`s groin (femoral pulse) and subsequently examining stomach contents (naso-gastric tube manipulation)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

SECTION F

Please indicate the percent of time (0 - 100%) **you actually cleanse** your hands during the following clinical situations. Please circle one answer only.

Before direct contact with a patient	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
After direct contact with a patient	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Immediately before touching a clean site during patient care (e.g. manipulating IV apparatus)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
After exposure to a patient's body fluids (e.g. diaper change)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
After removing gloves used for patient care	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
After touching an object in the immediate vicinity of a patient (e.g. cardiorespiratory monitor)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Between touching two patients sequentially	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Between touching a patient`s groin (femoral pulse) and subsequently examining stomach contents (naso-gastric tube manipulation)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

FINAL QUESTIONS

i. Please indicate the percent of time (0 - 100%) that you **intend to cleanse your hands** as recommended by HH guidelines?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

ii. Please indicate the percent of time (0 - 100%) that you **cleanse your hands** as recommended by HH guidelines?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

iii. In your opinion, what is the **average compliance of Healthcare professionals** with HH guidelines?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

iv. In your opinion, what is the **average length of time** it takes you to cleanse your hands _____(seconds)?

APPENDIX E

RE: Request for Permission to use Questionnaire

From: **ryanj@uwindsor.ca** on behalf of **Josepha TAI** (taiwm@ha.org.hk)
Sent: June 18, 2010 10:18:52 AM
To: candaceryan_7@hotmail.com

Dear Ryan,

Thanks for your requisition.

This mail serves as a permission to use the questionnaire in my article "Nurses and Physicians' Perceptions of the Importance and Impact of Health-care Associated Infections and Hand Hygiene: a Multi-Centre Exploratory Study in Hong Kong".

Best regards,
Josepha

From: Ryan C [mailto:ryanj@uwindsor.ca]
Sent: Friday, June 18, 2010 12:36 PM
To: didier.pittet@hcuge.ch; Josepha TAI, QMH SNO(ICN)
Subject: Request for Permission to use Questionnaire

Good Morning Professors Pittet and Tai,

I am a MSc. candidate at the University of Windsor, Windsor, Canada. For my thesis I would like to replicate your study among Neonatal nurses in a small community hospital in Windsor, Canada.

Therefore I would like permission to use the questionnaire published in your article "Nurses and Physicians' Perceptions of the Importance and Impact of Health-care Associated Infections and Hand Hygiene: a Multi-Centre Exploratory Study in Hong Kong. The article was published in 2009 in the journal **Infection 37(4): 320-333.**

I fully intend to give yourself and your colleagues full credit for the questionnaire.

thank you for your consideration,

Candace Ryan BSc., RN, MSc. (C)

RE: Request for Permission to use Questionnaire

From: **ryanj@uwindsor.ca** on behalf of **PITTET Didier** (Didier.Pittet@hcuge.ch)
Sent: September 10, 2010 3:57:23 PM
To: candaceryan_7@hotmail.com

Dear Candace,

Professor Pittet gives permission willingly for you to use the questionnaire in the article cited below. However, I note that one of the co-authors, Josepha Tai, has already given you this permission in mid-June.

Kind regards,
Rosemary Sudan
for Professor Didier Pittet

De : Ryan C [mailto:ryanj@uwindsor.ca]
Envoyé : mardi, 7. septembre 2010 07:20
À : PITTET Didier
Objet : Request for Permission to use Questionnaire

Good Morning Professor Pittet,

I am a MSc. candidate at the University of Windsor, Windsor, Canada. For my thesis I would like to replicate your study among Neonatal nurses in a small community hospital in Windsor, Canada.

Therefore I would like permission to use the questionnaire published in your article "Nurses and Physicians' Perceptions of the Importance and Impact of Health-care Associated Infections and Hand Hygiene: a Multi-Centre Exploratory Study in Hong Kong. The article was published in 2009 in the journal **Infection 37(4): 320-333.**

I fully intend to give yourself and your colleagues full credit for the questionnaire.

thank you for your consideration,

Candace Ryan BSc., RN, MSc. (C)

APPENDIX F

Appendix

Questionnaire on hand hygiene and nosocomial infections for healthcare workers

You are in direct contact with patients on a daily basis; this is why we are very interested in your opinion on healthcare-associated infections (HCAIs) and hand hygiene. Your answers will be kept confidential. It should take you about 15 minutes to fill in this questionnaire. Please read the questions carefully, and then respond spontaneously.

Section A

A1. Gender: O female O male
A2. Age: O ≤ 20 O 21 – 30 O 31 – 40 O 41 – 50 O > 51
A3. Years since completion of basic professional training: _____ years
A4. Years in present institution: _____ years
A5. Profession: O nurse O physician O health care assistant O others: _____
A6. Department: O medicine O surgery O intensive care unit
O other (specify): _____
A7: Have you experienced a hand hygiene promotional campaign in the past? O no O yes: year _____
A8: Did you receive a formal education in hand hygiene after your basic training? O no O yes: year _____

Section B

In this session of the questionnaire, we are interested in your perception of the importance and impact of HCAIs in your country.

In your opinion:
B1. On average, what percentage (between 0 and 100%) of hospitalized patients will suffer from an HCAI? _____%
B2. On average, what percentage (between 0 and 100%) patients with an HCAI will die due to the infection? _____%
B3. On average, how many additional days will patients with an HCAI have to stay in hospital because of their infection? _____
B4. On average, how much does an HCAI cost in HK dollars? _____

Section C

In this session, we are interested in your perception of the importance of hand hygiene.
In your opinion:
C1. What percentage of HCAIs can be prevented by optimal hand hygiene practices: _____%
C2. On average, how many times per hour do you (ideally) have to cleanse your hands during your patient care activity? _____
C3. What is the average compliance (between 0 and 100%) of healthcare workers with hand hygiene recommendations at your institution (*in general?*)? _____%
C4. How highly ranked is the issue of hand hygiene among all patient safety issues by the top management of **your institution**?
O top priority O among 2-5 top priorities O lower than 5th priority
C5. How highly ranked is the issue of hand hygiene among all patient safety issues by the top management of **your department**?
O top priority O among 2-5 top priorities O lower than 5th priority
C6. How highly ranked is the issue of hand hygiene among all patient safety issues by **yourself**?
O top priority O among 2-5 top priorities O lower than 5th priority

Section D

Healthcare workers do not usually cleanse their hands often enough during patient care.
We are interested in your judgment of the **effectiveness** of the following interventions to increase compliance with hand hygiene guidelines in a healthcare institution.

D1. The head of your department regularly includes this topic in his/her main messages to staff.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D2. Your preferred superior performs hand hygiene each time this is required (being a perfect example).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D3. The healthcare facility makes alcohol-based handrub easily available at each point of patient care.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D4. Hand hygiene posters are displayed in patient care areas of the healthcare facility as reminders.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D5. Each healthcare worker receives basic training in hand hygiene.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D6. Clear, easily understandable hand hygiene guidelines are easily accessible for every healthcare worker.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D7. Healthcare workers receive regular feedback on their compliance with recommended hand hygiene practices (results of direct observations).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D8. Revision of common patient care protocols to reduce the frequency of mandatory indications for hand hygiene.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D9. You perform hand hygiene each time this is required (being a perfect example).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D10. Patients are educated about the importance of hand hygiene during care by healthcare workers and remind them to perform it.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

D11. A promotional campaign for hand hygiene featuring most of the elements mentioned above (D1-D10).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Section E

In this session of the questionnaire, we are interested in your opinion of the clinical application of hand hygiene.

A. Please indicate **your perception of the effectiveness** of cleansing your hands to reduce HCAIs in the following clinical situations (by filling in a "O") on the visual scale.

Ea1. Before direct contact with a patient (e.g. helping him/her into bed).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea2. After direct contact with a patient (e.g. after having examined his/her elbow).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea4. After exposure to a patient's body fluids (e.g. respiratory secretions).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea5. After removing gloves used for patient care.
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea7. Between touching two patients sequentially (e.g. measuring the blood pressure of pt. A, then of pt. B).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

Ea8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).
Not all effective O----------O----------O----------O----------O----------O----------O Extremely effective

B. Please indicate **your perception of the difficulty or ease** to cleanse your hands in the following clinical situations (by filling in a "O") on the visual scale.

Eb1. Before direct contact with a patient (e.g. helping him/her into bed).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb2. After direct contact with a patient (e.g. after having examined his/her elbow).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb4. After exposure to a patient's body fluids (e.g. respiratory secretions).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb5. After removing gloves used for patient care.
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb7. Between touching two patients sequentially (e.g. measuring the blood pressure of patient A, then of patient B).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy
Eb8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).
Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy

C. Please indicate **your perception of how much your superiors want you** to cleanse your hands in the following clinical situations (by filling in a "O") on the visual scale.

Ec1. Before direct contact with a patient (e.g. helping him/her into bed).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec2. After direct contact with a patient (e.g. after having examined his/her elbow).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec4. After exposure to a patient's body fluids (e.g. respiratory secretions).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec5. After removing gloves used for patient care.
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec7. Between touching two patients sequentially (e.g. measuring the blood pressure of patient A, then of patient B).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it
Ec8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).
Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it

D. Please indicate in **which of the following clinical situation** you actually cleanse your hands (by filling in a "O") on the following visual scale.

Ed1. Before direct contact with a patient (e.g. helping him/her into bed).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed2. After direct contact with a patient (e.g. after having examined his/her elbow).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed4. After exposure to a patient's body fluids (e.g. respiratory secretions).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed5. After removing gloves used for patient care.

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed7. Between touching two patients sequentially (e.g. measuring the blood pressure of patient A, then of patient B).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Ed8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

And some summary questions:

E9. Please indicate on the visual scale your perception of the **effectiveness** of cleansing your hands to reduce HCAIs:

Not all effective O---------O---------O---------O---------O---------O---------O Extremely effective

E10. Please indicate your perception of **the ease or difficulty** of actually cleansing your hands during your clinical work with patients:

Extremely difficult O---------O---------O---------O---------O---------O---------O Extremely easy

E11. Please indicate your perception of **how much your supervisors want you** to cleanse your hands during your clinical work with patients:

Do not care at all O---------O---------O---------O---------O---------O---------O Want me to do it

E12. Please indicate the number of times (0-100%) you actually cleanse your hands when required:

O---------O---------O---------O---------O---------O---------O---------O---------O---------O---------O

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

REFERENCES

Aiello, A.E., Cimiotti, J., Della-Latta, P., & Larson, E. L. (2003). A comparison of the bacteria found on the hands of homemakers and neonatal intensive care unit nurses. *Journal of Hospital Infection, 54,* 310-315. doi:10.1016/S0195-6701(03)00146-4

Ajzen, I. (1985). A theory of planned behavior. In J. Kuhl & J.Beckmann (Eds.), Action-control: from cognition to behavior (pp 11-35). Heidelberg: Springer-Verlag.

Ajzen, I. (1988). Attitudes, personality, and behaviour: A review of its application to health-related behaviours. Buckingham, UK: Open University Press.

Auriti, C., Maccallini, A., Di Liso, G., Di Ciommo, V., Ronchetti, M. P., & Orzalesi, M. (2003). Risk factors for nosocomial infections in a neonatal intensive-care unit. *Journal of Hospital Infection, 53,* 25-30. doi:10.1053/jihn.2002.1341

Aziz, K., McMillan, D. D., Andrews, W., Pendray, M., Qui, Z., Karuri, S., et al. (2005). Variations in rates of nosocomial infections among Canadian neonatal intensive care units may be practice-related. *BMC Pediatrics, 5,* 22-34. doi:10.1186/1471-2431-5-22

Baker, G. R., Norton, P. G., Flintoft, V., Blais, R., Brown, A., Cox, J…Tamblyn, R. (2004). The Canadian adverse events study: Incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal 170*(10), 1678-1686. doi:10.1053/cmaj.1040498

Banerjee, S. N., Grohskopf, L. A., Sinkowitz-Cochran, R. L., Jarvis, W. R., NNIS, PPN Incidence of pediatric and neonatal intensive care unit-acquired infections. Infection Control and Hospital Epidemiology, *27*(6), 561-570.

Bhalla, A., Pultz, N. J., Gries, D. M., Ray, A. J., Eckstein, E. C., Aron, D. C. et al. (2004). Acquisition of nosocomial pathogens on hands after contact with environmental surfaces near hospitalized patients [Electronic version]. *Infection Control and Hospital Epidemiology, 25*(2),164-170.

Bloom, T. B., Craddock, A., Delmore, P. M., Kurlinski, J. P., Voelker, M., Landfish, N., et al. (2003). Reducing acquired infections in the NICU: Observing and implementing Meaningful differences in process between high and low acquired infection rate centers. Journal of Perinatology, *23*, 489-492.

Boyce J. M., Pittet, D. (2002). Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. *Morbidity Mortality Weekly Report Recommendations and Reports, 5*1(RR16), 1-44. Retreived from http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5116a1.htm

Brady, M. T. (2005). Health care-associated infections in the neonatal intensive care unit. *American Journal of Infection Control, 33*, 268-275. doi: 10.1016/j.ajic.2004.11.006

Callaghan, C. (2007). Infection control in the neonatal intensive care unit [Electronic version]. *Nursing Standard, 22* (1), 35-42.

Carey, A. J., Saiman, L., & Polin, R. A. (2008). Hospital-acquired infections in the NICU: Epidemiology for the new millennium. *Clinical Perinatology, 35*, 223-249. doi:10.1016/j.clp.2007.11.014

Chudleigh, J., Fletcher, M., & Gould, D. (2005). Infection control in neonatal intensive care units. *Journal of Hospital Infection, 61,* 123-129. doi:10.1016/j.jhin.2005.02.017

Clark, R., Powers, R., White, R., Bloom, B., Sanchez, P., & Benjamin, D. K. Jr. (2004). Nosocomial infection in the NICU: A medical complication or unavoidable problem? *Journal of Perinatology, 24,* 382-388. doi:10.1038/sj.jp.7211120

Creedon, S. A. (2005). Healthcare workers' hand decontamination practices: Compliance with recommended guidelines [Electronic version]. *Journal of Advanced Nursing, 51*(3), 208-216.

Docherty, S. L., Miles, M. S., Holditch-Davis, D. (2002). Worry about child health in mothers of hospitalized medically fragile infants. Advances in Neonatal Care, *2*(2), 84-92.

Duggan, J. M., Hensley, S., Khuder, S., Papadimos, T. J., & Jacobs, L. (2008). Inverse correlation between level of professional education and rate of handwashing compliance in a teaching hospital. *Infection Control and Hospital Epidemiology, 29*(6), 534-538. doi:10.1086/588164

Erasmus, V., Brouwer, W., van Beck, E. F., Oenema, A., Daha, T. J., Richardus, J. H. et al. (2009). A qualitative exploration of reasons for poor hand hygiene among hospital workers: Lack of positive role models and of convincing evidence that hand hygiene prevents cross-infection. *Infection Control and Hospital Epidemiology, 31*(3), 283-294. doi:10.1086/596773

Erasmus, V., Daha, T. J., Brug, H., Hendrik, R., Behrendt, M. D., Vos, M. C. et al. (2010). Systematic review of studies on compliance with hand hygiene guidelines in hospital

care. *Infection Control and Hospital Epidemiology, 31*(3), 283-294. doi:10.1086/650451

Field, A. (2005). Discovering statistics using SPSS (2nd ed.). London: Sage Publications.

Field, A. (2010). Discovering statistics using SPSS (3rd ed.). Washington DC: Sage Publications

Gilmore, G. K. (2003). Evolving standards challenge compliance [Electronic version]. *Nursing Management, 34*(12), 24-26.

Holditch-Davis, D. & Miles, M. S. (2000). Mothers' stories about their experiences in the neonatal intensive care unit. *Neonatal Network, 19*, 13-21.

Hosmer, D., & Lemshow S., eds. (2000) Applied Logistic Regression. New York: John Wiley & Sons.

Jang, J., Wu, S., Kirzen, D., Moore, C., Youssef, G., Tong, A., et al. (2010). Focus group study of hand hygiene practice among healthcare workers in a teaching hospital in Toronto, Canada. *Infection Control and Hospital Epidemiology 31*(20, 144-150. doi:10.1086/649792

Jenner, E. A., Fletcher, B., Watson, P., Jones, F. A., Miller, L., & Scott, G. M. (2006). Discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals. *Journal of Hospital Infection, 63*, 418-422. doi:10.1016/j.jhin.2006.03.012

Jenner, E. A., Watson, P. W. B., Miller, L., Jones, F., & Scott, G. M. (2002). Explaining hand Hygiene practice: An extended application of the Theory of Planned Behaviour. *Psychology, Health & Medicine, 7*(3), 311-326. doi:10.1080/13548500220139412

Kennedy, A. M., Elward, A. M., & Fraser, V. J. (2004). Survey of knowledge, beliefs, and practices of neonatal intensive care unit healthcare workers regarding nosocomial infections, central venous catheter care, and hand hygiene [Electronic version]. *Infection Control and Hospital Epidemiology*, *25*(9), 747-752.

Korniewicz, D. M., & El-Masri, M. (2010). Exploring the factors associated with hand hygiene compliance of nurses during routine clinical practice. *Applied Nursing Research, 23*(2), 86-90. doi:10.1016/j.apnr.2008.06.002

Kline, R. B. (2011). Principles and practice of structural equation modeling (3rd ed.). New York, NY: Guildford Press.

Lankford, M. G., Zembower, T. R., Trick, W. E., Hacek, D. M., Noskin, G.A., & Peterson L. R. (2003). Influence of role models and hospital design on hand hygiene of healthcare Workers [Electronic version]. *Emerging Infectious Diseases, 9*(2), 217-223.

Lam, B. C. C., Lee, J., & Lau, Y. L. (2004). Hand hygiene practices in a neonatal intensive care unit: A multimodal intervention and impact on nosocomial infection. *Pediatrics, 114*(5), e565-e571. doi:10.1542/peds.2004-1107

Larson, E. L., Aiello, A. E., & Cimiotti, J. P. (2004). Assessing nurses' hand hygiene practices by direct observation or self-report. *Journal of Nursing Measurement, 12*(1), 77-85.

Larson, E. L., Cimiotti, J., Haas, J., Parides, M., Nesin, M., Della-Latta, P., et al. (2005). Effect of antiseptic handwashing vs. Alcohol sanitizer on health-care associated infections in neonatal intensive care units [Electronic version]. *Archives of Pediatrics & Adolescent Medicine, 159,* 377-383.

Larson, E. L., McGinley, K. J., Foglia, A., Leyden, J. J., Boland, N., Larson, J., et al. (1992). Handwashing practices and resistance and density of bacterial hand flora on two pediatric units in Lima, Peru. *American Journal of Infection Control, 20,* 65-72.

Lewis, K. L., & Thompson, J. M. (2009). Health care professionals' perceptions and knowledge of infection control practices in a community hospital [Electronic version]. *The Health Care Manager, 28*(3), 230-239.

Leroyer, A., Bedu, A., Lombrail, P., Desplanques, L., Dinkite, B., Bingen, E…Brodin, M. (1997). Prolongation of hospital stay and extra costs due to hospital-acquired infection in a neonatal unit [Electronic version]. *Journal of Hospital Infection, 35,* 37-45.

Maury, E., Moussa, N., Lakermi, C., Barbut, F., & Offenstadt. G. (2006). Compliance of health care workers to hand hygiene: Awareness of being observed is important. Intensive Care Medicine, *32,* 2088-2089. doi:10.1007/s00134-006-0398-9

Muto, C. A., Sistrom, M.G., & Farr, B, M. (2000). Hand hygiene rates unaffected by installation of dispensers of a rapidly acting hand antiseptic. *American Journal of Infection Control, 8,* 273-276. doi:10.1067/mic.2000.103242

Nagata, E., Brito, A. S. J., & Matsuo, T. (2002). Nosocomial infections in a neonatal intensive care unit: Incidence and risk factors. *American Journal of Infection Control, 30,* 26-31. doi:10.1016/mic.2002.119823

Nicol. P. W., Watkins, R. E., Donovan, R. J., Wynanden, D., & Cadwallader, H. (2009). The power of vivid experience in hand hygiene compliance. *Journal of Hospital Infection, 72,* 36-42. doi:10.1016/j.jhin.2009.01.021

Nobile, C. G. A., Montuori, P., Diaco, E., & Villari, P. (2002). Health personnel and hand decontamination in intensive care units: Knowledge, attitudes, and behaviour in Italy. *Journal of Hospital Infection, 51,* 226-232. doi:10.1053/jhin.2002.1248

O`Boyle, C. A., Henly, S. J., & Larson, E. (2001). Understanding adherence to hand hygiene recommendations: The Theory of planned behaviour. *American Journal of Infection Control, 29*(6), 352-360. doi:10.1067/mic.2001.118405

O`Boyle, C. A., Larson, E., & Duckett, L. J. (2001). Nurses' motivation to wash their hands: A standardized measurement approach. *Applied Nursing Research, 14*(3), 136-145. doi:10.1053/apnr.2001.24412

Ontario Ministry of Health and Long Term Care. (2010, February 12). Just clean your hands: Ontario's evidence-based hand hygiene program.Retrieved July 16, 2010, from http://www.health.gov.on.ca/en/ms/handhygiene/hospitals/default.aspx

Osborne, J. W., & Overbay, A. (2004). The power of outliers (and why researchers should always check for them). [Electronic version]. *Practical Assessment, Research & Evaluation*, 9(6).

Pender, N. J., Murdaugh, C. L., & Parsons, M. (2002). *Health promotion in nursing practice* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Pessoa-Silva, C. L., Dharan, S., Hugonnet, S., Touveneau, S., Posfay-Barbe, K., Pfister, R., et al. (2004). Dynamics of bacterial hand contamination during routine neonatal care [Electronic version]. *Infection Control and Hospital Epidemiology, 25*(3), 192-197.

Pessoa-Silva, C. L., Posfay-Barbe, K., Pfister, R., Touveneau, S., Perneger, T. V., & Pittet, D. (2005). Attitudes and perceptions toward hand hygiene among healthcare workers caring for critically ill neonates [Electronic version]. Infection *Control and Hospital*

Epidemiology, *26*(3), 305-311.

Pessoa-Silva, C. L., Hugonnet, S., Pfister, R., Touveneau, S., Dharan, S., Posfay-Barbe, K., et al. (2006). Reduction of health care associated infection risk in neonates by successful hand hygiene promotion. *Pediatrics*, *120*, e382-e390. doi:10.1542/peds.2006-3712

Pittet, D., Mourouga, P., Perneger, T. V., et al. (1999). Compliance with handwashing in a teaching hospital [Electronic version]. Annuals of Internal Medicine, *130*(2), 126-130.

Pittet, D., Hugonnet, S., Harbarth, S., Mourouga, P., Sauvan, V., Touveneau, S., & Perneger, T. V. (2000). Effectiveness of a hospital wide programme to improve compliance with hand hygiene [Electronic version]. *The Lancet, 356*, 1307-1311.

Pittet, D., Simon, A., Hugonnet, S., Pessoa-Silva, C. L., Sauvan, V., & Perneger, T. V. (2004). Hand hygiene and physicians: Performance, beliefs, and perceptions Electronic version]. *Annuals of Internal Medicine*, *141,* 1-8.

Pittet, D., Allegranzi, B., Sax, H., Dharan, S., Pessoa-Silva, C. L., Donaldson, L., Boyce. J. M. on behalf of the WHO Global Patient Safety Challenge, World Alliance for Patient Safety. (2006). Evidence-Based model for hand transmission during patient care and the role of improved practices [Electronic version]. *Lancet Infectious Diseases, 6,* 641-652.

Pittet, D., Allegranzi, B., Boyce, J. (2009). World Health Organization World Alliance for Patient Safety First Global Patient Safety Challenge Core Group of Experts. The World Health Organization Guidelines on Hand Hygiene in Health Care and their consensus recommendations. Infect Control Hosp Epidemiol. 30(7), 611-22. Retrieved from http://whqlibdoc.who.int/publications/2009/9781241597906_eng.pdf

Polak, J. D., Ringler, N., & Daugherty, B. (2004). Unit based procedures: Impact on the incidence of nosocomial infections in the newborn intensive care unit. *Newborn and Infant Nursing Reviews, 4*(1), 38-45. doi:10.1053/j.nainr.2003.12.001

Quiros, D., Lin S., & Larson, E. L. L. (2007). Attitudes toward practice guidelines among intensive care unit personnel: A cross-sectional anonymous survey. *Heart & Lung, 36*(4), 287-297. doi:10.1016/j.hrtlng.2006.08.005

Raju, T. N. K., & Kobler, C. (1991). Improving hand hygiene habits in the newborn nurseries [Electronic version]. *American Journal of the Medical Sciences, 302*(6), 355-358.

Raskind, C. H., Worley, S., Vinski, J., & Goldfarb, J. (2007). Hand hygiene compliance rates after an educational intervention in a neonatal intensive care unit [Electronic version]. *Infection Control and Hospital Epidemiology*, *28*(9), 1096-1098.

Rickard, N. A. (2004). Hand hygiene: Promoting compliance among nurses and health workers. *British Journal of Nursing, 13,* 404-410.

Saiman, L. (2002). Risk factors for hospital-acquired infections in the neonatal intensive care unit. Seminars in Perinatology, *26*(5), 315-321.

Saiman, L. (2006). Strategies for prevention of nosocomial sepsis in the neonatal intensive care unit. Current Opinions in Pediatrics, *18*, 101-106.

Saiman, L., Lerner, A., Saal, L., Todd, E., Fracaro, M., Schneider, N., et al. (2002). Banning artificial nails from health care settings. *American Journal of Infection Control*, *30*, 252-254. doi: 10.1067/mic.2002.122102

Sankaran, K., Chien, L-Y., Walker, R., Seshia, M., Ohlsson, A., Lee, S. K., et al. (2002). Variations in mortality rates among Canadian neonatal intensive care units [Electronic version]. *Canadian Medical Association Journal*, *166*(2), 173-178.

Sax, H., Uckay, I., Richet, H., Allegranzi, B., & Pittet, D. (2007). Determinants of good adherence to hand hygiene among healthcare workers who have extensive exposure to hand hygiene campaigns. *Infection Control and Hospital Epidemiology, 28*(11), 1267-1274. doi:10.1086/521663

Sheng, W.H., Wang, J.T., Lu, D.C.T., Chie, W.C., Chen, Y.C., & Chang, S.C. (2005). Comparative impact of hospital-acquired infections on medical costs, length of hospital stay and outcome between community hospitals and medical centres. Journal of Hospital Infection *59*, 205-214.

Snow, M., White, G. L. Jr., Alder, S. C., & Stanford, J. B. (2006). Mentor`s hand hygiene practices influences student`s hand hygiene rates. *American Journal of Infection Control, 34*(1), 18-24. doi:10.1016/j.ajic.2005.05.009

Soper, D. S. (2011). *The free statistics calculators website*. Online software: http://www.danielsoper.com/statcalc

Stevens, B., Lee, S. K., Law, M. P., Yamada, J., and Canadian Neonatal Network EPIC Study Group. (2007). A qualitative examination of changing practice in Canadian neonatal intensive care units. *Journal of Evaluation in Clinical Practice, 13*, 287-294. doi:10.1111/j.1365-2753.2006.00697.x

Tabachnick, B. G. & Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.

Tai. J. W. M., Mok, E. S. B., Ching, P. T. Y., Seto, W. H., & Pittet, D. (2009). Nurses and Physicians` perceptions of the importance and impact of healthcare-associated infection and hand hygiene: A multi-center exploratory study in Hong Kong. *Infection 37*(4), 320-333. doi:10.1007/s15010-009-8245-x

Van de Mortel, T., Bourke, R., McLoughlin, J., Nonu, M., & Reis, M. (2001). Gender influences handwashing rated in the critical care unit. *American Journal of Infection Control, 29*(6), 395-399. doi: 10.1067/mic.2001.119511

Whitby, M., McLaws, M-L., & Ross, M. W. (2006). Why healthcare workers don't wash their hands: A behavioural explanation [Electronic version]. *Infection Control and Hospital Epidemiology, 27*(5), 484-492.

Wilcox, R. R. & Keselman, H. J. (2003). Modern robust data analysis methods: Measures of central tendency [Electronic version].*Psychological methods*, 8(3), 254-274. doi: 10.1037/1082-989X.8.3.254

Won, S-P., Chou, H-C., Hsieh, W-S., Chen, C-Y., Huang, S-M., Tsou, K-I., et al. (2004). Handwashing program for the prevention of nosocomial infections in a neonatal intensive care unit [Electronic version]. *Infection Control and Hospital Epidemiology, 25*(9), 742-746.

VITA AUCTORIS

NAME:	Candace Elizabeth Ryan (Nee: Martin)
PLACE OF BIRTH:	Etobicoke, Ontario
YEAR OF BIRTH:	1977
EDUCATION:	University of Toronto, Toronto, Ontario 1997 – 2001 B.Sc. (Human Biology)
	University of Windsor, Windsor, Ontario 2002 – 2006 B.Sc.N. (Nursing)
	University of Windsor, Windsor, Ontario 2007 – 2011 M.Sc. (Nursing)