

**TOTAL JOINT ARTHROPLASTY PATIENTS' ADHERENCE TO A PRE-OPERATIVE  
STAPHYLOCOCCUS AUREUS DECOLONIZATION PROTOCOL**

by

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## Abstract

**Background:** *Staphylococcus aureus* surgical site infections and their treatment, in the total joint arthroplasty population, can significantly affect patients' recovery and their quality of life, and can generate considerable economic cost for the health care system. The use of a pre-operative screening and decolonization protocol has shown promising eradication rates of *Staphylococcus aureus* and a decreased incidence of surgical site infections, however, the results have lacked statistical significance. Adherence to the decolonization protocol has been identified as a possible missing link or explanation for these equivocal findings.

**Objective:** The purpose of this study was to examine the relationships between age, self-efficacy, and adherence to a *Staphylococcus aureus* screening and decolonization protocol in the total joint arthroplasty population.

**Methods:** A descriptive correlational study design was conducted. The study sample included 40 participants who underwent primary total joint arthroplasty surgery between May 1, 2013 and October 1, 2013 at a hospital in Vancouver, British Columbia. Self-efficacy and adherence were assessed using two self-report measures: the Self-efficacy Survey and the Adherence Questionnaire. Data were analyzed using correlational and multiple linear regression analyses.

**Results:** The findings suggest that there was a positive relationship between age and adherence to the use of chlorhexidine gluconate cloths, and a negative relationship between age and adherence to the use of nasal Mupirocin. These results were not statistically significant. There was a statistically significant and strong positive relationship between the patients' level of self-efficacy in applying Mupirocin and their adherence to its use, timing, and application. Little if no relationship was found between the patients' level of self-efficacy to chlorhexidine gluconate cloths and their adherence to its use, timing, and application. Age, and not self-efficacy,

contributed significantly to the outcome, adherence.

**Conclusions:** The study found inconclusive results with respect to the relationships between age, self-efficacy, and adherence. In light of these results, this study highlights the many ways in which age and self-efficacy can influence adherence in adults. This information can be useful when evaluating the effectiveness of a decolonization protocol and for nurses in their attempts to design, implement, and evaluate patient education materials relevant to the protocol.

## **Preface**

This dissertation is original unpublished work by the author, Daniela Martino. All aspects from conceptual formulation, to study design, data collection, and analysis, as well as composition are original work. Professor Pamela Ratner was the supervisor of this research project and was involved throughout the project in planning the study, supervising the analysis, and guiding the development of the thesis. Ms. Laurel Archer, a thesis committee member, assisted with the data collection at the hospital. All thesis supervisory committee members read drafts of the thesis and provided suggestions for content, organization, and style.

Approval for this research project, “Total Joint Arthroplasty Patients’ Adherence to a Pre-operative Staphylococcus Aureus Decolonization Protocol,” was granted by the University of British Columbia, Behavioural Research Ethics Board, under certificate number H13-01011.

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## **Chapter 1: Introduction**

*Staphylococcus aureus* has been identified as the main perpetrator of surgical site infections in many tertiary health care centres (Anderson, Sexton, Kanafani, Auten, & Kaye, 2007). Surgical site infections and their treatment, especially in the total joint arthroplasty population, have been shown to significantly affect patients' recovery from surgery and their quality of life, and generate considerable economic cost for the health care system (Rao et al., 2011). Consequently, global efforts have been made to find ways to eradicate or minimize the detrimental effects of this pathogen. Van Rijen, Bonten, Wenzel, and Kluytmans (2008a) conducted a systematic review of randomized control studies that examined the effects of a pre-operative screening and decolonization protocol on patients undergoing total joint arthroplasty. They found promising eradication rates of *Staphylococcus aureus* and a decreased incidence of post-operative surgical site infections, although the results were not statistically significant. Some methodological limitations of the studies included in the systematic review likely contributed to these findings; however, a recognizable gap in the research literature related to patients' adherence to the decolonization protocol may also have been a contributing factor (Hansen et al., 2007).

### **Background**

#### **Significance of the problem**

According to the Antibiotic Resistant Organisms Prevention and Control Guidelines, recommended by the Provincial Infection Control Network of British Columbia (2008), a pre-operative screening and *Staphylococcus aureus* decolonization protocol is warranted in acute care facilities and should be implemented under the guidance of an infection control practitioner. A particular screening and decolonization protocol, introduced in March 2012 at a community

hospital, in British Columbia, requires that all patients undergoing total joint arthroplasty be screened for nasal carriage of *Staphylococcus aureus* before surgery. All patients are advised to wash with six Sage 2% chlorhexidine gluconate cloths (free of latex, alcohol, and rinse), the evening before surgery and repeated on the day of admission for surgery. Chlorhexidine gluconate is a chemical antiseptic that is effective against gram-positive and gram negative bacteria. It is both bactericidal and bacteriostatic in action. In addition to the use of chlorhexidine gluconate cloths, those who test positive for nasal carriage of *Staphylococcus aureus* are prescribed nasal Mupirocin twice daily for five days before surgery to eradicate the nasal area of this pathogen. Mupirocin calcium ointment, 2% (Bactroban® Nasal), is an antibiotic of the monoxycarboxylic acid class. It is bacteriostatic in low concentrations and bactericidal at high concentrations.

Positive nasal carriage of *Staphylococcus aureus*, more so than carriage in any other body part, is a significant risk factor for the development of surgical site infections (Kim et al., 2010). Wenzel and Perl (1995) estimated the risk to be two to nine times greater in positive *Staphylococcus aureus* nasal carriers than in non-carriers. Similarly, Perl et al. (2002) found that in surgical site infections where *Staphylococcus aureus* was identified as the isolate, 85% of the infections were associated with nasal carriage of the same isolate. With the use of nasal Mupirocin as a preventive measure, a risk reduction of 1% has been shown to translate into cost savings in the millions of dollars for every ten thousand patients screened (Van Rijen et al., 2008a). Based on these findings it is easy to appreciate the importance of patient adherence to a decolonization protocol to minimize the adverse outcomes and health care costs arising from *Staphylococcus aureus* infections.

Patient adherence is a complex and dynamic concept rooted in multiple disciplines;

consequently, many variations of a definition exist. For the purpose of this study, patient adherence was defined as the extent to which patients' actions coincide and follow the instructions they are given for a prescribed treatment or regimen (Christensen, 2004; Haynes et al., 2005). It is worth noting that, in the literature, the word "adherence" is often used interchangeably with the word "compliance" (Bissonnette, 2008). Because the term compliance is often strongly associated with an underlying notion of blame or an unwillingness to follow or consent to orders, the word adherence rather than compliance is used here (Bissonnette, 2008).

Patient adherence in the health care literature has predominantly been examined in areas of chronic and cardiovascular disease, HIV/AIDS, and cancer treatment and has focussed primarily on medication compliance and compliance with recommended exercise and lifestyle changes (Bissonnette, 2008). An examination of patients' adherence to a pre-operative screening and decolonization protocol, specifically, is lacking. The orthopaedic specialty, more so than any other specialty, has studied the effects of such protocols on the rates of surgical site infections and has found some positive results (Van Rijen et al., 2008a). However, despite these promising results, the overall findings have not been statistically significant, which has left room for much speculation as to the reasons why (Van Rijen et al., 2008a). Could a lack of adherence to the decolonization protocol be an important missing link?

Just as there is a lack of research about patients' adherence to a pre-operative decolonization protocol, there has been an equivalent lack of objective measurement or operationalization of adherence in health care research (Bissonnette, 2008). These gaps make the evaluation of treatment protocols difficult and they prevent the implementation of necessary quality control measures in hospitals (Hansen et al., 2007). Although adherence in the total joint arthroplasty population has not been examined, it has been examined in other patient

populations. Research findings from these other areas lend themselves to enhancing our knowledge and understanding of patients' adherence in the orthopaedic population. Research concerning patients' adherence, specifically in the areas of chronic and cardiovascular disease, and HIV/AIDS, has examined the influence of socio-demographic variables (e.g., income, education, and age), health literacy, and social support (Vaughn-Cooke, 2009). This research has also included the examination of self-efficacy as a predictor of adherence (Vaughn-Cooke, 2009). One would expect the factors that influence patients' adherence in the total joint arthroplasty population to be similar to those of other patient populations, but without adequate research in the orthopaedic population this assumption cannot be verified. The examination of patients' adherence to an established decolonization protocol, in the joint arthroplasty population, could have significant implications for the design, implementation, and evaluation of relevant patient education materials.

### **Problem statement and purpose**

*Staphylococcus aureus* has been identified as the main perpetrator of surgical site infections in the total joint arthroplasty population, which has motivated researchers to design pre-operative screening and decolonization protocols aimed at eradication (Anderson et al., 2007). Non-adherence to these protocols has significant implications for patients' quality of life and for health care costs (Rao et al., 2011). There also is an important need to understand the factors that influence patients' adherence, particularly for this population, which could enhance the design and implementation of patient education and the evaluation of a protocol's effectiveness. The purpose of this study was to examine the relationship between socio-demographic variables and levels of self-efficacy on patients' adherence to a *Staphylococcus aureus* decolonization protocol in the total joint arthroplasty population.

## **Research Questions**

The following research questions guided this study: What is the rate of adherence to a pre-operative screening and decolonization protocol, in the total joint arthroplasty population? Is patients' adherence influenced by their age? Specifically, is there a relationship between age and adherence? Is there a relationship between patients' level of self-efficacy and adherence? The following hypotheses were tested:

*Hypothesis 1:* There is a relationship between patients' age and adherence.

*Hypothesis 2:* There is a positive relationship between patients' level of self-efficacy and adherence.

## **Theoretical Framework**

The Health Belief Model is one of the most commonly used theoretical frameworks by researchers that have examined adherence (Rosenstock, Strecher, & Becker, 1988). This model proposes that personal health beliefs or perceptions of an illness or disease can predict health behaviour, which is multifaceted and can be conceptualized in many different ways. For the purpose of this study, health behaviour was conceptually defined as adherence to a prescribed regimen. Similarly, rather than examining health beliefs or perceptions of an illness or disease, this study was based on a conceptual definition of illness or disease as meaning the risk of *Staphylococcus aureus* infection. The Health Belief Model predicts that if people perceive their vulnerability to develop an illness or disease as being high, they perceive the illness or disease to be serious, and they perceive the benefits of engaging in particular health behaviour as outweighing the risks, they are more likely to adhere to that health behaviour (Sirur, Richardson, Wishart, & Hanna, 2009). There is a large body of literature that supports the theory that perceptions and personal beliefs about illnesses or diseases stem from prior experiences and

personal interactions with the environment (Bandura, 1977; Vaughn-Cooke, 2009). Hence, embedded in the Health Belief Model are components of Bandura's (1977) self-efficacy theory, specifically, the influence of vicarious and mastery experiences and verbal persuasion on adherence.

Self-efficacy, the belief in one's ability to perform a specific task, is determined by personal experiences with adherence (mastery experiences), the observed successes and failures that others have had with performing the same task (vicarious experiences), the ability to be persuaded by others to adhere (verbal persuasion), and the perception of one's capability to adhere (one's physiological state, such as anxiety) (Sirur et al., 2009). There is strong support for the use of both the Health Belief Model and self-efficacy theory, as suitable theoretical frameworks, for the examination of patients' adherence in relation to socio-demographic variables and levels of personal self-efficacy (Granger, Moser, Harrell, Sandelowski, & Ekman, 2007). The high degree of interconnectivity between these two theoretical frameworks is further supported by the Social Personal Organizational Technological (SPOT) patient compliance model (Vaughn-Cooke, 2009), which identifies socio-demographic variables and perceived treatment complexity and self-care capability, two components of self-efficacy theory, as three of fourteen performance shaping factors that affect compliance. The SPOT model proposes that performance shaping factors play a large role in the development of patients' attitudes and knowledge acquisition, which in turn affect their compliance (Vaughn-Cooke, 2009). Patients' attitudes and knowledge shape their personal health beliefs and perceptions about a particular health phenomenon. They often guide the type of personal interactions they will have with their environment and they can often predict the types of experiences that will stem from those interactions (Vaughn-Cooke, 2009). It is clear that the principles and components of both the



Health Belief Model and self-efficacy theory can assist the quest for a clearer understanding of the factors that influence and predict patients' adherence.

## Chapter 2: Literature Review

Van Rijen, Bonten, Wenzel, and Kluytmans (2008b) conducted a systematic review of randomised controlled trials and found a statistically significant reduction in the rate of *Staphylococcus aureus* infections with the use of intranasal Mupirocin in diverse surgical populations. Similar results were found with the use of chlorhexidine gluconate cloths applied the evening before surgery and the day of surgery in hip and knee arthroplasty patients (Johnson, Daley, Zywiell, Delanois & Mont, 2010; Zywiell et al., 2011). These findings provide strong support for the use of a decolonization protocol to prevent the development of post-operative *Staphylococcus aureus* surgical site infections. The efficacy and success of a decolonization protocol, however, like any treatment, is heavily reliant on adherence. Bearing this latter point in mind, a closer examination of adherence and the factors that influence adherence was warranted to ensure optimal quality control in clinical practice.

While the success and effectiveness of a decolonization protocol, like any treatment, is heavily influenced by adherence, there is a lack of research that has examined patients' adherence to this protocol in the total joint arthroplasty population specifically. In a study that specifically examined adherence to outpatient preoperative methicillin-resistant *Staphylococcus aureus* therapy across diverse surgical populations, a complete adherence rate to both nasal Mupirocin and the use of chlorhexidine gluconate cloths was determined to be only 31.1% (Caffrey et al., 2011). Bailey et al. (2011) explained that even with low patient compliance rates there is still great economic value in the decolonization protocol when one considers that a small reduction in the incidence of surgical site infections can translate into cost savings in the millions. In addition to unrealized cost savings, a low adherence rate is concerning and has many implications for the health status of patients and for clinical practice, in general. Non-adherence

is a poorly understood phenomenon. A better understanding of the factors that influence adherence is necessary, as is further elaboration of the theories that explain it.

Although adherence in the total joint arthroplasty population has not been thoroughly examined, it has been examined in other patient populations, particularly in relation to medication compliance and compliance with recommended exercise and lifestyle changes (Bissonnette, 2008). Research findings from these other areas lend themselves to enhancing our knowledge and understanding of patient adherence in the orthopaedic population. Research in these areas has examined the influence of socio-demographic variables (e.g., income, education, and age), health literacy, and social support (Vaughn-Cooke, 2009). This research also has included the examination of self-efficacy as a predictor of patient adherence (Vaughn-Cooke, 2009). One would expect the factors that influence patient adherence in the total joint arthroplasty population to be similar to those of other patient populations, but without adequate research in the orthopaedic population this assumption cannot be verified.

This review of the literature summarizes the findings of research that has examined the relationships between socio-demographic variables, namely age, and self-efficacy and medication compliance, adherence to pre-operative guidelines, adherence to recommended exercise and lifestyle regimens, and adherence to prophylactic treatments in diverse patient populations. Prior to discussing the overall research findings, this review first summarizes the methods applied in the studies, including the study designs, methods of subject recruitment, sample populations, variables examined, the instrumentation or measures used within the studies, and the statistical analyses used to examine the relationships between the variables. The review concludes with a discussion of the limitations and gaps in the current literature and some recommendations for future research.

## Search Strategy

A systematic literature search was conducted using the CINAHL and PubMed databases to find research articles published between 2003 and September 2013 in the English language. To conduct the search, the following search terms were used separately and in combination: ‘adherence,’ ‘compliance,’ ‘Staphylococcus aureus,’ ‘decolonization,’ ‘exercise programs,’ ‘rehabilitation programs,’ ‘patient guidelines,’ ‘surgical guidelines,’ ‘pre-operative guidelines,’ ‘medication adherence,’ ‘age,’ ‘age associated predictors,’ ‘age factors,’ ‘sociodemographic factors,’ ‘self-efficacy,’ ‘health beliefs,’ ‘health perceptions,’ and ‘patient attitudes.’ The search was restricted to adults and human studies. The following tables summarize the search queries and citation history for each specific database searched.

**Table 1. Search Strategy for CINAHL via EBSCOHost**

Step	Search Query	Citation Count
1	TI adherence OR TI compliance	9,945
2	Staphylococcus aureus	6,779
3	Decolonization	129
4	2 AND 3	106
5	1 AND 4	1

Given that the above search returned only one citation with respect to adherence to a *Staphylococcus aureus* decolonization protocol, an expanded search of adherence in the context of recommended rehabilitation or exercise programs, medications, and patient, surgical and preoperative guidelines, was undertaken.

**Table 2. Search Strategy for CINAHL via EBSCOHost (expanded)**

Step	Search Query	Citation Count
6	TI exercise programs OR TI rehabilitation programs	405
7	patient guidelines OR TI surgical guidelines OR TI pre-operative guidelines	122
8	medication adherence	799

Step	Search Query	Citation Count
9	6 OR 7 OR 8	1326
10	9 AND 1	831
11	Published Date: 20030101-20130931; English Language; Research Article; Human; Age Groups: All Adult	373

The specific question of the relationship between age and adherence in the context of managing *Staphylococcus aureus* was not addressed in the set of papers identified in the previous searches. A search with respect to the role of age in the context of adherence or compliance, in general, was undertaken.

**Table 3. Search Strategy for CINAHL via EBSCOHost (expanded)**

Step	Search Query	Citation Count
12	TI age OR TI age associated predictors OR TI age factors Published Date: 20030101-20130931; English Language; Research Article; Human; Age Groups: All Adult	4,975
13	TI sociodemographic factors Published Date: 20030101- 20130931; English Language; Research Article; Human; Age Groups: All Adult	54
14	12 and 1	18
15	13 and 1	1

To address the specific question of the relationship between self-efficacy and adherence, a more specific search using the terms “self-efficacy” and constructs of self-efficacy, including “health beliefs,” “patient attitudes,” and “health perceptions” was undertaken. This search was combined with the previous search results that explored adherence in relation to recommended exercise programs, medications, and patient, surgical and preoperative guidelines.

**Table 4. Search Strategy for CINAHL via EBSCOHost (expanded)**

Step	Search Query	Citation Count
16	TI self-efficacy OR TI health beliefs OR TI health perceptions OR TI patient attitudes	3,332
17	16 AND 11	19

Once the search was concluded, reference lists of relevant papers were scanned for relevant manuscripts not identified through the search.

**Table 5. Search Strategy for PubMed**

Step	Search Query	Citation Count
1	adherence OR compliance	179,873
2	<i>Staphylococcus aureus</i>	81,125
3	decolonization	376
4	2 AND 3	300
5	1 AND 4	21

Of the 21 citations obtained from the above search, only one examined adherence to a *Staphylococcus aureus* decolonization protocol. The reference list for this article was scanned for relevant manuscripts not identified in the search, but no additional articles of relevance were identified. An expanded search of adherence in the context of recommended exercise or rehabilitation programs, medications, and patient, surgical and preoperative guidelines, was then undertaken.

**Table 6. Search Strategy for PubMed (expanded)**

Step	Search Query	Citation Count
6	adherence[Title]) OR compliance[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	6267
7	patient guidelines[Title]) OR surgical guidelines[Title]) OR preoperative guidelines[Title]) OR rehabilitation programs[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	62
8	exercise programs[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	40
9	7 OR 8	102
10	medication adherence[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	576
11	9 OR 10	678
12	11 AND 6	582

The specific question of the relationship between age and adherence in the context of a *Staphylococcus aureus* decolonization protocol was not addressed in the set of papers identified in the previous searches. A specific search with respect to the role of age in the context of adherence or compliance to recommended exercise or rehabilitation programs, medications, and patient, surgical and preoperative guidelines, was then undertaken.

**Table 7. Search Strategy for PubMed (expanded)**

Step	Search Query	Citation Count
13	age[Title]) OR age associated predictors[Title]) OR age factors[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	21,553
14	13 AND 12	5

The specific question of the relationship between self-efficacy and adherence in the context of a *Staphylococcus aureus* decolonization protocol was not addressed in the citations identified in the previous searches. A more specific search with respect to the role of self-efficacy and other constructs related to self-efficacy, including health beliefs, health perceptions and patient attitudes, was undertaken. This search was combined with the search results of adherence in the context of recommended exercise and rehabilitation programs, medications, and patient, surgical and preoperative guidelines.

**Table 8. Search Strategy for PubMed (expanded)**

Step	Search Query	Citation Count
15	self-efficacy[Title]) OR health perceptions[Title]) OR health beliefs[Title]) OR patient attitudes[Title] Filters: Journal Article; published in the last 10 years; Humans; English; Adult: 19+ years	1453
16	15 AND 12	18

Once the search was concluded, reference lists of relevant papers were scanned for relevant

manuscripts not identified through the search.

## **Search Results**

A total of 39 published research studies were returned from the CINAHL database search and 44 published research articles were returned from the PubMed database search. The reference lists of relevant research articles were scanned for relevant manuscripts not identified through the search. Fifteen studies were selected for review based on the following criteria: (i) the study sample included adults  $\geq 19$  years of age who were outpatients; (ii) the study focused on age and adherence or compliance or on self-efficacy and adherence or compliance; and (iii) the study measured adherence or compliance to medication prescriptions, patient, surgical or pre-operative guidelines, or exercise or rehabilitation programs.

## **Methods of the Selected Studies**

### **Study design**

Whether examining the relationship between age and adherence or self-efficacy and adherence, there appeared to be consistency in the studies with respect to their study designs. Prospective, cross-sectional observational study designs were the most common designs used to examine these variables across diverse patient populations whether in relation to medication adherence, adherence to pre-operative or surgical guidelines, or adherence to patient instructions (Barclay et al., 2007; Birkenfeld et al., 2011; Boeka, Prentice-Dunn, & Lokken, 2010; Curtin et al., 2008; Fawzi et al., 2012; Liang, Yates, Edwards, & Tsay, 2008; Tarantino et al., 2010; Yuhas et al., 2012). Three published systematic reviews also found that cross-sectional, observational designs were the most dominant methodological design used in the examination of medication adherence in the elderly, patient adherence to cardiac rehabilitation programs, and adherence to chronic treatment (Chia, Schlenk, & Dunbar-Jacob, 2006; Ingersoll & Cohen, 2008; Taylor,



Wilson, & Sharp, 2011). Although not as prevalent a design in the literature examining adherence, a prospective repeated measures design was used to examine the effects of self-efficacy on adherence outcomes, a relatively strong design in the evidence hierarchy (Ngamvitroj & Kang, 2007). Because cross-sectional, descriptive correlational study designs are positioned at the lower tier of the evidence hierarchy, they are considered relatively weak in their ability to support causal inferences. However, given the nature of the research questions for this study, randomised controlled trials may not be suitable because the variables under examination cannot be manipulated or controlled (i.e., self-efficacy). Despite the weakness of the study designs, the findings from descriptive correlational observational studies are informative and can offer a wealth of evidence about phenomena for which little is known or understood. They also build a strong foundation from which future research can be conducted and research questions generated.

### **Study target populations and settings**

Adherence to a methicillin-resistant *Staphylococcus aureus* decolonization protocol has not been thoroughly examined in the total joint arthroplasty population. To assist in the quest for a clearer understanding of the factors that influence adherence to such protocols, it was necessary to examine other patient populations where adherence has been more closely examined: the areas of chronic and cardiovascular disease, HIV/AIDS, cancer, and mental health. Across the 15 studies selected for review, samples were drawn from these specific patient populations.

All 15 studies used non-probability sampling, specifically convenience sampling, to recruit study participants (Barclay et al., 2007; Birkenfeld et al., 2011; Boeka et al., 2010; Chia et al., 2006; Curtin et al., 2008; Fawzi et al., 2012; Ingersoll & Cohen, 2008; Liang, et al., 2008; Ngamvitroj & Kang, 2007; Osterberg & Blaschke, 2005; Peddle et al., 2009; Shi et al., 2010;

Tarantino et al., 2010; Taylor et al., 2011; Yuhas et al., 2012). The use of convenience sampling has advantages; it is a very rapid, feasible, and inexpensive method of recruitment to ensure that a sufficient number of study participants are enrolled. It lends itself well to research studies that aim to collect data regarding trends and relationships between variables that are poorly understood. However, despite these advantages, the use of convenience sampling likely introduces bias. With this method of sampling, subjects are not randomly selected, and thus the sample may not be representative of the population to which the study is intended to be generalized. Furthermore, similar to other methods of sampling, many factors, which cannot be controlled, can influence participants' decisions about whether to participate in research. These factors then act as confounding variables when interpreting the study results. Because adherence is still a poorly understood phenomenon, it is easy to appreciate the wide use of convenience sampling in studies that have examined it in great depth.

A wide range of settings have been used to examine the relationships between age, self-efficacy, and adherence. Outpatient clinical settings specific to a wide range of patient populations were the most prevalent locations in which the research has been carried out (Barclay et al., 2007; Birkenfeld et al., 2011; Chia et al., 2006; Schlenk, & Dunbar-Jacob, 2006; Fawzi et al., 2012; Ingersoll & Cohen, 2008; Liang et al., 2008; Ngamvitroj & Kang, 2007; Shi et al., 2010; Taylor et al., 2011; Yuhas et al., 2012). Another common setting was inpatient hospital units. Curtin et al. (2008) examined the relationship between self-efficacy and the self-management behaviour of patients with chronic kidney disease in two inpatient renal units. Similarly, Boeka et al. (2010) based their study in a surgical unit of a major medical centre in the southeastern United States to examine the psychosocial predictors of intentions to comply with bariatric surgery guidelines for patients scheduled to undergo gastric bypass surgery. Tarantino

et al. (2010) set their study in a general medicine unit to examine socio-cognitive factors associated with non-adherence to medication prescriptions. A unique setting, outside of the hospital environment, was a university research fitness centre in Western Canada in which adherence to a pre-operative, supervised exercise regimen was evaluated with patients awaiting surgical removal of malignant lung lesions. It is apparent from this wide array of study settings that the relationship between adherence and socio-demographic variables and self-efficacy is multi-faceted and can be examined in diverse study populations and treatment regimens. Adherence and self-efficacy are such broadly defined concepts in the literature and, with diverse patient populations and settings examined, there is consequently much ambiguity in the interpretation and meaning assigned to these concepts. Given this state, caution must be used in generalizing the results from other patient populations to the total joint arthroplasty population. Despite this limitation, however, there is a wealth of evidence that can be considered when examining the documented relationships among these variables in other patient populations; this evidence can guide and enhance research in the area of orthopaedics.

### **Variables examined**

Before discussing the findings of research that has examined the relationships between socio-demographic variables, namely age, self-efficacy, and adherence, it is important to first review the types of variables examined in the selected studies. To examine what is known about the relationship between age and adherence it was necessary to review studies that examined the relationship between various socio-demographic variables and adherence or compliance and wherein age was specifically noted and examined. Birkenfeld et al. (2011) conducted a study that examined whether socio-demographic factors (i.e., age, gender, socioeconomic status, and immigrant status) were associated with compliance in faecal occult blood testing in a screening

program for colorectal cancer. Although this study met the inclusion criteria for this literature review, it was problematic in that the sample was limited to adults aged 50-75 years of age. It is not known whether the relationship between age and adherence in those 50-75 years of age is the same as in those older than 75 or younger than 50 years of age. Barclay et al. (2007) examined whether the four dimensions of the Health Belief Model and closely related constructs of the model, self-efficacy and locus of control, were predictive of adherence to antiretroviral therapy in HIV-positive adults. They hypothesized that these dimensions and constructs predicted adherence in both younger and older adult cohorts. They predicted higher rates of medication adherence in the older cohort. Although their study included adults of all ages, there was a disproportionate number of men compared with women in their study. Again, it is not known whether age-associated predictors of medication adherence vary by gender. Tarantino et al. (2010) examined socio-cognitive factors associated with non-adherence to medication across a wide range of ages, 35 to 80 years of age. Using elements of the Health Belief Model, the Protection Motivation Theory, and the Theory of Planned Behavior, they examined whether age and cognitive factors, including perceived risks and benefits of non-adherence, perceptions of susceptibility to disease, and perceived health values were associated with non-adherence to medication prescriptions. This study drew attention to an important gap in the literature. It is uncertain whether perceived risks and benefits of non-adherence, perceptions of disease susceptibility, and the value we assign to health change with age. To close this literature gap, further research is warranted.

To examine the relationship between self-efficacy and adherence, it was necessary to broaden the keyword search to include words or word combinations that captured some of the key constructs of the Health Belief Model and self-efficacy theory (i.e., health beliefs, health

perceptions, patient attitudes, and health behaviours), two theoretical models with a high degree of interconnectivity. Fawzi et al. (2012) examined whether health beliefs about medications predicted older adults' adherence to prescribed antidepressants. This study, although informative, was limited in the generalizability of its results; it likely is not generalizable to younger age groups and to the total joint arthroplasty population because the study included only patients 55 years of age and older. Furthermore, there may be other confounding factors specific to the mental health population that may influence adherence. Chia et al. (2006) examined the relationship between medication adherence and factors such as self-efficacy, medication efficacy, beliefs in one's control over one's health, and illness perceptions. Similar to the work of Chia et al. (2006), Liang et al. (2008) explored the relationships between adherence to prescribed opioid administration and opioid-taking self-efficacy and beliefs. These latter two studies point to another gap in the literature: the lack of differentiation between personal self-efficacy and medication administration efficacy. The two concepts are conceptually different and likely influence adherence in different ways. Study outcomes can vary depending on which construct(s) of self-efficacy are examined. For example, Boeka et al. (2010) explored the association between adherence and the perceived threat of not following guidelines, as well as the association between perceived self-efficacy and adherence to bariatric surgery guidelines. The results of this study were of particular interest because the context in which adherence was examined (i.e., in relation to patient guidelines) is similar to the way adherence was examined in the current study, in relation to patient guidelines to a decolonization protocol. Other variables explored in the published studies included patients' attitudes and perceptions about a treatment or a disease, and other elements of self-efficacy (e.g., Yuhas et al., 2012).

In the 15 studies included in this review, the outcome variable, adherence, was considered

with respect to several therapies: (a) medication use, (b) pre-operative exercise regimens and cardiac rehabilitation programs, (c) prophylactic treatment, and (d) patient and surgical guidelines (Barclay et al., 2007; Birkenfeld et al., 2011; Boeka et al., 2010; Chia et al., 2006; Curtin et al., 2008; Fawzi et al., 2012; Ingersoll & Cohen, 2008; Liang et al., 2008; Ngamvitroj & Kang, 2007; Osterberg & Blaschke, 2005; Peddle et al., 2009; Shi et al., 2010; Tarantino et al., 2010; Taylor et al., 2011; Yuhas et al., 2012). It is clear from this discussion that there are a number of approaches that have been taken and numerous outcomes that have been explored in the selected literature to examine the influence of age and self-efficacy. This reflects the complexity of these variables and the dynamic relationships among them.

### **Statistical analyses**

The studies selected for this literature review varied in their approaches to examining the relationships between age, self-efficacy, and adherence. Analytical statistics, specifically correlational techniques (i.e., Pearson correlations), were the most prevalent statistical tests used to describe the relationships between self-efficacy and adherence (Chia et al., 2006; Curtin et al., 2008; Liang et al., 2008; Ngamvitroj & Kang, 2006; Peddle et al., 2009; Tarantino et al., 2010; Taylor et al., 2011). In some instances, the researchers used more than one statistical test or a combination of statistical tests. Regression analyses were often conducted after a relationship was established to determine the proportion of variance explained or the contribution of particular variables to the variability in adherence (Barclay et al., 2007; Boeka et al., 2010; Liang et al., 2008). In studies that explored socio-demographic variables in relation to adherence, descriptive statistics were often used to summarize the data and chi-square statistics were used to determine the relationships among the demographic variables (Barclay et al., 2007; Curtin et al., 2008; Ngamvitroj & Kang, 2007; Tarantino et al., 2010). In studies that explored differences in

adherence across various age groups and genders or examined differences in demographic variables between groups categorized as adherent versus non-adherent, statistical tests capable of measuring within and between group differences, such as independent *t* tests or ANOVA, were used (Birkenfeld et al., 2011; Fawzi et al., 2012; Peddle et al., 2009; Tarantino et al., 2010). Evident from the discussion thus far is the prevalence of quantitative approaches to examining the role of age and self-efficacy in relation to adherence. In one instance, a qualitative approach was used. Yuhas et al. (2012) examined patients' attitudes and perceptions of implantable cardioverter-defibrillators (ICDs) as primary prophylaxis for those at risk for sudden cardiac death. Given that ICDs are underutilized, Yuhas et al. (2012) sought to obtain a better understanding of the potential barriers to consenting to have an ICD implanted. Using grounded theory to extrapolate some common themes that surfaced from the perspectives of affected patients, they strived to gain an understanding of the factors that influence patients' decisions to consent to the implantation of prophylactic cardioverter-defibrillators. The use of both quantitative and qualitative research designs to address these research questions has deepened our understanding of the relationships between age and self-efficacy, and has generated more questions to drive future research.

### **Instruments Used for the Measurement of Relevant Concepts**

#### **Self-efficacy**

The measurement of self-efficacy is plagued with shortcomings and difficulties. Numerous conceptual definitions of self-efficacy exist. Elements and constructs from theoretical models such as the Health Belief Model, Bandura's (1977) self-efficacy theory, Theory of Planned Behavior, and the Protection Motivation Theory have guided the design of self-efficacy measurement instruments (Ajzen, 1991; Barclay et al., 2007; Boeka et al., 2010; Peddle et al.,

2009; Tarantino et al., 2010). Health beliefs, health perceptions, perceived susceptibility or risk of developing an illness or disease, and the belief in one's capability to perform a particular health behaviour are some of the constructs of self-efficacy that stem from the Health Belief Model and Bandura's (1977) self-efficacy theory (Sirur, Richardson, Wishart, & Hanna, 2009). Perceived behavioural control, attitude towards performing a behaviour, and the degree of control patients believe they have over their health are other constructs related to self-efficacy that have been derived from Bandura's (1977) self-efficacy theory and the Protection Motivation Theory (Rogers & Prentice-Dunn, 1997). Irrespective of patient population or health domain, researchers that have examined the relationship between self-efficacy and adherence have conceptually defined self-efficacy based on constructs and elements from these theoretical models. Consequently, these constructs and elements have been used as a framework in designing instruments to measure self-efficacy.

Taylor et al. (2011) conducted a systematic review to explore the medical, psychological, and socio-demographic factors associated with adherence to cardiac rehabilitation programs. The Illness Perceptions Questionnaire-Revised (IPQ-R) (Moss-Morris et al., 2002) was used to examine illness perceptions, with eight different subscales, in 2 of the 18 studies included in their systematic review. Even though a medium to large positive association was found between the perceived consequences of developing an illness and adherence, in their meta-analysis, assessments of the instrument's reliability and validity were not reported (Taylor et al., 2011). With a lack of evidence of internal consistency, test-retest reliability, and validity (i.e., content or construct validity), the validity and robustness of a tool are questionable and caution must be used in the interpretation of the overall study results. Chia et al. (2006) conducted a systematic review of published research studies to examine the relationships between self-efficacy, and



other belief-laden variables, and medication adherence in the elderly. Four studies in this review, all using different measuring instruments, examined self-efficacy. Two of the studies used a self-efficacy and outcome expectation scale to measure self-efficacy (Brus et al., 1999; Clark & Dodge, 1999), another study used a 12-item questionnaire (Siegel, Karus, & Schrimshaw, 2000), and the fourth study used the Beliefs Related to Medication Adherence Survey (McDonald-Miszczak et al., 2004). No measures of instrument reliability and validity were reported in this literature review. Fawzi et al. (2012) also used the Beliefs Related to Medication Adherence Survey to examine whether beliefs about medication could predict adherence to antidepressants in older adults and again no measures of instrument reliability and validity were reported. Barclay et al. (2007) examined health beliefs and attitudes using a questionnaire based on the Health Belief Model known as the Adherence Determination Questionnaire (DiMatteo et al., 1993). They also examined self-efficacy by exploring patients' locus of control using the Multidimensional Health Locus of Control Scale (Wallston, Wallston, & DeVellis, 1978). In both instances, no documentation of the reliability and validity of the instruments was provided.

The operationalization of self-efficacy is problematic because (a) multiple definitions exist and (b) depending on how self-efficacy is conceptually defined, a reliable and valid instrument may not exist to operationalize the construct. Inadequate reporting of instruments' reliability and validity is a widespread issue in the literature exploring self-efficacy and adherence, which is likely an issue in other areas of research, as well. Caution must be used in interpreting the findings from these studies because, without confirming that an instrument is reliable and valid, there is greater risk for the introduction of bias and error. Depending on the degree of bias and magnitude of error introduced, the quality of a study can be compromised. Despite these limitations, however, these studies have contributed some knowledge to our

understanding of self-efficacy. Furthermore, in instances where a study has not determined or reported instrument reliability and validity, our focus should instead be directed to studies where this information or evidence has been provided. This will allow for a more accurate synthesis of the overall findings.

With the exception of two studies included in this review, all studies relied on self-report methods, either in the form questionnaires or surveys, to measure self-efficacy. Five studies reported a Cronbach alpha (Boeka et al., 2010; Curtin et al., 2008; Liang et al., 2008; Ngamvitroj & Kang, 2007; Peddle et al., 2009). Using constructs derived from Ajzen's (1991) Theory of Planned Behavior, Peddle et al. (2009) examined the relationships between perceived behavioural control, attitudes towards a pre-operative exercise program, intention to comply with the exercise program, and actual adherence to the program. Subjects completed a questionnaire that generated a personal score for each of these constructs. Cronbach alpha for each construct was reported in the range of .72 and .97, depending on the construct, an acceptable indicator of internal consistency. Similarly, Curtin et al. (2008) measured the relationship between self-efficacy and medication adherence in patients with kidney disease. They administered a validated questionnaire, known as the Perceived Efficacy in Patient Physician Interaction Questionnaire, and reported Cronbach alphas of .70 to .92. Comparable values were found in a study conducted by Ngamvitroj and Kang (2006), who examined the effects of self-efficacy on adherence to peak expiratory flow rate monitoring in asthma patients. They administered a validated questionnaire, the Knowledge, Attitude, and Self-efficacy Asthma Questionnaire, to measure self-efficacy and reported Cronbach alphas of .86 to .92. Liang et al. (2008) reported a Cronbach alpha, a test-retest reliability measure, and construct validity evidence for their measurement of opioid taking self-efficacy. The Pain-Opioid Analgesic Beliefs Scale and the

Opioid-Taking Self-efficacy Scale-Cancer had Cronbach alphas of .74 to .84 and .93 to .95, respectively. Test-retest reliability coefficients of .94 and .68 to .82, respectively, were reported and the construct validity coefficients were .84 and .95, respectively (Liang et al., 2008).

In summary, in the five studies that reported reliability assessments, the Cronbach alpha values ranged from .65 to .92, which are considered acceptable according to established measurement standards (Boeka et al., 2010; Curtin et al., 2008; Liang et al., 2008; Ngamvitroj & Kang, 2007; Nunnally & Bernstein, 1994; Peddle et al., 2009). Researchers, however, should be making greater effort to include evidence of their instruments' reliability and validity, when appropriate, to establish greater rigor in their studies.

### **Measuring adherence**

Similar to the measurement of self-efficacy, the operationalization of adherence presents its own set of challenges. Defining and measuring adherence is difficult primarily because of the lack of a consensual definition of adherence (Fawzi et al., 2012). It is important to ascertain whether adherence is defined in terms of timing, dosing, attendance, or other considerations when evaluating patients' responses to treatment recommendations. It is also important to establish what is meant by adequate adherence. Is a rate of 80% considered adequate? Is a rate of 95% a more appropriate indicator of good adherence? (Osterberg & Blaschke, 2005) The answer to these questions may be dependent on the type of patient population being studied and the context in which adherence is examined. Measuring adherence to retroviral therapy in HIV-positive adults may warrant an adherence rate closer 95% to be considered adequate for achieving optimal patient outcomes, whereas an adherence rate of 60% or 70% may be considered adequate when measuring adherence to baby aspirin in healthy older adults taking it for prophylaxis. Issues such as these have left room for much ambiguity when it comes to

defining adherence and deciding on the most appropriate method to measure it.

In a literature review of 41 articles, Osterberg and Blaschke (2005) identified both direct and indirect methods of measuring adherence. Direct methods include measures of drug concentrations or metabolites in the blood or urine and measurement of biological markers in the blood (Osterberg & Blaschke, 2005; Shi et al., 2010). Direct methods can be very costly, they can be labour intensive for health providers, and they may be susceptible to distortion by the patient or other physiological factors (Osterberg & Blaschke, 2005; Shi et al., 2010). They can, however, provide accurate results in studies that examine medication adherence in high risk populations. Depending on the research question or the variables being examined, direct methods are not always suitable. In some instances it may be necessary to consider the use of an indirect method of measurement, the most popular method used in the studies selected for this literature review.

Indirect methods of measurement include the use of electronic monitoring devices, pill counts, the tracking of prescription refills, patients' medication diaries, self-reported behaviour, and so forth (Osterberg & Blaschke, 2005; Shi et al., 2010). Self-reported questionnaires or surveys have been the most widely used methods of measurement in the adherence literature (Barclay et al., 2007; Birkenfeld et al., 2011; Boeka et al., 2010; Chia et al., 2006; Curtin et al., 2008; Fawzi et al., 2012; Ingersoll & Cohen, 2008; Liang et al., 2008; Ngamvitroj & Kang, 2007; Osterberg & Blaschke, 2005; Peddle et al., 2009; Shi et al., 2010; Tarantino et al., 2010; Taylor et al., 2011). Although self-report methods are convenient, easy to administer, often generate data quickly, and are relatively inexpensive, their accuracy is uncertain (Shi et al., 2010). Self-report methods are subject to many forms of bias including recall and response bias as well as social desirability bias and the Hawthorne effect (Shi et al., 2010). There also are

many confounding factors that influence responses to questionnaires or surveys and this significantly limits the precision, credibility, and validity of the data collected (Shi et al., 2010). Another limitation of self-report methods was identified in a literature review that examined the relationship between self-reported adherence questionnaires and electronic medication monitoring devices (Shi et al., 2010). Given the moderate to strong correlations found between self-administered questionnaires and electronic monitoring devices in terms of measuring adherence, Shi et al. (2010) still found a higher reported rate of adherence through self-report methods, approximately 14.9% higher, when compared with the rates derived from electronic monitoring devices (Shi et al., 2010). These results point to an important limitation of self-report methods, the tendency for patients to overestimate their level of adherence. Lastly, similar to the measurement of self-efficacy, there is incomplete reporting of the reliability and validity of the instruments used to measure adherence (Fawzi et al., 2012). Only one study, conducted by Boeka et al. (2010), reported evidence related to the reliability of their instrument. They administered an Intention to Comply Questionnaire to assess compliance with bariatric surgery guidelines and reported a Cronbach alpha of .66 with respect to that questionnaire (Boeka et al., 2010).

Electronic medication monitoring devices, another indirect method to measure adherence, can be used in studies that examine medication adherence. Barclay et al. (2007) used a medication event monitoring system (MEMS) to measure adherence in HIV-positive adults. This device attaches to a medication vial and records the date and time of each bottle opening (Shi et al., 2010). Although a good method for providing precise information with regard to patients' medication-taking behaviour, it is limited in its ability to monitor whether patients actually ingest the medication and, if so, whether they ingest the correct dose (Osterberg & Blaschke, 2005).

In five of the studies included in this review, adherence was measured simply by

documenting whether a patient adhered to a regimen (Birkenfeld et al., 2011; Curtin et al., 2008; Ngamvitroj & Kang, 2007; Peddle et al., 2009; Taylor et al., 2011). Adherence rates were then calculated by dividing the observed level of adherence by the expected level of adherence. Although this method of measurement lacks objectivity, and caution must be used in interpreting the overall study results, this information can enhance our understanding of adherence.

## **Research Findings**

### **Age and adherence**

The relationship between age and adherence is one of complexity. Contributing to this complexity are: (a) the existence of co-variables that can influence the magnitude and direction of the relationship, (b) the overall inconclusive results with respect to the magnitude of the relationship, and (c) the overall inconsistency in the direction of the relationship when a relationship between age and adherence has been detected (Birkenfeld et al., 2011; Chia et al., 2006; Tarantino et al., 2010; Taylor et al., 2011). As mentioned previously, adherence to a decolonization protocol has been largely understudied in the total joint arthroplasty population making it necessary to consider other health domains and patient populations where adherence has been examined. Adherence to medication, patients' instructions, surgery guidelines, and physician-recommended exercise programs are just a few examples of the types of health domains where the relationship between age and adherence has been examined. Although the generalizability of the results to the orthopaedic population and the decolonization protocol, specifically, is limited, these areas have contributed to our understanding of the relationship between adherence and age.

Taylor et al. (2011) conducted a systematic review of the medical, psychological, and socio-demographic factors associated with adherence to cardiac rehabilitation programs.

They found a statistically significant relationship between age and adherence in 6 of the 18 studies examined, but the direction of the relationship was inconsistent across those studies (Taylor et al., 2011). Why such variation in the results? Inconsistencies in how adherence was defined and measured within those studies, the research design that was used, the characteristics and size of the samples, and the presence of co-variables could explain the equivocal results. Although this review did not shed light on the adherence behaviour of older and younger adults, the authors discussed some of the factors that might influence adherence across various age groups. Co-variables, such as the perception of personal control over an illness or disease or the presence of life commitments to work or family, could be mediating factors in the relationship between age and adherence (Taylor et al., 2011). Further research is needed with more representative samples, an explicit definition and reliable and valid measurement of adherence, and more robust and rigorous methods to further examine the contribution of these co-variables to the overall interpretation of study outcomes (Taylor et al., 2011). Similarly, more research about age-related differences in adherence behaviour across various health fields is needed to better understand the relationship between age and adherence and to improve the generalizability of the study outcomes. Although the findings from this study did not generate conclusive results with respect to the magnitude and direction of the relationship between age and adherence, the findings do reflect the state of the literature. In other words, there is considerable variance among the outcomes of studies that have examined age and adherence.

Barclay et al. (2007) examined age-associated predictors of medication adherence in HIV-positive adults and found that adults older than 50 years of age had significantly greater rates of adherence to antiretroviral therapy than did those under 50 years of age. The participants' ages ranged from 25 to 69 years. When the researchers examined the poor adherers

in each age group, they found a greater percentage of non-adherers in the under-50-year-age group compared with the over-50-year-age group (Barclay et al., 2007). They found positive relationships between non-adherers in the under-50-age group and drug dependency and a lack of independent financial resources. In other words, younger HIV-seropositive adults who were reliant on family, friends, and government programs for income, were less likely to adhere. They also found lower levels of social support, weaker internal locus of control, and more perceived barriers to treatment in this younger age group (Barclay et al., 2007). Poor adherence in the older group was significantly and solely related to cognitive changes (Barclay et al., 2007). They speculated, like Taylor et al. (2011), that adherence rates may be greater in older adults because medication adherence in older individuals does not require as many lifestyle changes and, if alterations are necessary, they find incorporating these changes to be less of an inconvenience (Barclay et al., 2007). Furthermore, older individuals may perceive the risk of mortality with non-adherence to be greater than those of a younger age (Barclay et al., 2007). The generalizability of these findings to the elective orthopaedic population and to the decolonization protocol, specifically, is questionable. The HIV population is unique in its attributes. The social stigma and barriers encountered by this population in terms of accessing health resources and medication are not attributes necessarily shared by other patient populations. Hence, the factors that influence medication adherence in this population are not easily generalized to other patient populations. Nonetheless, this study identifies some very important psychological determinants of adherence that will be discussed later in this review, including the influence of health beliefs, self-efficacy, and perceived risk on adherence (Barclay et al., 2007).

Birkenfeld et al. (2011) examined factors affecting compliance in faecal occult blood testing for colorectal cancer screening in Israeli adults aged 50 to 75 years of age. They found



that those aged 60 years of age and older had significantly greater adherence rates and more women than men adhered (Birkenfeld et al., 2011). The generalizability of these results, however, is questionable because of the potential influence of cultural factors. Replicating this study in Canada could generate very different results to the ones obtained in Israel due, in part, to cultural differences between the two countries. The influence of cultural differences was apparent in the Netherlands when a replication of this study did not generate similar results (Birkenfeld et al., 2011). Ethnicity and cultural differences should be examined to a greater extent in future studies to ascertain the generalizability of study results across ethnically diverse patient populations globally (Chia et al., 2006).

Tarantino et al. (2010) examined socio-cognitive factors in relation to non-adherence to medication prescriptions in adults aged 35 to 80 years of age, who were recently discharged from hospital. Similar to Birkenfeld et al. (2011), they found greater adherence rates in the over-65 age group when compared with the under-65 age group, but unlike Birkenfeld et al. (2011), these results were not modified by gender. Similar to Taylor et al. (2011) and Barclay et al. (2007), Tarantino et al. (2010) studied lifestyle factors as possible explanations for these findings. Younger patients who are employed and raising a family often have very busy lifestyles. Work or family commitments place relatively younger patients, aged 35 to 65 years, at greater risk for non-adherence or ineffective and inaccurate management of medication (Tarantino et al., 2010). To speculate that lifestyle alone drives non-adherence may be short sighted, but it is nonetheless an important factor to consider when interpreting the findings of research that has explored the relationship between age and adherence.

The discussion thus far has focussed on research domains that have shown greater adherence rates in older adults. There is however a body of literature that reveals the converse,

the vulnerability of the older population and the multitude of factors that often put this population at risk for non-adherence. The manner in which psychosocial, cognitive, and contextual factors play out in relation to adherence is strongly linked to age (Park & Meade, 2007). Psychosocial factors, such as personal beliefs and motivational states, and cognitive factors, such as memory and comprehension, often change with age (Park & Meade, 2007). The beliefs and perceptions that people have of their health and the factors that motivate and drive personal behaviour look very different at the age of 40 than they do at the age of 80. Similarly, contextual factors, such as daily commitments and routines or level of busyness, also change with age (Park & Meade, 2007). As one ages, these changes may not favour adherence, especially when the regimen to which they are adhering is complex (Park & Meade, 2007). “Effortful cognitive processes,” Park and Meade (2007) explained, become more difficult as one ages and becomes more cognitively frail. The ability to consciously interpret, comprehend, and translate instructions into action diminishes with age, and this, more so than memory, is the greatest barrier to adherence in older adults (Park & Meade, 2007). These factors were found to be most significant in those aged 71 years of age and older (Park & Meade, 2007).

Although Park and Meade (2007) did not identify memory as the greatest barrier to adherence in the older population, many researchers that have examined the relationship between age and adherence have identified memory, particularly prospective memory decline, as a strong determinant of adherence in older adults (McDaniel & Einstein, 2007; Tarantino et al., 2010). Prospective memory is what allows one to remember to perform a particular action at a time when it is intended to be done (McDaniel & Einstein, 2007). Time-based prospective memory relates to the memory of performing everyday tasks, such as remembering to take a medication, which tends to diminish with age-related cognitive decline in adults aged 61 to 76

years of age, but not in those under the age of 61 years (McDaniel & Einstein, 2007). Given that following physicians' instructions is a prospective memory task, specifically a time-based task, it is easy to appreciate the relevance of these findings in the examination of age and adherence to patient instructions or guidelines for a decolonization protocol.

When presented with a time-based task, such as following patient instructions, Liu and Gonzalez (2007) explained that one of the ways that older adults often compensate for age-related cognitive decline is by placing greater reliance on “cognitive shortcuts.” An example of a “cognitive shortcut” might be the memory of prior successes and failures with performing the same task in the past, a construct of self-efficacy referred to as “vicarious experience” in Bandura's (1977) self-efficacy theory. Understanding how older adults compensate for age-related decline and use their past experiences to make decisions and judgments has significant clinical implications when designing instructions for older adults and expecting that they will adhere to them (Liu & Gonzalez, 2007).

In summary, there is considerable variance among the outcomes of studies that have examined the relationship between age and adherence. There is a large body of literature that shows greater adherence rates, to medication and physician-recommended exercise programs and screening guidelines, in adults over 50 years of age compared with those under 50 years of age (Barclay et al., 2007; Birkenfeld et al., 2011; Tarantino et al., 2010; Taylor et al., 2011). There is however a body of literature that reveals the converse, the vulnerability of the older adult population and the multitude of factors that often put this population at risk for non-adherence (Liu & Gonzalez, 2007; McDaniel & Einstein, 2007; Park & Meade, 2007). The potential influence of co-variables, such as contextual or lifestyle factors and cognitive, psychological, and social factors, on the relationship between age and adherence remains unclear. Similarly, the

social stigma and barriers encountered by certain patient populations, (i.e., the HIV population), in terms of accessing health resources and medication are not attributes necessarily shared by other patient populations. These factors can limit the generalizability of study outcomes from these patient populations to other patient populations, making the interpretation of research findings from studies that have examined the relationship between age and adherence, more complex.

### **Self-efficacy and adherence**

Unlike the relationship between age and adherence, where the overall findings from the literature yield inconclusive results with respect to the magnitude and direction of the relationship, the literature about the relationship between self-efficacy and adherence paints a very different picture. As previously mentioned, elements and constructs from theoretical models such as the Health Belief Model, Bandura's (1977) self-efficacy theory, the Theory of Planned Behavior, and the Protection Motivation Theory have been the basis of most research studies that have explored the relationship between self-efficacy and adherence. They also have guided the design and selection of instruments used to measure self-efficacy (Ajzen, 1991; Barclay et al., 2007; Boeka et al., 2010; Peddle et al., 2009; Tarantino et al., 2010).

Chia et al. (2006) conducted a systematic review of the influence of self-efficacy, the belief in one's ability to perform a particular behaviour under diverse conditions, and five other belief-laden variables on medication adherence (Chia et al., 2006). They found a statistically significant positive relationship between adults' beliefs in their ability to take medication (i.e., medication-taking self-efficacy) and medication adherence in four of the fourteen studies included in the review. In other words, adults who were confident in their ability to take a medication were more likely to adhere to the prescribed medication (Chia et al., 2006). Of the six

variables examined, self-efficacy was the only variable that significantly differed between adherent and non-adherent subjects (Chia et al., 2006). Similar findings were found by Curtin et al. (2008), who conducted a study of the association between patients' perceived self-efficacy and five self-management behaviours, one of which was medication adherence in patients with chronic kidney disease. After controlling for socio-demographic and health-related variables, they concluded that self-efficacy was positively and significantly associated with four of the five self-management behaviours, including medication adherence ( $r = .37$ ) (Curtin et al., 2008). To further support there being a positive relationship between self-efficacy and adherence, Ngamvitoj and Kang (2007) found similar results when they examined the effects of asthma self-efficacy, social support, and knowledge on adherence to peak expiratory flow rate (PEFR) monitoring in asthma patients. They found predictive effects between higher scores of asthma self-efficacy and adherence to PEFR monitoring when univariate analyses were performed, however, the three variables did not contribute significantly to the total variance on adherence to PEFR self-monitoring (Ngamvitoj & Kang, 2007). Perhaps with a larger sample size and greater variability between the variables, these results may have been statistically significant (Ngamvitoj & Kang, 2007).

Another construct of self-efficacy that has been widely examined in relation to adherence is the level of perceived risk, commonly referred to as perceived threat. Levels of perceived risk or threat associated with not following physicians' instructions or guidelines or with developing illness or disease are a few examples of measures used to predict personal adherence behaviour. In a systematic review that measured medical, psychological, and socio-demographic factors associated with adherence to a cardiac rehabilitation program, a large effect size of 0.77 to 0.82 was found between more serious perceived consequences of developing cardiac complications

and greater adherence to cardiac rehabilitation programs (Taylor et al., 2011). In other words, patients who perceived greater health risks associated with not attending the program were more likely to attend (Taylor et al., 2011). In one particular study included in this review, a positive correlation ( $r = .41$ ) was also found between the level of self-efficacy and adherence to a cardiac rehabilitation program. Similar results were found by Tarantino et al. (2010) who examined the association between socio-cognitive factors and non-adherence to medication instructions in patients discharged from a general medicine unit. They found statistically significant positive relationships between medication adherence and perceived personal susceptibility to disease, perceived risks of non-adherence, and perceived absence of benefits of non-adherence (Taylor et al., 2011). In other words, patients who believed that they were putting themselves at risk by not following medication instructions and who believed there were greater overall health risks with not taking a prescribed medication as opposed to taking it, were more likely to take the medication and follow their physicians' instructions. These findings were further supported by Boeka et al. (2010) who conducted a study to examine the psychosocial predictors of intentions to comply with bariatric post-operative surgical guidelines in adults 21 to 56 years of age. Using constructs derived from the Protection Motivation Theory (i.e., perceived threat and self-efficacy), Boeka et al. (2010) designed two questionnaires, one to measure self-efficacy and perceived threat and the other to measure behavioural intentions. The questionnaires were validated according to their reported assessments of reliability and validity. They found that higher levels of personal self-efficacy and a greater degree of perceived threat correlated strongly and positively with intentions to comply with the post-operative guidelines ( $r = .37$ ). The extent to which behavioural intentions to adhere translate into actual adherence remains unknown. Further research would be needed before concluding that behavioural intentions could act as

reliable and valid predictors of actual adherence. Barclay et al. (2007) found similar results when they examined medication adherence in HIV-positive adults. Greater perceived treatment utility (i.e., belief in the efficacy of a medication or treatment) was predictive of medication adherence in adults of all ages, but heightened feelings of self-efficacy were predictive of medication adherence only in adults younger than 50 years of age (Barclay et al., 2007). The extent to which age influences predictors of adherence remains unclear.

Health beliefs and illness perceptions, constructs derived from the Health Belief Model (Rosenstock et al., 1988), are other constructs of self-efficacy that have been used by researchers to examine the relationship between self-efficacy and adherence. Similar to the findings of studies that have examined self-efficacy and adherence, researchers that have examined health beliefs about medication use and health prevention or illness perceptions with respect to disease severity or susceptibility have found strong associations between these variables and adherence (Chia et al., 2006; Fawzi et al., 2012; Liang et al., 2008). Fawzi et al. (2012) examined whether health beliefs about medications could be used to predict adherence to anti-depressant prescriptions in older adults diagnosed with depression. They found a moderate, but significantly positive, correlation between beliefs regarding the necessity of such medications for improving overall health and adherence to antidepressant prescriptions ( $r = .34$ ) (Fawzi et al., 2012). In other words, those who perceived their depression to be a serious health issue and who believed that taking antidepressant medication could improve their overall health were more likely to adhere to them. They similarly found negative correlations between adherence to anti-depressant medication and (a) beliefs that the medication could cause harmful side effects ( $r = -.34$ ), (b) perceptions that anti-depressants are over-prescribed by physicians ( $r = -.23$ ), and (c) perceptions that medications are fundamentally harmful ( $r = -.21$ ) (Fawzi et al., 2012). In a study that

examined factors influencing opioid-taking self-efficacy and analgesic adherence in Taiwanese cancer outpatients, similar results were found (Liang et al., 2008). Cancer patients with negative beliefs about opioids demonstrated poor adherence ( $r = -.30$ ), whereas patients with higher perceived opioid-taking self-efficacy showed greater adherence to the opioid regimen ( $r = .22$ ) and reported greater pain relief ( $r = .35$ ) (Liang et al., 2008). The degree to which the findings from these two studies can help predict and explain adherence to a decolonization protocol in an elective orthopaedic population is debatable. Attributes of mental health and cancer patient populations, similar to the HIV population, are unique in their attributes. There are likely many confounding factors to consider when generalizing results from studies that have examined these populations to other patient populations such as an elective orthopaedic surgery population. Despite this limitation, these studies provide a solid foundation from which researchers can adopt ideas, concepts, and themes to conduct further research or replicate studies in other patient populations.

Lastly, Peddle et al. (2009) applied constructs related to self-efficacy from the Theory of Planned Behavior (Ajzen, 1991) to examine adherence to a supervised exercise program in patients awaiting surgical removal of malignant lung lesions. Constructs such as one's perceived confidence and control in performing a particular action (i.e., perceived behavioural control), one's attitude towards performing that action, and perceived social pressure to perform an action (i.e., the subjective norm) were examined in relation to adherence to the exercise program. They found statistically significant correlations between adherence to the exercise program and stronger behavioural control ( $r = .63$ ) and greater subjective norm awareness ( $r = .51$ ) (Peddle et al., 2009). In other words, patients who were confident in their ability to do the exercise program and who felt more social pressure from their family and friends to do so were more likely to



complete the program. The influence of social pressure on personal levels of self-efficacy (i.e., verbal persuasion) is one of the key elements of Bandura's (1977) self-efficacy theory.

Based on this discussion, it is clear that the body of relevant literature shows overwhelming support for their being a relationship between self-efficacy and adherence. Higher levels of personal self-efficacy appear to be significantly and positively correlated with adherence. The relationship however is moderate in strength with Pearson's product moment correlation coefficients ( $r$ ) reported in the range of .3 to .6 (Boeka et al., 2010; Curtin et al., 2008; Fawzi et al., 2012; Liang et al., 2008; Peddle et al., 2009; Taylor et al., 2011). The literature findings related to the relationship between age and adherence have yielded more inconclusive results with respect to the magnitude and direction of that relationship. Caution, however, must be used in interpreting and generalizing these overall findings because there are several methodological limitations that need to be acknowledged, and confounding factors that need to be considered, before predictions and conclusions can be made with any degree of certainty.

### **Limitations of the Research**

In studies that have examined the relationships between age, self-efficacy, and adherence, a number of methodological limitations and weaknesses have been noted. First, the field lacks a consensual or standard definition of adherence (Fawzi et al., 2010; Ingersoll & Cohen, 2008). It is important to ascertain whether adherence is defined in terms of timing, dosing, attendance, or other considerations when evaluating patients' responses to treatment recommendations. It is also important to establish what is meant by adequate adherence or what an appropriate indicator of good adherence is. In certain circumstances, 80% adherence may be considered adequate adherence, whereas in other circumstances, 90% may be a better indicator of good adherence.

These parameters are often stipulated by the type of population being examined and the type of treatment being evaluated. Ninety-five percent may be considered a better standard or measure of adherence in studies where high-risk patient populations are being examined for adherence with life-altering medication prescriptions. Despite there being justification for using different standards of measurement of adherence, in certain circumstances, a lack of consensual definition of adherence makes the operationalization of adherence, and comparisons of studies, difficult. Similarly, as evident in the literature and throughout this discussion, there are numerous constructs of self-efficacy that exist. The use of these various constructs to examine a particular outcome has undoubtedly added depth and richness to the literature and enhanced our understanding and knowledge of self-efficacy. On the other hand, they have prevented researchers from speaking a uniform language when it comes to defining self-efficacy. Second, studies that have examined the relationships between age, self-efficacy, and adherence have relied heavily on self-reported instruments (i.e., patient questionnaires and surveys) for measurement. Although there are many advantages to using this method of measurement, there are many disadvantages as well. Many researchers have reported that there is a tendency for subjects to overestimate their adherence with this method of assessment in comparison with other more objective methods (Barclay et al., 2007; Curtin et al., 2008; Fawzi et al., 2012; Ngamvitroj & Kang, 2007). There are also many forms of bias introduced in studies that have used self-reported methods of measurement and caution must be applied in the interpretation of those study results (Shi et al., 2010). There is no perfect fit or gold standard of measurement for self-efficacy or adherence. When selecting an appropriate instrument for measurement, researchers must consider several factors: the study design, patient population, sample size, method of sampling, nature of the research question, and study outcomes (Shi et al., 2010).

Third, there is an overall lack of evidence of the reliability and validity of the instruments that have been used (Ingersoll & Cohen, 2008; Shi et al., 2010; Taylor et al., 2011). Failure to conduct studies that are designed to establish the reliability and validity of instruments, or failure to report the statistical evidence, are major limitations in the literature that has examined age and its relationship with self-efficacy and adherence (Ingersoll & Cohen, 2008; Shi et al., 2010; Taylor et al., 2011). Without evidence of reliable and valid instrumentations, it is difficult to ensure that accurate and precise data have been collected, and without accurate and precise data, it is difficult to draw valid conclusions or make valid predictions. Fourth, the use of convenience sampling to recruit subjects and the use of cross-sectional observational designs to examine the relationships between age, self-efficacy, and adherence, although appropriate for the research objectives, are problematic. In their own way, both factors make it difficult to control for confounding variables that may be present during the particular study period. Without the ability to control for these variables, it is difficult to draw conclusions with any degree of certainty. Furthermore, the studies chosen for this review examined age, self-efficacy, and adherence in various contexts: different age groups, diverse patient populations, and a range of treatments or regimens. Consequently, the generalizability of these results to an elective orthopaedic surgery population, and to a decolonization protocol specifically, is uncertain. Nonetheless, these studies have provided some evidence of the relationships between these variables and they have formed a solid foundation from which further research can be generated.

## **Chapter 3: Methods**

This study examined whether there were relationships between age and adherence and self-efficacy and adherence to an established pre-operative *Staphylococcus aureus* decolonization protocol, in the total joint arthroplasty population, at a single health institution. The study hospital performed approximately 600 elective total joint replacement surgeries annually with primary hip and knee replacements comprising approximately 90% of that total (L. Archer, personal communication, July 10, 2012). On March 5, 2012, the hospital implemented a pre-operative screening and decolonization protocol for their primary hip and knee replacement patients (L. Archer, personal communication, July 10, 2012). This protocol mandated that all primary hip and knee replacement patients undergoing surgery be screened for nasal carriage of *Staphylococcus aureus* approximately two weeks before surgery and wash with chlorhexidine gluconate cloths pre-operatively. Key aspects of the decolonization protocol included the application of chlorhexidine gluconate cloths the evening before surgery and on the day of admission for surgery, and the administration of nasal Mupirocin, twice daily for five days before surgery, for those who tested positive for nasal carriage of *Staphylococcus aureus*. This study specifically examined whether age and level of self-efficacy influenced the patients' adherence to the established decolonization protocol.

### **Study Design**

A descriptive, correlational study design was used to examine the relationships between age and adherence and level of self-efficacy and adherence.

### **Sampling Plan**

#### **Sample population**

All patients undergoing a primary total hip or knee replacement surgery between May 1,

2013 and October 1, 2013 were eligible to participate in the study. Patients had the freedom and right to accept or refuse the invitation to participate.

### **Inclusion and exclusion criteria**

All patients, men and women, 19 years of age and older, scheduled for a primary total hip or knee replacement surgery between May 1, 2013 and October 1, 2013, at the hospital, were eligible to participate. Eligible participants had to be competent to make an informed decision and they had to be proficient in the English language; that is, they were required to read and write English proficiently.

Patients undergoing other orthopaedic procedures including hip and knee revisions and ankle and shoulder replacement surgeries were excluded from this study. Patients who had a history of an allergic reaction to either chlorhexidine gluconate or Mupirocin or for whatever reason were unable to administer either of these treatments, perhaps due to a physical or mental disability, were excluded. There have been rare reports of patients reacting to topical chlorhexidine gluconate. Two studies reported that 15% to 27% of sampled patients experienced skin inflammation and none had a hypersensitivity reaction (Mimoz et al., 2007; Valles et al., 2008). In a study of 586 patients, from 18 facilities, Kallen, Patel, and Hess (2011) reported that 17% of hemodialysis patients, who had chlorhexidine gluconate applied for the care of central line insertion sites, were perceived to be chlorhexidine gluconate intolerant. In clinical trials of Bactroban nasal ointment (Mupirocin) reported by the manufacturer, less than 1% of 2,340 participants were withdrawn from the research because of adverse events. The most frequent adverse events reported were headache, rhinitis, respiratory disorder, including upper respiratory tract congestion, pharyngitis, and taste perversion (GlaxoSmithKline, 2009).

Eligible participants could not be current patients of another health facility or residents of

an extended care facility. All participants were required to be outpatients. This exclusion criterion was necessary because hospitals and extended care facilities often prohibit patients from self-administering medications. Because adherence, in this study, was operationalized in terms of whether a participant washed with the six chlorhexidine gluconate cloths the evening before surgery, whether they applied those cloths to the correct body areas and, if applicable, whether a participant filled the required prescription for Mupirocin, began its application as advised, and self-administered the recommended number of applications, eligible participants were required to be autonomous in following the decolonization protocol. For this reason, only outpatients were considered eligible.

Lastly, eligible participants had to be residents of Metro Vancouver or the Lower Mainland of British Columbia. Out-of-town patients were eligible to participate in the study as long as they attended their pre-operative appointments two weeks before surgery. Out-of-town patients were usually not seen in the hospital's pre-surgical screening clinic until two or three days before surgery, whereas in-town patients were seen two weeks before surgery. If out-of-town patients were screened for nasal carriage two to three days before surgery and their cultures were found to be positive, they would not have had the opportunity to begin the administration of nasal Mupirocin for the recommended five days before surgery. Therefore, unless out-of-town patients were willing to attend their pre-operative appointments two weeks before surgery, they were not eligible to participate in the study.

### **Recruitment of participants**

Consecutive sampling was used for the study recruitment. Two weeks before surgery, at the time of the patients' scheduled pre-operative appointments, nurses in the pre-surgical screening clinic gave eligible patients an information package that included an invitation and

consent form. The nurses in the pre-surgical screening clinic advised prospective participants to review the invitation and, if willing to participate, sign and return the consent form to the surgical day care unit on the day of surgery. If the prospective participants had any questions regarding the study, they had the opportunity to have their questions answered by contacting the research team via the contact information indicated on the study invitation.

### **Power analysis**

DiMatteo, Haskard, and Williams (2007) conducted a meta-analysis of the relationships between patients' adherence and patients' ratings of their health status, perceived disease severity, and beliefs about the threat of their disease, factors reflective of the principles and components of both self-efficacy theory and the Health Belief Model. They calculated the effect sizes to be .25, .22, and .32, respectively. Using the findings from this meta-analysis, a medium or moderate effect size of .30 was specified for an *a priori* power analysis (Cohen, 1992). The power analysis was conducted to determine the sample size needed to detect a relationship between patients' age and adherence and self-efficacy and adherence using correlation estimation for the statistical analysis. Specifying power of .80, a two-tailed alpha probability level of .05, and a medium effect size of .30, a total sample size of 84 participants was needed. To account for an estimated attrition rate of 10% because of surgeries being cancelled or postponed due to medical reasons or other unforeseen circumstances, a sample size of 100 participants was sought.

### **Procedures and Data Collection**

#### **The established decolonization protocol**

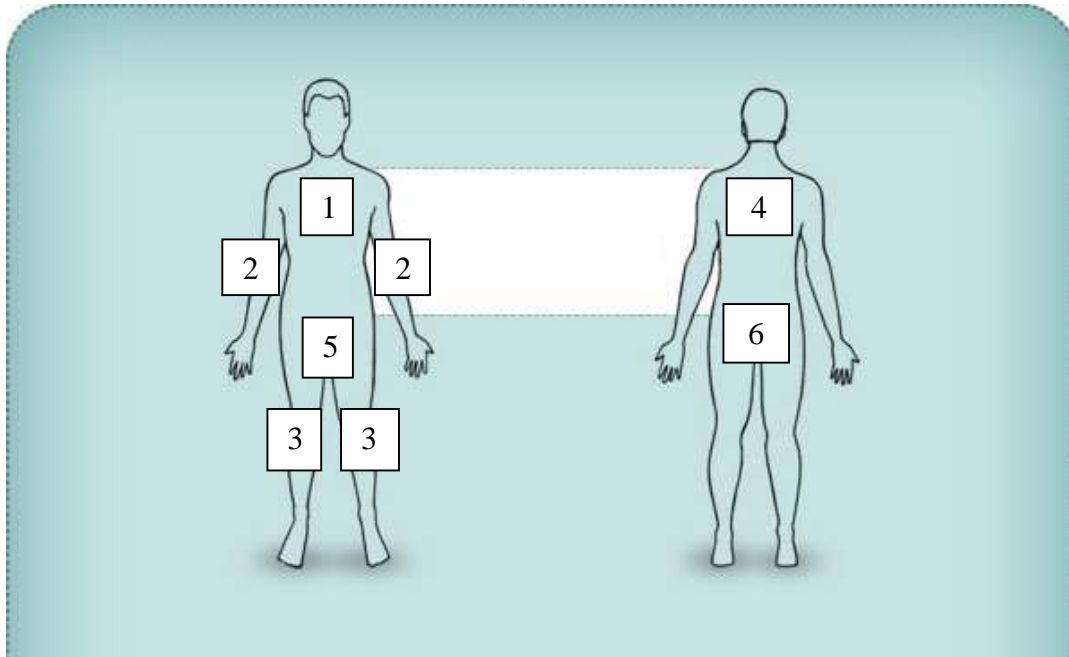
The established decolonization protocol, as described here, was followed; no modifications were made for the purpose of the study. In the pre-surgical screening clinic, the

patients were screened for nasal carriage of *Staphylococcus aureus* and were given a prescription for nasal Mupirocin ointment along with a patient instruction pamphlet. The clinic's nurses reviewed the instruction pamphlet with the patients, who were advised not to fill the prescription unless they received a call from a pre-surgical screening nurse advising them to do so. The patients had each nostril swabbed by a registered nurse and the specimen was sent to the outpatient laboratory for testing. The results of the testing were returned to the pre-surgical screening clinic within 48 to 72 hours. If a patient's test was positive, a pre-surgical screening nurse contacted the patient and informed her or him of the results. The patient was then advised to fill the prescription for nasal Mupirocin ointment and to begin applying the ointment twice daily into each nostril for five days before surgery, as described in the patient instruction pamphlet. Patients whose test results were negative were not contacted and hence did not fill the Mupirocin prescription.

In the pre-surgical screening clinic, the patients were given a box of six Sage® 2% chlorhexidine gluconate cloths for pre-operative skin preparation with written instructions for their use. The manufacturer supplies each box with three individually wrapped packages with two 7.5" x 7.5" applicator cloths in each package. The cloths are alcohol-, rinse-, and latex-free. The nurses in the pre-surgical screening clinic advised the patients to apply the cloths the evening before surgery and reviewed the six body locations to which the cloths must be applied (see Figure 1). The patients received a second box of Sage® 2% chlorhexidine gluconate cloths the morning of surgery, once they were admitted. Adherence to this last phase of the decolonization process was not included in the study evaluation because the distribution and application of the cloths were supervised by a nurse (i.e., the participant was not fully autonomous).



As per the established protocol, registered nurses in the pre-surgical screening clinic advised patients of the findings in the literature that showed that side effects to these two products were for the most part restricted to local irritation of the nose or skin, both of which have been shown to resolve after discontinued use of the products (Bode et al., 2010).



**Figure 1. Assigned Body Areas for the Six Chlorhexidine Gluconate Cloths**

## **The study protocol**

The principal investigator conducted in-service education with all nursing staff in the pre-surgical screening clinic before the commencement of the study to ensure that the decolonization process was administered by all the nurses in the established fashion and that they understood the purpose and protocol of the study.

## **Data collection**

The primary outcome for this study was participants' adherence to the decolonization protocol; the two explanatory variables of interest were age and level of self-efficacy. Level of self-efficacy was operationalized in the form of a self-efficacy score that was generated using a rating scale. Because a validated instrument to measure self-efficacy in relation to adherence to the decolonization protocol did not exist, it was necessary to examine other health domains where self-efficacy and adherence had been thoroughly examined, the area of medication compliance. Sleath et al. (2010) developed a validated instrument to measure glaucoma medication self-efficacy. Specifically, they developed an instrument that measured three different elements of self-efficacy: (a) self-efficacy in overcoming the barriers that interfered with glaucoma medication compliance, (b) self-efficacy in carrying out specific tasks required to use the medication, and (c) self-efficacy in relation to perceived expectations and outcomes with the use of the medication. These three elements were used to develop an instrument that measured self-efficacy in relation to the use of chlorhexidine gluconate cloths and Mupirocin (see Appendix A).

At the end of the patients' pre-operative appointments in the pre-surgical screening clinic, two weeks before surgery, eligible patients were given an information package. Included in this package were a study invitation, a consent form, and a self-efficacy survey. If willing to

participate, the participant was asked to sign the consent form and complete the 15-minute self-efficacy survey at home, before surgery. The participants were asked to document their age, gender, and date of surgery on the questionnaire. They were asked to place the completed questionnaire and signed consent form in an envelope labelled “consent form and survey” provided in the information package. They were then instructed to seal the envelope and give it to the admitting nurse in the surgical day care unit on the day of surgery. To ensure that participants remained anonymous to the research team, these envelopes had an outside label containing a unique code number.

Adherence to the decolonization protocol was operationalized in the form of an adherence score that was generated from the results of an adherence questionnaire. The purpose of the questionnaire was to collect information about whether the participants applied the chlorhexidine gluconate cloths, the number of cloths applied, whether the cloths were applied to the appropriate areas, and the time of day the cloths were applied. In addition, for participants who tested positive for nasal carriage of *Staphylococcus aureus*, items related to whether they filled the required prescription for Mupirocin, when they started applying the Mupirocin, the number of applications per day, and the location of the applications, were measured. Because a validated tool to measure adherence to the decolonization protocol, specifically, did not exist, a questionnaire was designed to capture the above measures of adherence (see Appendix A). The questionnaire was administered to the enrolled patients by a registered nurse in the surgical day care unit on the day of admission for surgery. The patients verbalized their responses to the questionnaire and the registered nurse documented those responses. The questionnaire took approximately 5-10 minutes to complete.

Sealable envelopes, with a code number labelled on the outside, were stored in the

surgical day care unit. Each envelope contained an adherence questionnaire for the nurses to complete with the patients. When the participants returned an envelope containing the self-efficacy survey and consent form to a nurse in the surgical day care unit on the day of surgery, the nurse took note of the code number on the envelope and then obtained the envelope with the adherence questionnaire and the same code number. In other words the envelope containing the consent form and survey had the same code number as the envelope containing the adherence questionnaire. The nurses were instructed to complete the adherence questionnaire with the participant, to place the completed questionnaire into the envelope, to seal the envelope, and to return the two envelopes to the research team. This process was in place to ensure that (a) the participants remained anonymous to the research team and (b) the self-efficacy questionnaire, consent form, and adherence questionnaire for each participant were kept together.

Before the commencement of the study, the principal investigator conducted in-service education with all the nursing staff of the pre-surgical screening and surgical day care units to clarify the purpose of the study and the purpose and administration of the questionnaires. The intention of the in-service education was to minimize information biases by ensuring that all the nurses provided the information package to the participants and documented the participants' responses to the questionnaire in a standardized manner. Furthermore, it was crucial that they were aware of the numeric coding system used to ensure the anonymity of the participants.

### **Data Analysis**

To determine whether there was a relationship between self-efficacy and adherence, correlation analysis was used to examine the relationship between self-efficacy scores and adherence scores. The self-efficacy survey consisted of 31 questions (see Appendix A). Two questions, specifically, assessed whether participants' had access to someone who could help

them with the decolonization protocol, should it be necessary. These 2 items were not included in the calculation of the self-efficacy scores. The remaining 29 items in the survey measured participants' levels of self-efficacy with respect to: 1) the application of chlorhexidine gluconate cloths (12 items), 2) the application of Mupirocin (15 items), and 3) participants' perceived infection risk with the use of both chlorhexidine gluconate cloths and Mupirocin (2 items). Each item on the questionnaire was scored on a 5-point scale with "4" indicating that the participant was "extremely confident" and "0" indicating that he or she was "not at all confident." For the application of chlorhexidine gluconate cloths, an averaged self-efficacy score, for each participant, was calculated by summing the scores on each of the 12 items and then dividing by 12. Similarly, an averaged self-efficacy score for the use of nasal Mupirocin was calculated by summing the scores on each of the 15 items and then dividing by 15. Finally, an averaged self-efficacy score with respect to the participants' perceived infection risk was calculated by summing the scores on the 2 items and then dividing by 2. Thus, the final scores ranged from 0.0 to 4.0.

Adherence scores for each participant were calculated based on the participants' responses to the adherence questionnaire. Adherence scores for the application of chlorhexidine gluconate cloths were calculated for all participants. For those participants who also required Mupirocin treatment, an additional adherence score was calculated. Adherence to the use of chlorhexidine gluconate cloths was based on a possible total score of 10 points with a score of 10 indicating complete adherence to the timing and application of the chlorhexidine gluconate cloths. Similarly, adherence to the use of nasal Mupirocin was based on a total score of 10 points with a score of 10 indicating complete adherence to the timing, application, and use of nasal Mupirocin. A breakdown of the score allocation is listed in Figure 2. When the adherence

questionnaire was verbally administered to the participants by the registered nurses in the surgical day care unit, on the day of admission for surgery, the patients who had not adhered to the chlorhexidine gluconate cloths or Mupirocin requirements was asked to explain why. A content analysis was conducted to examine some of the common themes for non-adherence.

The self-efficacy and adherence scores were plotted with scatter plots and a Pearson's product moment correlation coefficient ( $r$ ) was calculated using SPSS software. This correlation coefficient was used to estimate the magnitude and direction of the relationship between the variables.

To examine the relationship between age and adherence, age and adherence scores were plotted with scatter plots and a Pearson's product moment correlation coefficient ( $r$ ) was calculated using SPSS software. The correlation coefficient ( $r$ ) mathematically stated the direction and strength of the relationships between age and adherence and self-efficacy and adherence, but it did not measure the amount of variance ( $r^2$ ) accounted for in the outcome variable, adherence, given the explanatory variables, age and self-efficacy. To measure this variance ( $r^2$ ), multiple linear regression analysis with SPSS software was used. The regression equation,  $y = a + b_1x_1 + b_2x_2 + e$ , where  $y$  equalled adherence,  $x_1$  and  $x_2$  corresponded to self-efficacy and age, respectively,  $b_1$  and  $b_2$  corresponded to the assigned weight given to self-efficacy and age, respectively, and  $e$  was the residual error, allowed us to predict the level of adherence for a given age and self-efficacy score. Multiple regression analysis not only measured the significance of the correlation between the two independent variables and the outcome variable, it also tested the significance of each of the  $b$ -weights (Munro, 2005). Testing each of the  $b$ -weights told us whether the explanatory variables associated with those  $b$ -weights significantly contributed to the total variance accounted for in the outcome variable, adherence,

and if so to what magnitude (Munro, 2005).

<b>Adherence to Chlorhexidine Gluconate Cloths</b>		
<b>Name:</b>	<b>Age:</b>	
Did you apply the chlorhexidine cloths evening before sx.?	Yes= 2 points	No= 0 points
If yes, what time did you apply the cloths?	After 5pm= 2 points	Before 5pm= 0 points
If you did apply the cloths, how many did you apply?	If 6 applied= 2 points If 5 applied= 0.5 points	If < 5 applied= 0 points
Where did you apply the cloths?	<ul style="list-style-type: none"> <li>•All 6 correct locations = 4 points</li> <li>•Any combination of 5 locations = 3 points</li> <li>•Any combination of 4 locations = 2 points</li> <li>•Any combination of 3 locations = 1 points</li> <li>•2 or fewer locations = 0</li> </ul>	
	<b>Total Score        /10</b>	

<b>Adherence to Nasal Mupirocin</b>		
<b>Name:</b>	<b>Age:</b>	
Did you fill the prescription for Mupirocin?	Yes= 2 points	No= 0 points
When did you begin the application?	5 days before surgery= 2 points	< 5 days before surgery = 0 points
How many times a day did you apply the Mupirocin?	Twice daily= 2 points	< twice daily= 0 points
Where did you apply the Mupirocin?	Nares= 2 points	Any other area= 0 points
Did you apply Mupirocin to each nostril?	Yes= 2 points	No= 0 points
	<b>Total Score        /10</b>	

**Figure 2. Score Allocation for Adherence Questionnaire**

### **Ethical Considerations**

Caution was used and measures were put in place to design a sampling plan that respected participants' privacy and right to refuse to participate in the study. Approval from the University of British Columbia, Behavioural Research Ethics Board, and Vancouver Coastal Health was obtained before proceeding with this study.

The study invitation explained the purpose of the study, the expectations of participation, the time investment required, the potential risks associated with the study, and the measures that were put in place to ensure the participants' privacy and confidentiality were respected. The inclusion and exclusion criteria for the study were outlined in the invitation as was information pertaining to the anonymization of participants to the research team. Eligible participants had a minimum of two weeks to review the invitation and if they had any questions or concerns, they had the opportunity to have their questions answered by contacting the research team via the contact information indicated on the study invitation and consent form. This process ensured that the decision to participate in the study remained both voluntary and informed.

### **Overcoming Potential Challenges**

Several difficulties were anticipated with the current study plan. The first pertained to the in-service education of the nursing staff. Staff turnover was inevitable and ensuring that all of the nursing staff attended an in-service session was challenging. The study's investigators worked closely with the peri-operative clinician to devise a schedule that included all of the nursing staff. Staff attendance at the in-service sessions was monitored and documented. Similarly, there was ongoing communication between the study investigators and the peri-operative clinician regarding staff turnover and new employees to ensure that all of the nursing staff were trained in the study protocol.

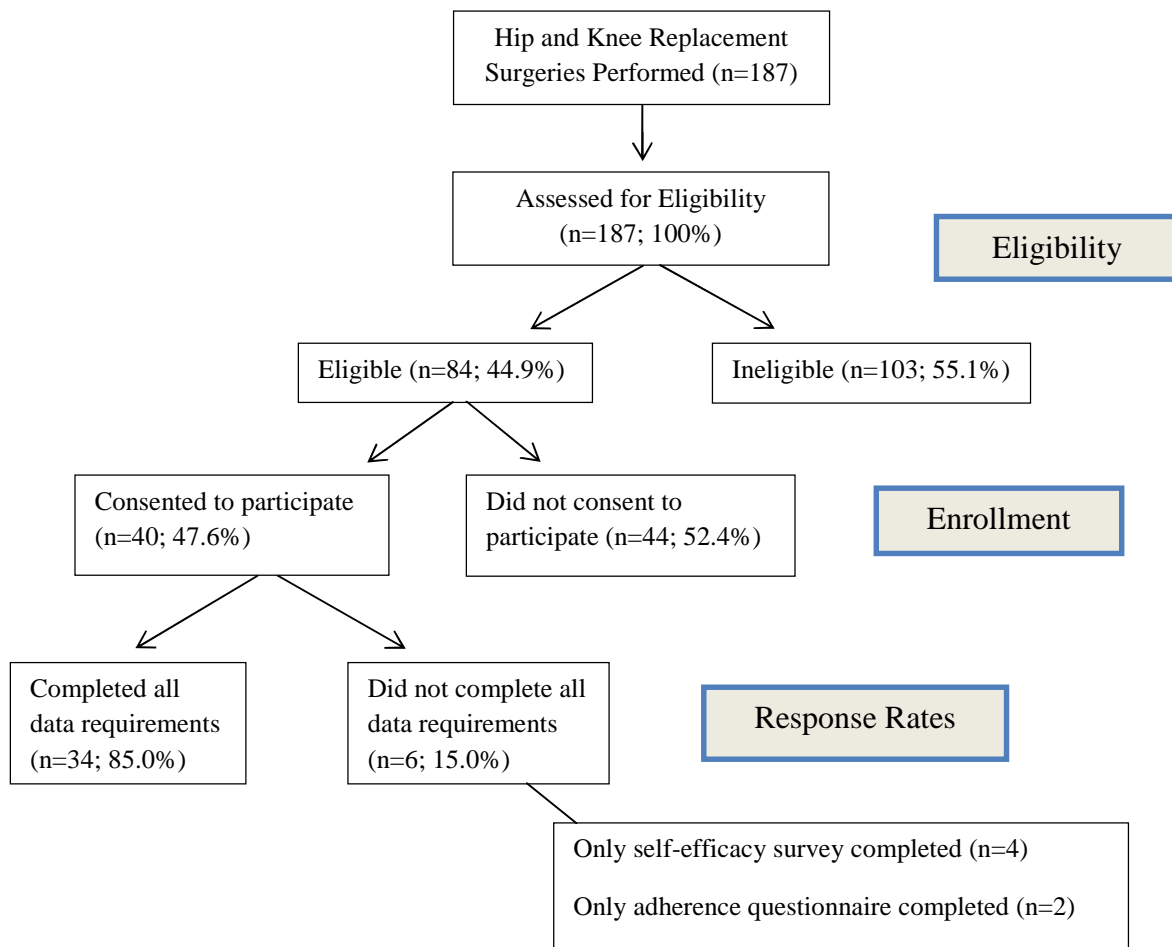


The second difficulty pertained to eligible participants' possible concerns with the established protocol, especially the potential side effects associated with the use of chlorhexidine gluconate cloths and Mupirocin. Specifically, the participants could express concern about antibiotic resistance with the use of Mupirocin. Short term use of nasal Mupirocin has not been shown to cause widespread resistance (Ammerlaan, Kluytmans, Wertheim, Nouwen, & Bonten, 2009). These concerns were addressed by the registered nurses according to their usual practice.

## Chapter 4: Results

### Eligibility and Participants' Response Rates

From May 1, 2013 to October 1, 2013, 187 total hip and knee replacement surgeries were performed at the study hospital. All 187 patients were assessed for eligibility. Eighty-four patients were found to be eligible and 103 patients were ineligible to participate based on the inclusion and exclusion criteria. Figure 3 below summarizes the eligibility rates of potentially eligible patients and the enrollment and response rates of participants.



**Figure 3. Eligibility and Response Rates**

### **Sample Description**

Forty patients consented to participate. The sample included 13 (34.2%) men and 25 (65.8%) women. In two cases, the gender of the participant was not reported. The participants ranged in age from 41 to 86 years with a mean age of 67.4 years (SD = 9.9 years). The median age was 67.5 years. Two of the 31 items in the self-efficacy survey assessed whether the participants had someone available to help them with the decolonization protocol, should they require it. Twenty-six (89.7%) respondents indicated that they had someone available to help them with the chlorhexidine gluconate wash cloths, if necessary. Only 3 (10.3%) of the respondents indicated that they had no one to help them. In 11 cases, this information was not provided. Fourteen participants (82.4%) also indicated that they had someone available to help them with the application of Mupirocin, if necessary, while 3 (17.6%) of the respondents indicated that they did not have someone available to help them. In 23 cases, this information was not provided.

### **Self-Efficacy and Perceived Infection Risk**

Averaged self-efficacy scores reflecting the participants' levels of self-efficacy in relation to both the application of chlorhexidine gluconate and Mupirocin were calculated. The self-efficacy survey was divided into three sections consisting of a total of 29 items. Twelve items assessed the participants' levels of self-efficacy in relation to the application of chlorhexidine gluconate, 15 items assessed the participants' levels of self-efficacy in relation to the application of Mupirocin, and 2 items assessed the participants' perceived infection risk with the use of chlorhexidine gluconate and Mupirocin. Each item on the questionnaire was scored on a 5-point scale with "4" indicating that the participant was "extremely confident" and "0" indicating that he or she was "not at all confident." Averaged self-efficacy scores for the application of

chlorhexidine gluconate were calculated by summing the scores on each item and then dividing by 12. Similarly, average self-efficacy scores for the application of Mupirocin were calculated by summing the scores on each item and then dividing by 15. Finally, scores for the participants' perceived infection risk were calculated by summing the scores on each item and then dividing by 2. Scores ranged from 0.0 to 4.0. Table 9 below summarizes the participants' self-efficacy and perceived infection risk scores.

**Table 9. Self-Efficacy and Perceived Infection Risk Scores**

Averaged Scores	Mean ( $\bar{X}$ )	Median	SD	Range	$\bar{X}$ 95% CI
Self-Efficacy - Chlorhexidine	3.35	3.50	0.56	1.7-4.0	3.16-3.53
Self-Efficacy - Mupirocin	3.59	3.73	0.48	1.9-4.0	3.41-3.77
Perceived Infection Risk	3.46	3.50	0.65	2.0-4.0	3.24-3.68

*Note.* SD = Standard Deviation; CI = Confidence Interval

Table 10 below is a summary report of the participants' response rates with respect to each of the three sections of the self-efficacy survey.

**Table 10. Self-Efficacy Survey Response Rates**

Section of Self-Efficacy Survey	Cases					
	No. of respondents who completed the section		No. of respondents who didn't complete the section		Total	
	n	Percent	n	Percent	n	Percent
Chlorhexidine Application	37	92.5%	3	7.5%	40	100.0%
Mupirocin Application	30	75.0%	10	25.0%	40	100.0%
Perceived Infection Risk	37	92.5%	3	7.5%	40	100.0%

## Adherence

Adherence scores were generated from the results of the adherence questionnaire. All of the participants were scored on their adherence to the use of the chlorhexidine gluconate cloths. For those participants who used both the chlorhexidine gluconate cloths and nasal Mupirocin, they were scored on each treatment separately. Adherence to the use of the chlorhexidine gluconate cloths was based on a possible total score of 10 points with a score of 10 indicating complete adherence to the timing and application of the chlorhexidine gluconate cloths. Similarly, adherence to the use of nasal Mupirocin was based on a total score of 10 points with a score of 10 indicating complete adherence to the timing, application, and use of nasal Mupirocin. Table 11 summarizes the participants' adherence scores.

**Table 11. Adherence Scores**

Adherence Scores	Mean ( $\bar{X}$ )	Median	SD	Range	$\bar{X}$ 95% CI
Chlorhexidine Application	9.01	9.00	1.03	5.0-10.0	8.66-9.37
Mupirocin Application	9.75	10.00	0.71	8.0-10.0	3.41-3.77

*Note.* SD = Standard Deviation; CI = Confidence Interval

In four cases, the adherence questionnaires were not completed by a registered nurse in the surgical day care unit. In another case, items in the adherence questionnaire, measuring adherence to the use of chlorhexidine gluconate were not fully completed. Therefore, adherence scores reflecting the use of chlorhexidine gluconate cloths were based on 35 of the 40 enrolled cases. Only 8 of the 40 respondents required Mupirocin treatment, in addition to the use of chlorhexidine gluconate. Adherence scores for the use of Mupirocin were based on the data collected from all 8 respondents.

### Correlations: Age, Self-Efficacy, and Adherence

Pearson's product moment correlation coefficient ( $r$ ) was calculated using SPSS software. Table 12 below provides a statistical summary of the correlation coefficients and their corresponding levels of significance for the relationships between the variables age, self-efficacy, and adherence.

**Table 12. Pearson's Correlations: Age, Self-Efficacy, and Adherence**

Variables		Age	ASE Score- Chlorhexidine	ASE Score- Mupirocin	Perceived Infection Risk Score	Adherence Score- Mupirocin	Adherence Score- Chlorhexidine
ASE Score- Chlorhexidine	$r$	.081					
	$p$ value	.634	-				
	$n$	37					
ASE Score- Mupirocin	$r$	.084	.701*				
	$p$ value	.658	.000	-			
	$n$	30	30				
Perceived Infection Risk Score	$r$	.182	.467*	.437*			
	$p$ value	.280	.004	.016	-		
	$n$	37	36	30			
Adherence Score- Mupirocin	$r$	-.268	.679	.860*	.600		
	$p$ value	.522	.064	.006	.116	-	
	$n$	8	8	8	8		
Adherence Score- Chlorhexidine	$r$	.334	.049	.249	-.173	-.114	
	$p$ value	.058	.792	.231	.344	.788	-
	$n$	33	32	25	32	8	

Note. ASE Score = Averaged Self-Efficacy Score

\*  $p < .05$ , 2-tailed.

The correlation coefficient ( $r$ ) presented in Table 12 mathematically stated the direction and strength of the relationships between age and adherence and self-efficacy and adherence, but it did not measure the amount of variance ( $r^2$ ) accounted for in the outcome variable, adherence, given the explanatory variables, age and self-efficacy. To measure this variance ( $r^2$ ), multiple linear regression analysis with SPSS software was used. Only 8 of the 40 respondents required Mupirocin treatment. With the exception of 1 case, there was no variance in the adherence

scores, for the use, timing, and application of Mupirocin among the remaining 7 respondents. All 7 respondents received maximum scores of 10 points. One respondent received a score of 8 points. Due to the lack of variance in adherence scores among those respondents who used Mupirocin, linear regression analysis was used only to examine the amount of variance in the outcome variable, chlorhexidine gluconate cloth adherence, given the explanatory variables age and self-efficacy. Table 13 below summarizes the results of the regression analysis that was conducted to predict adherence to the use of chlorhexidine gluconate cloths given the variables age, perceived risk for infection, and level of self-efficacy.

**Table 13. Regression Analysis Predicting Adherence to the Application of Chlorhexidine Gluconate**

Variables	B	$\beta$	95% Confidence Interval for B	
			Lower Bound	Upper Bound
Age	.038*	.378	.001	.075
ASE Score-Chlorhexidine	.264	.151	-.449	.977
Perceived Infection Risk Score	-.445	-.294	-1.067	.177

*Note.* ASE Score = Averaged Self-Efficacy Score

\*  $p < .05$

## Chapter 5: Discussion, Implications, and Conclusions

### Discussion

This study examined the relationships between age, levels of self-efficacy, and patients' adherence to a *Staphylococcus aureus* decolonization protocol in the total joint arthroplasty population. The study was designed to test the hypothesis that there is a relationship between patients' age and adherence and that there is a positive relationship between patients' level of self-efficacy and adherence. The findings suggest that there may be a positive relationship between age and adherence to the use of chlorhexidine gluconate cloths, and a negative relationship between age and adherence to the use of nasal Mupirocin. These results, however, were not statistically significant. The relationship between age and adherence to the recommendation to apply chlorhexidine gluconate cloths was statistically significant once the self-efficacy and perceived risk of infection scores were controlled.

With respect to the relationship between patients' level of self-efficacy and adherence, the results confirm that there is a statistically significant and strong positive relationship between patients' level of self-efficacy in applying Mupirocin and their adherence to its use, timing, and application. Of interest, little if no relationship was found between the patients' level of self-efficacy to chlorhexidine gluconate cloths and their adherence to the use, timing, and application of the chlorhexidine gluconate. Other major findings include: (a) a statistically significant and strong positive correlation between patients' level of self-efficacy to the use of chlorhexidine gluconate cloths and patients' level of self-efficacy to the use of Mupirocin, (b) statistically significant and moderately positive correlations between perceived risk for infection, with the use of both chlorhexidine gluconate and Mupirocin, and self-efficacy in using chlorhexidine gluconate cloths and Mupirocin, and (c) results of the multivariate regression analysis reveal that



age, but not self-efficacy or perceived infection risk, contributed significantly to the outcome, adherence.

As previously discussed, *Staphylococcus aureus* has been identified as the main perpetrator of surgical site infections in many tertiary health care centres (Anderson et al., 2007). Surgical site infections and their treatment, especially in the total joint arthroplasty population, have been shown to significantly affect patients' recovery from surgery and their quality of life, and generate considerable economic cost for the health care system (Rao et al., 2011). Van Rijen et al. (2008a) conducted a systematic review of randomized control studies that examined the effects of a pre-operative screening and decolonization protocol on patients undergoing total joint arthroplasty. They found promising eradication rates of *Staphylococcus aureus* and a reduced incidence rate of post-operative surgical site infections, although the results were not statistically significant. In a review of the literature presented in Chapter two, a recognizable gap related to patient adherence to a decolonization protocol was identified as a possible missing link or explanation for these findings. Given this literature gap, and given that the success and efficacy of such a protocol is heavily reliant on adherence, we can appreciate the importance of enhancing our knowledge regarding the factors that promote and predict adherence. The results of this study have significant clinical implications for the design, implementation, and evaluation of patient education material relevant to the decolonization protocol. Constructs of self-efficacy (i.e., health perceptions, perceived risk, and health beliefs) related to the protocol, are guided and influenced by many factors including the type of education patients receive about the protocol, how that education is structured and designed, and how it is implemented and provided to patients by health professionals, especially nurses. One's level of self-efficacy can in turn predict adherence. Having knowledge of this, appropriate changes and recommendations can be made, if

necessary, to the design, structure, and implementation of patient education. These changes and recommendations would be aimed at enhancing or improving patients' level of self-efficacy and adherence to the protocol. In this study, there were opposing findings with respect to the relationship between self-efficacy and adherence. There was a strong positive relationship between self-efficacy to Mupirocin and adherence to Mupirocin but little if no relationship between self-efficacy to chlorhexidine gluconate washes and adherence to chlorhexidine gluconate washes. There are a number of possible explanations for these findings that are discussed in the following sections; consideration must be given to the factors that influence and guide one's level of self-efficacy, namely patient education related to the decolonization protocol.

When considering the relationship between age and adherence, it is important to understand adherence as a function of age. In other words, it is important to comprehend how age-related differences might influence adherence depending on the patient population or health domain being considered. Similar to the relationship between self-efficacy and adherence, opposing outcomes were found with respect to the relationship between age and adherence. Age was found to be positively correlated with chlorhexidine gluconate adherence but negatively correlated with Mupirocin adherence. These results point to age-related differences between the application of chlorhexidine gluconate and that of Mupirocin, and these age-related differences, if they truly exist, must be considered in the design, structure, and implementation of education related to the decolonization protocol. Without a clear understanding of the relationship between age and adherence and the role and influence of self-efficacy on adherence, in the total joint arthroplasty population, a proper evaluation of the effectiveness of the decolonization protocol remains challenging as does the evaluation of patient education relevant to the protocol. Ongoing

assessment and evaluation of quality control measures in relation to physician-recommended guidelines, such as the decolonization protocol, is necessary, to ensure that the needs of patients are met and clinical practice remains evidence-based.

### **Age and adherence**

As previously discussed, adherence to a decolonization protocol has been largely under studied in the total joint arthroplasty population making it necessary to consider other health domains and patient populations where adherence has been examined: the areas of medication compliance, compliance to physician-recommended exercise programs, and compliance to patient guidelines. Reflecting the current state of the literature and consistent with the findings of a systematic review conducted by Taylor et al. (2011), which examined the medical, psychological, and socio-demographic factors associated with adherence to cardiac rehabilitation programs, the current study found equivocal results with respect to the direction of the relationship between age and adherence. This study found a moderately positive relationship between age and adherence to the chlorhexidine gluconate washes but a moderately negative relationship between age and adherence to Mupirocin. One would expect the relationship between age and these two decolonization protocol measures to be similar. There are a number of possible explanations for these findings, including lifestyle or contextual factors and age-related differences in cognition. It is uncertain whether these study outcomes can truly be attributed to age-related differences in cognition or lifestyle factors when there are several significant methodological limitations to consider in this study, particularly the large sampling error.

The positive correlation found between age and adherence to the chlorhexidine gluconate cloths is similar to the outcomes from studies that have examined medication compliance and

adherence to patient screening guidelines. Older adults often display greater adherence rates than do younger adults (Barclay et al., 2007; Birkenfeld et al., 2011; Tarantino et al., 2010). Lifestyle factors, including family and work commitments and financial constraints, have been identified in the literature as possible explanations for this outcome (Barclay et al., 2007; Tarantino et al., 2010). Regimens or medications that require individuals to alter their lifestyles to accommodate present a great challenge for young adults who have family and work commitments and very busy lifestyles. Changes in health perceptions and beliefs, such as greater perceived susceptibility to developing an illness or disease and heightened fear of mortality associated with non-adherence, are often characteristic of older adults (Taylor et al., 2011). This may explain why older adults may be more likely to adhere to a prescribed treatment, at least in certain patient populations or health domains (Taylor et al., 2011). The role and influence of these co-variables on the overall relationship between age and adherence is uncertain given that these variables were not examined nor controlled in the current study. Effort was made, however, when creating the adherence questionnaire, to include questions aimed at collecting information about the respondents' reasons for non-adherence. The hope was that these reasons would shed light on some of the factors at play. The nurses, in the surgical day care unit, were directed to ask the respondents about their reasons for non-adherence when a respondent reported that she or he did not fully adhere to one or more of the components of the decolonization measures. The nurses however demonstrated poor compliance in addressing these questions with the respondents. As a result, a content analysis addressing and exploring the themes of non-adherence could not be executed as planned. It is possible that the nurses were not comfortable asking the respondents about their reasons for non-adherence. The nurses may have believed that the questions had an underlying notion of blame and they may have concluded that asking the

questions could have heightened the patients' anxiety levels before surgery. In only one case, a nurse provided a reason for a participant having not washed with all six chlorhexidine gluconate cloths. It is therefore not known whether co-variables, such as lifestyle or contextual factors, or specific health perceptions and beliefs, influenced the overall relationship between age and adherence.

While there are many studies that have found greater adherence rates to medication and patient screening guidelines in older adults when compared to their younger counterparts, there is a body of literature that reveals the converse, the vulnerability of the older adult population and the multitude of factors that often put this population at risk for non-adherence (Liu & Gonzalez, 2007; McDaniel & Einstein, 2007; Park & Meade, 2007). Cognitive factors such as memory decline, particularly time-based memory decline, the memory of performing everyday tasks at the time they are intended to be done, tends to diminish with age-related cognitive decline in adults older than 61 years of age (McDaniel & Einstein, 2007). The ability to consciously interpret, comprehend, and translate instructions into action also diminishes with age, and this, more so than memory, is the greatest barrier to adherence in older adults (Park & Meade, 2007). Contextual factors, such as daily commitments and routines also change with age (Park & Meade, 2007). As one ages, these changes may not favour adherence, especially when the regimen to which they are adhering is complex (Park & Meade, 2007). It is possible that the older respondents managed and coped better with the use, timing, and application of the chlorhexidine gluconate cloths rather than the Mupirocin. The older respondents may have perceived the Mupirocin regimen to be more complex than the chlorhexidine gluconate wash regimen, which only required them to wash with six chlorhexidine gluconate cloths once, the evening before surgery. Mupirocin, on the other hand, was required twice daily for five days

before surgery and it was necessary to have good vision and hand-eye coordination to effectively apply the nasal ointment. As one ages, vision and coordination can deteriorate making it challenging for older adults to carry out particular tasks. Although there is a large body of literature that identifies cognitive decline as one of the major contributing factors of non-adherence in older adults, the extent to which this evidence can be used to explain the findings in this study is questionable. The majority of respondents in this study were between 60 and 70 years of age. Although adults most commonly begin displaying signs and symptoms of cognitive decline after the age of 61 years, this cognitive decline is not likely to interfere with daily activities and tasks until greater than 70 years of age (Park & Meade, 2007). Cognitive factors may therefore be a weak explanation for these study outcomes. Furthermore, the size of the sampling error in this study was large and there was a lack of variability in the adherence scores among the eight respondents required to undergo treatment with Mupirocin. Seven of the eight respondents received the maximum score of ten points for adherence. Again, these methodological limitations may be reasonable explanations of the negative relationship found between age and the application of Mupirocin.

Although the findings regarding the relationship between age and adherence were equivocal in nature, the results from the multivariate linear regression analysis revealed that age contributed significantly to the outcome variable, adherence. Despite these findings, however, age as a predictor of adherence remains a poorly understood phenomenon given the number of co-variables at play, for which little is known or understood, and the limitations to the generalizability of study results from other patient populations to the orthopaedic population.

### **Self-efficacy and adherence**

Little if no relationship was found between self-efficacy in the use of chlorhexidine

gluconate washes and adherence to the chlorhexidine gluconate washes, but a strong and statistically significant positive relationship was found between self-efficacy to Mupirocin and adherence to Mupirocin. The latter results reflect the current state of the literature, which shows overwhelming support for a positive association between overall levels of self-efficacy and adherence to medication and physician-recommended patient guidelines (Chia et al., 2006; Curtin et al., 2008; Ngamvitoj & Kang, 2007). In other words, adults who believe in their ability to take medication or who believe in their ability to carry out a particular task related to a treatment regimen are more likely to adhere to the regimen. An examination of the relationship between self-efficacy in applying the chlorhexidine gluconate cloths and adherence to washing with the chlorhexidine gluconate cloths revealed results that were inconsistent with the overall findings in the literature. One study conducted by Peddle et al. (2009) found that the influence of subjective norms (i.e., greater perceived social pressure or availability of social support), a construct derived from Bandura's (1977) self-efficacy theory, and increased levels of self-efficacy, were strongly associated with greater adherence to a supervised exercise program for patients awaiting surgical removal of malignant lung lesions. It may be that the study respondents who required Mupirocin treatment reported greater access to assistance with the decolonization protocol than did the respondents who only required chlorhexidine gluconate washes. Access to assistance with the protocol in turn resulted in higher levels of self-efficacy and greater adherence to Mupirocin. Although a possible explanation, it is weak in its ability to explain the differences in adherence to the two decolonization measures. The respondents who required Mupirocin treatment reported similar results with respect to the availability of social support with the decolonization protocol when compared with those who only required the use of chlorhexidine gluconate cloths. Another possible explanation for these opposing findings relates

to the design of the chlorhexidine gluconate wash adherence questionnaire. As previously discussed, the respondents were required to wash with six chlorhexidine gluconate cloths the evening before surgery and each cloth was assigned to one of six body areas: arms, legs, chest, back, buttocks, and genital area. The respondents were specifically told not to apply the cloth to the genitals but rather to wash the skin folds within the groin area. On the adherence questionnaire, the words genital area rather than groin were listed as one of the six body locations the participants were asked if they had washed. When the respondents were asked whether they had washed their genital area, they may have thought that they were being asked if they had washed their genitals. The nurses may not have clarified that this in fact referred to the area around the genitals (i.e., the groin area) and not the genitals themselves. Eleven of thirty-six respondents (30.6%) who were asked about their adherence to the chlorhexidine gluconate cloths responded that they did not wash their genital area. These respondents were scored as if they did not fully adhere to the recommended protocol. As a result, the overall self-efficacy scores may have been lower than predicted and this may have influenced the relationship between self-efficacy and adherence to the chlorhexidine gluconate washes. Despite these possible explanations, the results obtained from a correlation analysis conducted between the self-efficacy scores to chlorhexidine gluconate washes and the self-efficacy scores to Mupirocin, point to the influence of co-variables or methodological flaws within the study as more probable explanations of the conflicting results. Results from the correlation analysis revealed that there was a strong and statistically significant positive relationship between the self-efficacy scores to the chlorhexidine gluconate washes and the self-efficacy scores to Mupirocin. Based on these results, one would expect similar correlations between self-efficacy and adherence to the two separate decolonization measures, but these expectations did not emerge in this study.



A construct of self-efficacy known as perceived risk was examined in this study. The respondents were asked to rate how confident they were that chlorhexidine gluconate and Mupirocin use would reduce their risk of developing an infection, post-operatively. Findings from the literature suggest that greater perceived susceptibility to developing an illness or disease and stronger beliefs about the efficacy of a treatment in improving overall health and preventing disease are likely to be associated with greater adherence (Boeka et al., 2010; Rogers & Prentice-Dunn, 1997; Rosenstock et al., 1988; Tarantino et al., 2010; Taylor et al., 2011). The current study found a positive relationship between perceived infection risk and adherence to the use of Mupirocin. In other words, respondents who felt confident that the use of chlorhexidine gluconate washes and Mupirocin could prevent post-operative infection demonstrated greater adherence to Mupirocin, findings consistent with those of the published literature. These results, however, were not statistically significant. Of interest, opposing results were found for the correlation between perceived infection risk and adherence to the chlorhexidine gluconate cloths. Again these results were not statistically significant. The respondents who believed that Mupirocin and chlorhexidine gluconate could prevent post-operative infections demonstrated poor adherence to the use of chlorhexidine gluconate cloths, findings that are inconsistent with those in the literature. It is possible that the respondents perceived lesser risk of developing an infection with the use of Mupirocin than with the chlorhexidine gluconate. One of the many factors that could not be controlled in this study was the patient education provided by pharmacists. All of the respondents requiring Mupirocin treatment were required to fill a prescription for the ointment at a community pharmacy of their choice. Consistent with the framework of professional practice produced by the College of Pharmacists of British Columbia (2006), pharmacists have a duty to their clients and are responsible for ensuring that clients are

educated about the potential side effects, dosing, and mode of administration of a prescription. Depending on the type of education the respondents received from their pharmacist, they may have perceived greater threat or risk of infection with non-adherence to Mupirocin than non-adherence to the use of the chlorhexidine gluconate cloths. The study hospital supplied the respondents with the chlorhexidine gluconate cloths and patient education related to the use of the cloths was provided solely by nurses in the pre-surgical screening clinic. This explanation, although reasonable, cannot be validated given that the respondents' perceived infection risk was measured based on the two decolonization measures together rather than separate. On a different note, the perceived infection risk scores correlated significantly and positively with the self-efficacy scores to both the chlorhexidine gluconate washes and Mupirocin, which is strong evidence and support for the interconnectivity of the theoretical models used in the framework for this study, specifically, Bandura's (1977) self-efficacy theory, Theory of Planned Behavior (Ajzen, 1991), Protection Motivation Theory (Rogers & Prentice-Dunn, 1997), and the Health Belief Model (Rosenstock et al., 1988).

The results of the regression analysis revealed that neither self-efficacy nor perceived infection risk contributed significantly to the outcome, adherence. These results are consistent with the findings of a study conducted by Ngamvitoj and Kang (2007), who examined the effects of asthma self-efficacy, social support, and knowledge on adherence to peak expiratory flow rate (PEFR) monitoring in asthma patients. The current study, similar to that of Ngamvitoj and Kang's (2007), has methodological limitations, especially too small a sample size, as a major contributing factor for these results. Other contributing factors that Ngamvitoj and Kang (2007) noted in their study included decreased variability between the constructs of self-efficacy and the existence of co-variables. Decreased variability between the constructs of self-efficacy in this

study may also have had an influence on the study outcomes. The concept of self-efficacy is one of complexity. There is a great degree of overlap between the various constructs of self-efficacy (e.g., health beliefs, health perceptions, perceived risk, perceived threat) and multiple definitions for the concept exist. For example, self-efficacy can be defined in terms of medication or treatment efficacy (i.e., perceived treatment utility), it can be defined in terms of perceived susceptibility to developing an illness or disease, or it can be defined in terms of the perceived threat to overall health associated with non-adherence. Depending on how self-efficacy is chosen to be defined can generate different study outcomes. In this study, self-efficacy was defined as the belief in the participants' ability to perform the decolonization measures. Items in the self-efficacy survey addressed many different constructs of self-efficacy (i.e., perceived threat, subjective norm, perceived risk) so it is possible, similar to Ngamvitoj and Kang's (2007) study, that there was not enough variability between the constructs used to measure the respondents' levels of self-efficacy.

A number of possible explanations for the study outcomes have been discussed but there is another explanation, related to the education provided to the respondents about the decolonization protocol, that is worthy of mention. In regard to patient education related to the decolonization protocol, in one case, a respondent reported that she or he had not received a diagram showing the body areas to be washed with chlorhexidine gluconate. As a result, this respondent did not fully adhere to the decolonization measure before surgery. It may be possible that other respondents found themselves in similar situations and these cases were not reported. The nurses complied poorly with addressing the questions regarding non-adherence with the respondents, but it is also possible that the respondents did not report their lack of adherence for fear of having their surgeries cancelled. In two other cases, the respondents reported side effects

with the use of the chlorhexidine gluconate cloths, which was documented on the adherence questionnaire by the nurses. One respondent reported burning of the skin and a rash with the use of the chlorhexidine gluconate while the other reported skin itchiness. Both of the respondents did not complete the chlorhexidine gluconate wash. It is uncertain as to whether there were other cases wherein side effects prevented the respondents from completing the chlorhexidine gluconate wash. Information regarding the side effects that the respondents may have experienced from the two decolonization measures was not collected and so it is difficult to decipher the degree of influence this may have had on the study outcomes.

### **Clinical Implications**

Understanding how age and age-associated predictors, namely self-efficacy, influence adherence in adults has significant clinical implications. The state of the literature shows promising eradication rates with the use of a *Staphylococcus aureus* screening and decolonization protocol even though the results have not been robust and lack statistical significance (Van Rijen et al., 2008a). With the implementation of this protocol, a risk reduction of 1% has been shown to translate into cost savings in the millions of dollars for every ten thousand patients screened (Van Rijen et al., 2008a). These findings are of great clinical relevance not only to the health system but to patients as well when one considers the impact of treating surgical site infections on patients' recovery and quality of life. Given the clinical relevance of the protocol, it is easy to appreciate the importance of obtaining a better understanding of the factors that promote and predict patients' adherence to the protocol. Understanding adherence as a function of age, especially in the total joint arthroplasty population, is clinically significant given that the majority of patients requiring hip and knee replacements are 60 years of age or older. Specifically, understanding how health perceptions

and health beliefs change with age and how age-related cognitive decline influences adherence is fundamental to the design and implementation of patient education materials related to a decolonization protocol. Similarly, the role and influence of self-efficacy, the factors that promote and prevent it, and how self-efficacy changes with age are all important concepts to keep in mind when designing instructions for older adults and expecting that they will adhere to them (Liu & Gonzalez, 2007). Furthermore, the complexity of the language used in instructions or education material, the ease with which it is presented to patients and by whom, the setting in which it is presented or introduced, and how and when it is evaluated are all decisions that require an understanding of the factors that promote and predict adherence. The findings from this study reveal inconclusive results with respect to the overall relationships between age, self-efficacy, and adherence. Despite these results, the study does highlight a number of age-related factors and constructs of self-efficacy that are important for health professionals, especially nurses, to consider when providing education to patients with the expectation that patients will adhere to what is being recommended.

### **Methodological Limitations**

A descriptive correlational study design was used to examine the relationships between age, self-efficacy, and adherence to the decolonization protocol. This study design, although appropriate for addressing the research questions, had several limitations. First, the study design was weak in its ability to support a causal inference. Correlational studies work well for examining relationships or associations between variables, but not for making causal inferences (Polit & Beck, 2012). Second, because the participants were not randomly sampled, selection bias presented as a limitation. The participants may have chosen to participate in the study for reasons that could not be known or controlled and these reasons could have acted as confounding

variables. Such variables may have included income, level of education, health literacy, ethnicity, and social support. Selection bias can significantly limit the generalizability or external validity of a study (Polit & Beck, 2012). Thirdly, the self-efficacy survey and adherence questionnaire were not validated. The instruments were not tested for internal validity and reliability and caution must be used in the interpretation of the results. Fourthly, because nurses administered the adherence questionnaire, the social desirability response set bias must be considered when interpreting the overall results. The participants may have altered their responses to the adherence questionnaire simply to save face and not be perceived as someone who did not follow instructions (Polit & Beck, 2012). On the other hand, nurses demonstrated poor compliance in addressing the reasons for non-adherence in instances where the respondents reported that they had not fully adhered to the protocol. Hence, a content analysis aimed at identifying potential co-variables could not be executed as planned. Lastly, this study is significantly underpowered. In other words, the probability of detecting the relationships between age, self-efficacy, and adherence, if they in fact truly exist in the general population, was very low. It is very likely that a type II error has been made. Results of the power analysis initially conducted to determine the sample size needed to detect relationships between patients' age, self-efficacy, and adherence revealed that 84 participants would be required. Because of an unanticipated reduction in the availability of surgical operating time at the hospital, during the data collection period, fewer total hip and knee replacement surgeries were performed. Consequently, this reduced the number of eligible patients for the study. Furthermore, the exclusion criteria may have been too stringent. The hospital's catchment area is home to a very ethnic population and so excluding patients from participating in the study based on their proficiency in the English language, may have decreased the number of eligible patients. In order

to obtain a more precise and accurate estimate of the relationships between age, self-efficacy, and adherence, and improve the rigor and objectivity of the study, a larger sample size and more reliable and valid instruments to measure the variables would be needed.

### **Recommendations for Future Research**

Future research should be aimed at using a combination of both quantitative and qualitative study designs to examine the relationships between age, self-efficacy, and adherence (Yuhas et al., 2012). To obtain a better understanding of the constructs of self-efficacy (i.e., individual health beliefs and personal health perceptions) and their influence on patient outcomes (i.e., adherence), the use of more qualitative study designs is needed. Qualitative study designs will provide researchers with a greater opportunity to explore patients' beliefs and concerns with respect to a treatment, and they will also give researchers the ability to conduct more in depth evaluations of patients' understanding of physicians' instructions and guidelines (Yuhas et al., 2012).

There are a limited number of reliable and valid instruments available to measure self-efficacy and adherence and there are a number of advantages and disadvantages associated with the utilization of these tools. When possible and feasible to do so, researchers should be encouraged to use a combination of instruments (Osterberg & Blaschke, 2005). The use of both electronic monitoring devices and self-reported instruments to measure medication compliance, for example, could add precision and accuracy to the data collection processes and reduce the odds that the study results are due to chance alone (Osterberg & Blaschke, 2005). Furthermore, researchers should make greater effort to conduct studies that are designed to establish the reliability and validity of these instruments and report the statistical evidence. Without evidence of reliable and valid instrumentations, it is difficult to ensure that accurate and precise data have

been collected, and without accurate and precise data, it is difficult to draw valid conclusions or to make valid predictions.

Future studies should aim to use longitudinal study designs as opposed to cross-sectional designs (Chia et al., 2006; Fawzi et al., 2012). As mentioned throughout this discussion, one of the disadvantages of using cross-sectional study designs is that researchers have limitations in the control that can be introduced to minimize the effects of external factors that may be present during a particular time. When this design is used in conjunction with convenience sampling, the number of confounding variables at play significantly increases. Researchers should aim to use longitudinal designs to minimize the number of confounding variables at play, and when possible and feasible to do so, should use probability sampling as opposed to non-probability sampling. Furthermore, attrition in longitudinal studies may be an important aspect of adherence that may often get overlooked with the use of cross-sectional designs (Fawzi et al., 2012).

This study demonstrated that there are many contextual factors in health care that cannot be controlled but that can significantly affect the power of a study (e.g., unanticipated operating room closures, staff shortages, and bed closures). To be better prepared for these situations and to be able to effectively manage them when they do occur, consideration should be given to obtaining appropriate funding that would give researchers more resources to minimize the effects of these situations. For instance, researchers could utilize these resources to lengthen their data collection period to obtain a more representative and appropriately sized sample. These resources could also be utilized to hire research assistants to help with the recruitment of subjects and the data collection rather than rely on health professionals who often have heavy workloads and are busy providing patient care. Similarly, if health professionals, namely nurses, are involved and assisting with a research project in a clinical setting, it is crucial that the researchers assess how



much education the nurses might need to carry out their duties with respect to the project, how many in-service hours they might require, whether they require close supervision in carrying out their research duties, the type and amount of resources they might need to complete their tasks, and whether incentives may be needed to compensate those who have chosen to assist with the research project. To increase the commitment level of health professionals and to improve the quality of work produced by those involved with the research, these factors must be considered in the proposal of any research project.

Finally, given the high level of interconnectivity between health beliefs and self-efficacy, it is important to acknowledge that health beliefs are highly influenced by culture and ethnicity (Fawzi et al., 2012). Constructs of self-efficacy such as beliefs or perceptions of illness and disease are highly influenced by ethnicity and culture and they therefore must be examined in greater depth across diverse patient populations (Chia et al., 2006; Fawzi et al., 2012). Researchers should be encouraged to collect larger and more ethnically diverse samples to examine the effects of culture and ethnicity.

### **Conclusions**

In conclusion, an examination of adherence to an established pre-operative *Staphylococcus aureus* decolonization protocol in the total joint arthroplasty population was warranted. Non-adherence to this protocol could have significant clinical implications for patients' quality of life and the economic state of the health care system in light of the costs associated with the treatment of surgical site infections (Rao et al., 2011). This study examined the relationships between age, self-efficacy, and adherence to a *Staphylococcus aureus* decolonization protocol in the total joint arthroplasty population. The study found inconclusive results with respect to the relationships between age, self-efficacy, and adherence. In light of

these results, this study does highlight the many ways in which age and age-associated predictors, namely self-efficacy, can influence adherence in adults. It also identifies a number of co-variables that warrant exploration in future studies given their potential influence on the relationships between age, self-efficacy, and adherence. Without a clear understanding of the relationship between age and adherence and the role and influence of self-efficacy on adherence, in the total joint arthroplasty population, a proper evaluation of the effectiveness of the decolonization protocol remains challenging as does the evaluation of patient education relevant to the protocol. Ongoing assessment and evaluation of quality control measures in relation to physician-recommended guidelines, such as the decolonization protocol, is necessary, to ensure that the needs of patients are met and clinical practice remains evidence-based.

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## Appendix A

### Self-Efficacy Survey

Thank you for participating in the survey.

This survey will take you about 15 min to complete and consists of 3 sections. The answers you give are strictly confidential and will not be shared with anyone other than the people conducting this study.

Please answer the following questions by circling the number that best describes your level of confidence.

**0 = Not at all confident**

**1 = Slightly confident**

**2 = Somewhat confident**

**3 = Moderately confident**

**4 = Extremely confident**

<b>1.0</b>	<b><i>How confident are you that you can apply the chlorhexidine cloths.....</i></b>					
		<b>Not at all confident</b>	<b>Slightly confident</b>	<b>Somewhat confident</b>	<b>Moderately confident</b>	<b>Extremely confident</b>
1.1	When you are busy at home?	0	1	2	3	4
1.2	When there is no one to remind you?	0	1	2	3	4
1.3	When there is someone to remind you?	0	1	2	3	4
1.4	When they may cause side effects?	0	1	2	3	4
1.5	When you are afraid they might irritate or cause burning to your skin?	0	1	2	3	4
1.6	When they might smell unpleasant?	0	1	2	3	4

1.7	When you have other medications to take?	0	1	2	3	4
	<b><i>How confident are you that you can carry out the following tasks.....</i></b>					
		<b>Not at all confident</b>	<b>Slightly confident</b>	<b>Somewhat confident</b>	<b>Moderately confident</b>	<b>Extremely confident</b>
1.8	Open the packages of chlorhexidine cloths?	0	1	2	3	4
1.9	Apply the chlorhexidine cloths to the correct body areas?	0	1	2	3	4
1.10	Wash the appropriate body areas with the chlorhexidine cloths?	0	1	2	3	4
1.11	Remember to wash with the chlorhexidine cloths the evening before surgery?	0	1	2	3	4
1.12	Use the chlorhexidine cloths without having someone help you?	0	1	2	3	4
1.13	If you are not confident in using the chlorhexidine cloths without someone helping you, do you have someone that can help you if needed? Please circle your answer.	Yes	No	Not Applicable		
<b>2.0</b>	<b><i>How confident are you that you can apply nasal Mupirocin.....</i></b>					
		<b>Not at all confident</b>	<b>Slightly confident</b>	<b>Somewhat confident</b>	<b>Moderately confident</b>	<b>Extremely confident</b>
2.1	When you are busy at home?	0	1	2	3	4
2.2	When there is no one to remind you?	0	1	2	3	4
2.3	When there is someone available to remind you?	0	1	2	3	4
2.4	When it may cause side effects?	0	1	2	3	4

2.5	When you are afraid it might irritate or cause burning to your nostrils?	0	1	2	3	4
2.6	When you have other medications to take?	0	1	2	3	4
	<b><i>How confident are you that you can carry out the following tasks.....</i></b>					
		<b>Not at all confident</b>	<b>Slightly confident</b>	<b>Somewhat confident</b>	<b>Moderately confident</b>	<b>Extremely confident</b>
2.7	Fill your prescription for nasal Mupirocin?	0	1	2	3	4
2.8	Remember to apply the nasal Mupirocin twice daily for 5 days before surgery?	0	1	2	3	4
2.9	Open the tube of nasal Mupirocin?	0	1	2	3	4
2.10	Get the plastic seal off a new tube of nasal Mupirocin?	0	1	2	3	4
2.11	Squeeze the nasal Mupirocin tube?	0	1	2	3	4
2.12	Apply the Mupirocin ointment to a Q-tip?	0	1	2	3	4
2.13	Correctly angle your head to accurately apply the Q-tip in each nostril?	0	1	2	3	4
2.14	Get the right amount of ointment onto the Q-tip each time?	0	1	2	3	4
2.15	Use the nasal Mupirocin without having someone help you?	0	1	2	3	4
2.16	If you are not confident in using the nasal Mupirocin without someone helping you, do you have someone that can help you if needed? Please circle your answer.	Yes	No	Not Applicable		

<b>3.0</b>	<b><i>How confident are you that in using chlorhexidine cloths and nasal Mupirocin, if it is required.....</i></b>					
		<b>Not at all confident</b>	<b>Slightly confident</b>	<b>Somewhat confident</b>	<b>Moderately confident</b>	<b>Extremely confident</b>
3.1	You will prevent an infection from occurring after your surgery?	0	1	2	3	4
3.2	You will reduce your risk for developing an infection?	0	1	2	3	4

What is your gender?    Male      Female      Other, please specify\_\_\_\_\_

**Please circle your answer**

In what year were you born? \_\_\_\_\_

**Please print the full year on the line above (example: 1980)**

What is the date of your surgery? \_\_\_\_\_

**Please write the date on the line above in day/month/year format (example: 25/Dec/1980)**

Please place your completed survey inside the envelope provided labeled “consent form and survey.” Once you have placed this survey and your signed consent form inside the envelope, please seal the envelope by removing the white sticker at the back of the envelope. Please bring this envelope to the hospital on the day of your surgery and please give it to your nurse in the surgical day care unit when you check in.

Thank you for completing this survey.

## Adherence Questionnaire

<b>Age:</b>	<b>Sx. Date:</b>
Did you wash with the chlorhexidine cloths the evening before surgery? Please circle: Yes or No	
If no, why not?	
If yes, what time did you wash with the cloths? _____am or pm (please indicate the time)	
If not the evening before surgery, why not?	
If you applied the cloths, how many did you apply? _____cloths (please provide a number)	
If not all 6 cloths, why not?	
Where did you apply the cloths? Please circle where the cloths were applied.	
One or both arms	One or both legs
Chest	Back
Genital Area	Buttocks
<b>If applicable.....</b>	
Did you fill the prescription for Mupirocin? Please circle: Yes or No	
If no, why not?	
When did you begin the application? _____days before surgery. (Please provide a number)	
If not 5 days before surgery, why not?	
How many times a day did you apply the Mupirocin? Please circle: Once Twice None	
If not twice daily, why not?	
Where did you apply the Mupirocin? Please circle: Nostrils or Other, please specify_____	



If not the nostrils, why not?

Did you apply Mupirocin to each nostril? Please circle: Yes or No

If not to each nostril, why not?