EFFECT OF MULTIMODAL INTERVENTION TO ENHANCE HONG KONG HEALTHCARE WORKERS' HAND HYGIENE COMPLIANCE

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Effect of Multimodal Intervention to Enhance Hong Kong Healthcare Workers' Hand Hygiene Compliance

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Dec 2010

CERTIFICATE OF ORIGINALITY

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ABSTRACT

The purpose of this research was to develop and evaluate the process and impact of strategies to improve hand hygiene compliance in an acute hospital in Hong Kong. With reference to the results of the observation, questionnaire survey, review of literature and the small-group conference with the staff; hand hygiene program was developed, implemented and modified throughout the three cycles of action research. In the first cycle after ward-based educational talk, system change with the use of alcohol-based handrub and poster display, compliance to hand hygiene in the three experimental wards improved from 18.31% to 41.6%. However, when the hand hygiene program was extended to the whole hospital during the second cycle through provision of hospital-based educational talk and alcohol-based handrub, compliance in the control wards have no enhancement (baseline 25.4% to 25.6%) whereas the experimental wards improved steadily (44.4%). Due to poor outcome, the enhancement program was re-examined with mandatory intensive hand hygiene talk provided to all staff alongside with interventions of scenario description and immediate clarification after observation. At the end, overall compliance to hand hygiene enhanced from 22% to 54%. Additionally, the spiral process (plan, act, observe, reflect) of action research did enlighten the program coordinator that while promoting good standard practice; one should not neglect the role of supervisors, peers, infection control nurses who are significant ones in the implementation process. Furthermore, apart from changing of system in the environment to provide safety care, upholding professional values of healthcare workers is needed to sustain quality care.

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CHAPTER ONE

INTRODUCTION

1.1 General Introduction

Healthcare-associated infection is defined as "An infection occurring in a patient during the process of care in a hospital or health-care facility which was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge and also occupational infections among staff (Ducel, Fabry & Nicolle, 2002, p. 1)". Thus, all those receiving or providing care in the healthcare setting may acquire healthcare-associated infections.

These healthcare-associated infections pose a serious threat to patients requiring care, having a strong impact on morbidity, mortality, length of hospital stay and costs (Cosgrove, 2006; Duckworth, 2003; Graves et al., 2007; Pittet & Donaldson, 2006a; Plowman et al., 2001; Sax, Hugonnet, Harbarth, Herrault & Pittet, 2001). Hand hygiene, recognized as the most effective measure to prevent the transmission of infection, should therefore be practiced. However, overall compliance remains poor among healthcare workers.

A recent summary of the burden of healthcare-associated infection worldwide (WHO, 2010), has stated that the overall prevalence of healthcare-associated infections in developed countries varies from 5.1% to 11.6%, while in developing countries it can be higher than 10%. In the United States,

occurrence rate of healthcare-associated infections in 2002 was 4.5%, affecting 1.7 million patients and causing approximately 99,000 deaths (Stone, Braccia & Larson, 2005). In the United Kingdom, approximately 5,000 hospital deaths each year are believed to be caused by infections transmitted from other people (Smith, 2009).

Since most healthcare-associated infections are spread by direct contact, contaminated hands are believed to be the main vehicle (Larson, 1999). Hence, hand hygiene is recommended as a basic measure to prevent healthcare-associated infections (Allegranzi & Pittet, 2009; Boyce & Pittet, 2002; Larson, Early, Cloonan, Sugrue & Parides, 2000; Pittet et al., 2000). It is now a primary component of the World Health Organization's (WHO) patient safety program (WHO, 2010).

Hand hygiene action refers to either handwashing with soap and water or rubbing hands with an alcohol-based solution (WHO, 2009a). This is a simple procedure that can be mastered with ease by all levels of healthcare workers. Unfortunately, despite the simplicity of the procedure, compliance with hand hygiene rarely reaches 60%, with the average only at 40%–50% (Bischoff, Reynolds, Sessler, Edmond & Wenzel, 2000; Brown et al., 2003; Erasmus et al., 2010; Huggonet, Perneger & Pittet, 2002; Karabey, Ay, Derbentli, Nakipoglu & Esen, 2002; Novoa, Pi-Sunyer, Sala, Molins & Castells, 2007; Pessoa-Silva et al., 2007; Pittet, Mourouga et al., 1999; Pittet et al. 2003; Pittet et al. 2004; Rosenthal, McCormick, Guzman, Villamayor & Orellano, 2003; Sax, Uckay, Richet, Allegranzi & Pittet, 2007; Trick et al., 2007).

Factors affecting hand hygiene compliance include heavy workload, busy schedule of and/or limited time available for personnel, limited access to hand hygiene facilities, evidence or fear of dermatitis, a perception that the recommended frequency of hand hygiene is excessive, lack of knowledge, and gender and professional grouping (Larson & Kretzer, 1995; Pittet, 2000; Richard, 2004; Voss & Widmer, 1997; Weinstein, 2004; WHO, 2009a; Widmer, 2000; Zimakoff, Kjelsberg, Larsen & Holstein, 1992). Among the different reasons for noncompliance, time constraint is considered the factor with the greatest risk; personnel find that they cannot afford to take a minute to leave a patient and visit a sink, or use at least a fourth of the total of their nursing time in a busy ward to wash their hands (Boyce, 1999; Pittet, Mourouga et al., 1999; Voss & Widmer, 1997). Thus, despite the universal acknowledgement of the pivotal role of hand hygiene in preventing transmission of pathogens, enforcing compliance of healthcare workers with this simple task has always been a challenge.

1.2 Background and Rationale of the Study

In October 2005, Hong Kong pledged with the WHO World Alliance for Patient Safety, First Global Patient Safety Challenge to reduce healthcare-associated infections through the “Clean Care is Safer Care” campaign (Pittet & Donaldson, 2005). The campaign emphasized that hand hygiene is owed as a duty to patients, families and healthcare workers (Pittet & Donaldson, 2006a, 2006b). The gold standard method for hand hygiene practice in the “WHO Guidelines on Hand Hygiene in Health Care” (WHO, 2009a) is the use of alcohol-based handrub rather than handwashing with soap and water as the

former is easier, faster, better tolerated and possibly more cost-effective (Allegranzi et al., 2007). In Hong Kong, very few hospitals or units have adopted waterless hand antiseptics as the standard of care. Local study by Lam, Lee and Lau (2004) demonstrated that following inclusion of alcohol-based handrub in the procedures, hand hygiene compliance rose from 40% to 53% before patient contact and from 39% to 59% after patient contact. This resulted in a drop in healthcare-associated infection rate from 11.3 to 6.2 per 1,000 patient-days. Another study by Ng et al. (2004) after the introduction of the handrubbing protocol demonstrated a 2.8-fold reduction in the incidence of late onset systemic infection of the neonates. Although interventions to improve compliance have been successful, both studies were undertaken in the neonatal intensive care unit. No hospital wide study on hand hygiene compliance has been conducted to date.

An acute hospital in Hong Kong, being the pilot institution to participate in the First Global Patient Safety Challenge of the WHO World Alliance for Patient Safety Challenge, must introduce interventions to increase hand hygiene compliance. A study by Pittet et al. (2000) demonstrated sustained compliance after facilitating hand hygiene through easy access to alcohol-based handrub and through repeated reminders using the poster campaign. As stated, however, it is not easy to achieve sustainability if interventions only target individuals and neglect environmental constraints and organizational climate. An action research model with participant involvement in developing the promotion program may assist in dealing with factors that affect hand hygiene compliance. Action research differs from more conventional research paradigms in that it

examines the process of implementation as interventional studies that usually focus on the impact after strategies have been applied. An action research approach provides a way to address more effectively issues of participation from "users" of research alongside the integration of change into the research process. Unlike traditional research paradigms where data providers are variously seen as subjects or respondents, the underpinning philosophy of action research is not research "on" or "for" people, but with people (Reason & Bradbury, 2001). In this action research study, it is embedded in the context of an acute hospital and seeks to address the problem of hand hygiene compliance in a participatory way. Moreover, this study reflects on the efficacy of action research as an approach to investigate hand hygiene compliance. The cyclical process that involves action alongside reflection is another characteristic of the action research study.

1.3 Objectives of the Study

The central purpose of this study was to learn compliance of hand hygiene through an action research model in an acute hospital in Hong Kong. Objectives of the study were as follows:

1. Identification of the baseline hand hygiene compliance rate
2. Identification of the determinants of hand hygiene compliance
3. Examination of problems experienced by the staff with regard to compliance with hand hygiene and effective ways to improve it
4. Implementation and evaluation of the impact of the hand hygiene enhancement program on compliance in three experimental and three control wards

5. Implementation of the hand hygiene enhancement program for the whole hospital
6. Evaluation of the impact of the hand hygiene enhancement program on compliance in three experimental wards (sustainability of the program) and three control wards (any improvement in hand hygiene compliance)
7. Description of what can be learned from the process of using action research to develop knowledge and practice related to hand hygiene compliance in an acute hospital

1.4 Framework of the Study

The study was conducted in three cycles of action research (observe, reflect, plan and act) with the process of examining what is going on, identifying a concern, thinking of a possible way forward, testing, monitoring actions, evaluating progress and modifying the practice in light of the evaluation (Fig. 1.1). For the act of implementation of interventions, it was based on the concepts of PRECEDE model. PRECEDE stands for Predisposing, Reinforcing and Enabling constructs in Educational Diagnosis and Evaluation (Green, Kreuter, Deeds & Patridge, 1980). With these, the study attempted to understand and enhance the current hand hygiene practice by exploring the predisposing factors of the staff (knowledge, beliefs, and opinions), the enabling factors (skills and products) and reinforcing factors (peer support and performance feedback).

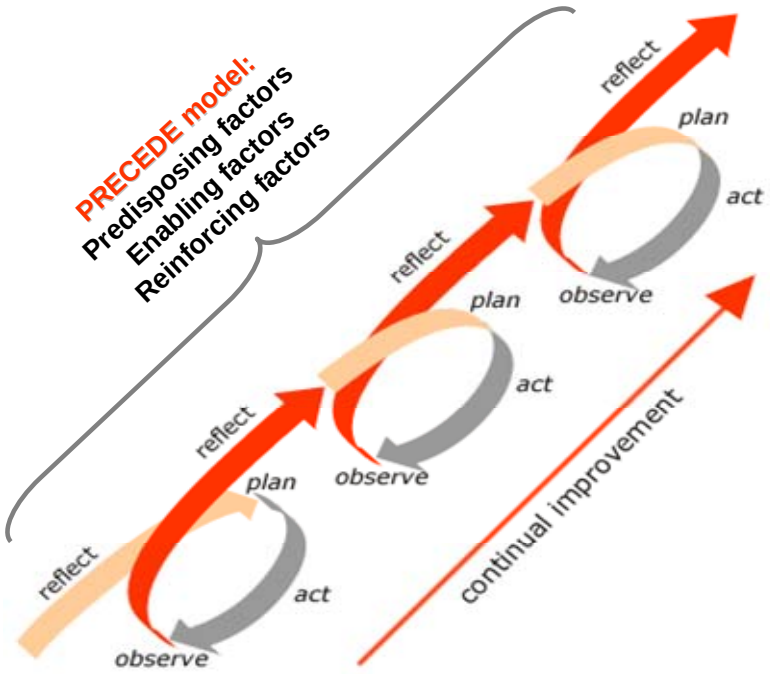

Fig. 1.1 Cycles of action research

The first cycle has a three-phase design covering exploratory, facilitation, and evaluation; while the second and third cycles focused on the phases covering facilitation and evaluation.

Cycle One

A) Exploratory phase

The goal was to understand current hand hygiene practices and independent predictors of compliance in the six study wards through baseline hand hygiene observation and questionnaire survey, respectively (Objectives 1, 2, and 3).

B) Facilitation phase

Based on feedback from the issues highlighted in the exploratory phase and literature review, the hand hygiene program was developed and implemented firstly for the three experimental wards (Objective 4).

C) Evaluation phase

The goal was to assess the impact of the hand hygiene enhancement program on compliance in the six study wards (three experimental and three control wards) through observation (Objective 4).

Cycle Two

A) Facilitation phase

The program was extended to the whole hospital, including the three control wards, in light of the findings from cycle one results (Objective 5).

B) Evaluation phase

The goal was to evaluate overall effectiveness of the hand hygiene enhancement program in the six study wards (Objective 5).

Cycle Three

Due to poor outcome in the study wards, the process of implementation of the enhancement program was reexamined and feedback was obtained from the staff. An additional third cycle was undertaken.

A) Facilitation phase

The goals were to revise and to implement the hand hygiene enhancement program in view of the outcomes obtained in the second cycle (Objective 6).

B) Evaluation phase

The goal was to evaluate overall effectiveness of the hand hygiene enhancement program in the six study wards (Objective 7) through observation and evaluation survey.

1.5 Summary

This chapter provided a broad overview of the study and its justification. It began with the reasons for promoting hand hygiene in Hong Kong followed by the objectives of the study. Chapter 2 examined literature that was relevant to healthcare-associated infections, factors affecting hand hygiene compliance, and intervention studies in so far as these related to the development, implementation, and evaluation of a hand hygiene enhancement program particularly focused on and relating to health care in Hong Kong. Chapter 3 explored the nature of action research as the preferred methodology of the study and described the design parameters for implementation and evaluation of the hand hygiene enhancement program. Chapter 4 illustrated the outcomes of first action research cycle while Chapter 5 provided the outcomes of second and third research cycles. Chapter 6 discussed the findings and examined the contributions to the field of hand hygiene. Chapter 7 explored the implications of research and provided the summary with reference to its significance and illustrated its limitations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The aims of the literature review were as follows: (1) to identify what and how to maintain compliance; (2) to discuss the evidence of hand hygiene in reducing healthcare-associated infections; (3) to understand factors affecting hand hygiene compliance; and (4) to review current interventions on the enhancement of hand hygiene and their outcomes.

2.2 Defining, Researching, Managing, and Maintaining Compliance

Compliance, though having been studied for years from various perspectives, has no agreeable definition (Kyngas, Duffy & Kroll, 2000). The most widely accepted was by Haynes (1979, p. 1–2), stating that compliance is "the extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice". Nevertheless 'compliance' requires further description of which and how behavior is involved, level of compliance and relationship between degree of compliance and health change. Moreover, it is burdened with reliability and validity problems thus making compliance-related research difficult (Blackwell, 1992). More importantly, the definition of compliance by Haynes underlines an authoritarian tone (Simons, 1992), ignoring counterpart decision-making.

Researching on ‘compliance’, Dracup and Meleis (1982) proposed an interactional approach, whereas Blackwell (1992) mentioned the approaches of bio-medical, operant behavioral, educational, health belief model and self-regulatory system. In terms of conceptualization, Dracup and Meleis (1982) identified the components of compliance as self-concept, role enactment, complementary roles, and periodic evaluation of role enactment by the self and others. Cameron (1996) conceptualized compliance as cognitive-motivational processes of personal attitudes and intentions, a set of self-care behaviors and outcomes of client-practitioner interactions. All these gave rise to the importance of individual values, goals, motivation, and expectations, as well as cognitive, developmental and contextual factors while studying compliance.

In managing compliance, a two-stage process including education and a variety of interventions was suggested (Blackwell, 1992) to assist the individual to assume the role to complete autonomy and self-care. Moreover, a two-way relationship with a shared learning process should be involved to empower the client to understand and change (Parmee, 1995).

Dunbar, Marshall and Hovell (1979) pointed out that improving compliance by considering prevention, remediation, or maintenance as the goals of intervention may be helpful. For prevention, the target is an entire population and the purpose is to shift current compliance toward a higher rate. For remediation, the target is a particular group and the goal is individual improvement. Meanwhile, for maintenance, the target is to sustain compliance. Basically, educational intervention is geared toward providing information and

instructions, while behavioral strategies in the form of reminders and self-monitoring may be used at all stages to remind and reinforce. In terms of organizational interventions focusing on the setting, procedures, or resources, these may be used in the preventive stage. As for maintenance interventions for enduring change, self-management strategies may help to achieve the desired outcome, including self-monitoring, participation, or self-reinforcement. Nevertheless, promoting hand hygiene among healthcare workers through behavioral change is a complex issue; though a simple act, hand hygiene is so highly repetitive that one may find it less important than any other practical tasks (Sax, Uckay et al., 2007).

2.3 Hand Hygiene and Healthcare-associated Infections

Patients can acquire healthcare-associated infections during treatment, investigation, or rehabilitation in a hospital or community. At any given time, over 1.4 million people worldwide develop infectious complications associated with health care (WHO, 2009a). People with healthcare-associated infections must remain in the hospital 2.5 times longer, incurring hospital costs that are almost three times higher (Plowman et al., 2000). In the United States (U.S.), the occurrence rate of healthcare-associated infections in 2002 was 4.5%, affecting 1.7 million patients and causing approximately 99,000 deaths (Stone et al., 2005). A recent report revealed that the annual direct medical costs of healthcare-associated infection to U.S. hospitals can be as high as $35.7 to $45 billion (Scott, 2009). In the United Kingdom, estimated healthcare-associated infection cases were more than 100,000, requiring additional 3.6 million hospital days, costing £1 billion with over 5,000 deaths per year (Mayor, 2000;

Plowman et al., 2000; Smith, 2009). For developing countries, the prevalence of healthcare-associated infection (pooled prevalence in high-quality studies, 15·5 per 100 patients) was considerably higher than proportions reported from Europe and the U.S. (Allegranzi et al., 2010). In connection to this, healthcare-associated infections complicated patient care delivery, contributed to death and disability, and added unnecessary economic burden (Allegranzi & Pittet, 2009; Cosgrove, 2006; Duckworth, 2003; Graves et al., 2007; Kim, Oh & Simor, 2001; Pittet, 2005; Pittet & Donaldson, 2006a; Plowman et al., 2001; Sax et al., 2001).

Among all means of transmission, hands are a primary cause, as illustrated by the following five sequential steps (Boyce & Pittet, 2002; Larson, 1988; Pittet et al., 2006; WHO, 2009a). First, **organisms are present on the patient's skin or shed onto fomites in the patient's inanimate environment** (Bonten et al., 1996; Larson, McGinley, Foglia, Talbot & Leyden, 1986; McFarland, Mulligan, Kwok & Stamm, 1989; Sanderson & Weissler, 1992; Sanford, Widmer, Bale, Jones & Wenzel, 1994). Second, **organisms transfer onto the hands of healthcare workers** (Casewell & Phillips, 1977; Duckro, Blom, Lyle, Weinstein & Hayden, 2005; McFarland et al., 1989; Ojajarvi, 1980; Pittet, Dharan, Touveneau, Sauvan & Perneger, 1999; Sanderson & Weissler, 1992). Third, **organisms survive on hands** (Doring et al., 1996; Fryklund, Tullus & Burman, 1995; Noskin, Stosor, Cooper & Peterson, 1995). Fourth, with **defective hand cleansing, this results in hands that remain to be contaminated** (Kac et al., 2005; Noskin et al., 1995; Trick et al., 2003). Finally, **contaminated hands cross-transmit organisms** (El Shafie, Alishaq & Leni

Garcia, 2004; Sartor et al., 2000). Therefore, hand hygiene plays a role in the prevention of healthcare-associated infections.

Historically, the link between hand antisepsis and healthcare-associated infections was demonstrated in 1847 by Semmelweis, who after introducing hand disinfection into clinical practice significantly reduced the rate of puerperal sepsis and maternal mortality (Beck, 1988; Best & Neuhauser, 2004; Newsom, 1993; Othersen & Othersen, 1987). Today, many studies demonstrate the association between hand hygiene and reduction of healthcare-associated infections. Majority employ a prospective design to determine infection rates at the baseline and after introduction of alcohol-based handrub. Selected studies in Table 2.1 were conducted mainly in adult intensive care (Casewell & Phillips, 1977; Conly, Hill, Ross, Lertzman & Louie, 1989; Larson et al., 2000; Rose, Rogel, Redl & Cade, 2009; Rosenthal, Guzman & Safdar, 2005; Salemi, Canola & Eck, 2002) and neonatal intensive care units (Brown et al., 2003; Helder, Brug, Looman, van Goudoever & Kornelisse, 2010; Lam et al., 2004; Larson et al., 2000; Pessoa-Silva et al., 2007; Won et al., 2004). A few studied across departments (Trick et al., 2007), involved more than one hospital (Larson et al., 2000; Trick et al., 2007), or were hospital-wide (Ellingson et al., 2011; Fendler et al., 2002; MacDonald, Dinah, MacKenzie & Wilson, 2004; Pittet et al., 2000; Rao, Jeanes, Osman, Aylott & Green, 2002; Trick et al., 2007; Zerr, Allpress, Health, Bornemann & Bennett, 2005). Studies were seldom conducted in the orthopedic context (Hilburn, Hammond, Fendler & Groziak, 2003) or in a community hospital (Fendler et al., 2002; Trick et al., 2007) be studied.

Table 2.1 Association between hand hygiene and healthcare-associated infection rates

Authors	**Year**	**Hospital Setting**	**Results**	**Duration of Follow-up**
Casewell & Phillips	1977	Adult ICU	Significant reduction ($p<0.001$) from 22.6% to 15.5% of patients colonized or infected by Klebsiella species.	2 years
Conly, Hill, Ross, Lertzman & Loule	1989	Adult ICU	Significant reduction ($p=0.02$) in HCAI after hand hygiene promotion (from 33% to 12% and from 33% to 9%).	5 years
Larson, Early, Cloonan, Sugrue & Parides	2000	Adult ICU/ NICU (Two hospitals)	Significant reduction (85%, $p=0.02$) of VRE rate in the intervention hospital as compared with insignificant reduction (44%) in the control.	6 months
Pittet, Hugonnet et al.	2000	Hospital wide	Significant reduction in the annual prevalence of HCAIs (41.5%, $p=0.04$) and MRSA transmission rate (87%, $p<0.001$).	5 years
Fendler et al.	2002	Hospital wide	Significant (30.4%, $p<0.05$) reduction of infection rate.	34 months
Rao, Jeanes, Osman, Aylott & Green	2002	Hospital wide	Reduction of hospital-acquired MRSA from 50% to 39%.	12 months
Salemi, Canola & Eck	2002	Adult ICUs	A decrease in the rate of central-line bloodstream infections from 3.2 to 1.4 / 1000 central-line days	30 months
Brown et al.	2003	NICU	The incidence of HCAI / 1000 patient- days with Klebsiella decreased from 21.5 to 4.7 then to 3.2.	6 months
Hilburn, Hammond, Fendler & Groziak	2003	Ortho-pedic	36.1% decrease in the infection rates from 8.2% to 5.3%.	10 months
Lam, Lee & Lau	2004	NICU	HCAI rate decreased from 11.3 to 6.2 per 1000 patient-days.	6 months
MacDonald, Dinah, MacKenzie & Wilson	2004	Hospital wide	Significant reduction ($p=0.03$) in hospital-acquired MRSA cases from 1.9% to 0.9%	1 year
Won et al.	2004	NICU	Significant ($p=0.03$) in HCAIs from 15.1 to 10.7 per 1000 patient-days.	2 years

Authors	Year	Hospital Setting	Results	Duration of Follow-up
Rosenthal, Guzman & Safdar	2005	Adult ICUs	Significant ($p<0.001$) reduction in HCAIs from 47.5 to 27.9 per 1000 patient days.	21 months
Zerr, Allpress, Health, Bornemann & Bennett	2005	Hospital wide	The rate of hospital-associated rotavirus infection decreased significantly ($p=0.01$) from 5.9 to 2.2 per 1000 discharged patients.	4 years
Pessoa-Silva et al.	2007	NICU	Bacteremia decreased after the intervention from 2.3 to 0.7 per 1000 patient-days ($p=0.12$).	9 months
Trick et al.	2007	Hospital wide (Four hospitals)	A significant ($p<0.001$) decrease in the incidence of hospital-acquired antimicrobial resistance organisms.	14 months
Cromer et al.	2008	Hospital wide	A significant 38% reduction of facility-acquired MRSA from 0.85 to 0.52 per 1000 patient-days.	1 year
Rose, Rogel, Redl & Cade	2009	Adult ICU	Mean monthly colonization rate of Acinetobacter decreased from 3.1 cases (first 12 months) to 1.5 per 100 bed-days (subsequent 12 months).	32 months
Helder, Brug, Looman, van Goudoever & Kornelisse	2010	NICU	Bacteremia of VLBW infants decreased after the intervention from 17.3.to 13.5 per 1000 patient-days ($p=0.03$).	4 years
Ellingson et al.	2011	Hospital wide	Clinical incidence of MRSA decreased by 61% ($p<0.001$) and the incidence of MRSA bloodstream infection decreased by 50% ($p=0.02$).	7 years

ICU = intensive care unit; NICU = neonatal ICU; HCAI = healthcare-associated infection

Of the above listed studies, five employed interventions of education with feedback, reminders, and organizational change; however, these did not involve any alcohol-based product (Conly et al., 1989; Larson et al., 2000; Rosenthal, Guzman & Safdar, 2005; Salemi et al., 2002; Won et al., 2004) while the remaining eleven included an alcohol-based product as part of the

program to reduce healthcare-associated infections. For the study design, only three examined other settings, the community hospital, and institutions with a control group (Fendler et al., 2002; Larson et al., 2000, Trick et al., 2007). The above studies demonstrated a temporal relationship existing between hand hygiene compliance and reduction of healthcare-associated infections, illustrating that hand hygiene should be enforced to enhance patient safety.

In interpreting the results, however, weaknesses of the studies must be taken into account. For example, the study by Fendler et al. (2002) did not include a control group. The study by Trick et al. (2007) was criticized by the updated review (Gould et al., 2010) for having control and intervention groups that were too dissimilar to allow for valid comparisons. The study by Pittet et al. (2000) had confounding variables, creating difficulty in determining which aspects of the multimodal approach actually accounted for the reduced rates in reported healthcare-associated infections. Meanwhile, in the study by Zerr et al. (2005), the cross-sectional design with no control group was the one that reported a significant reduction in the risk of hospital-associated gastrointestinal infections, demonstrating the flaws of including an unclear definition of outcome and the presence of confounding factors. Thus, given the limitations to their rigor, the results may not demonstrate a strong relationship between hand hygiene interventions and decreased incidence of healthcare-associated infections.

2.4 Hand Hygiene Frequencies, Practices and Compliances

Studies in Table 2.2 outlined that healthcare workers on average cleanse their hands five to 18 times per shift, while others reported that the average hand hygiene episodes per hour ranged from 0.7 to 12. Nonetheless, in different settings, the average opportunities for hand hygiene per healthcare worker may differ greatly from 22 in the intensive care unit to eight in the general wards (Pittet, Mourouga et al., 1999). Occasionally, hand hygiene opportunities per patient per hour of care may be as high as over 82 if the patient was being cared for by several healthcare workers at one time (Pittet et al., 2003).

Table 2.2 Hand hygiene frequency among healthcare workers

Authors	**Hospital Setting**	**Frequency of hand hygiene episodes**	
		Average no. / time period	**Average no. / hr**
Ayliffe, Babb, Davis & Lily, 1988	General wards	5 / 8 hr.	
Broughall, Marshman, Jackson & Bird, 1984	General wards	5 – 10 / shift	
Larson, McGinley, Grove, Leyden & Talbot, 1986	Oncology unit	8 / shift	
Winnefield, Richard, Drancourt & Grob, 2000	General wards	10 / shift	
McCormick, Buchman & Maki, 2000	General wards	12 – 18 / day (range 2 – 60)	
Boyce, Kelliher & Vallande, 2000	Adult ICU, hematology unit	13 – 15 / 8 hr. (range 5 – 27)	1.6 – 1.8 / hr.
Karabey, Ay, Derbentli, Nakipoglu & Esen, 2002	Adult ICU		0.7 / hr.
Meengs, Giles, Chisholm, Cordell & Nelson, 1994	Emergency department		1.8 / hr.
Larson, Hughes, Pyrek, Sparks, Cagatay & Bartkus, 1998	Pediatric and adult acute care		2.1 / hr.
Lam, Lee & Lau, 2004	NICU		2.2 / hr.
Taylor, 1978	General wards		3 / hr.

Authors	Hospital Setting	Frequency of hand hygiene episodes	
		Average no. / time period	Average no. / hr
Gould, 2004	Adult ICU, general wards		3.3 / hr.
Girard, Amazian & Fabry, 2001	Pediatric and adult acute care		3.5 / hr.
Gould, Wilson-Barnett & Ream, 1996	Adult ICU, general wards		6.67/hr.
Rosenthal, McCormick, Guzman, Villamayor & Orellano, 2003	Adult ICU, general wards		10 / hr.
Pittet et al., 2003	PACU		11.6 / hr.
Harbath, Pittet, Grady & Goldmann, 2001	Adult ICU		12 / hr.

ICU = intensive care unit; NICU = neonatal ICU; PACU = post-anaesthesia care unit.

Being related to the healthcare practice, handwashing with soap and water has been used for centuries to prevent the spread of disease (Broughall, Marshman, Jackson & Bird, 1984; Karabey et al., 2002; Larson, Friedman, Cohran, Treston-Aurand & Green, 1997; Larson et al., 1998; Meengs, Giles, Chisholm, Cordell & Nelson, 1994; Sharir, Teitler, Lavi & Raz, 2001; Taylor, 1978). Nevertheless, if not all hand surfaces were covered during handwashing with an average duration of 6.5 to 30 seconds (Broughall et al., 1984; Girard, Amazian & Fabry, 2001; Lam et al., 2004; Larson et al., 1998; Meengs et al., 1994; Sharir et al., 2001; Taylor, 1978), hands will remain contaminated. In addition, poor hand hygiene compliance has been documented repeatedly in relation to heavy workload and time required in handwashing. The use of an alcohol-based rub for hand hygiene, which was first recommended in the mid-'90s, is now the gold standard of care compared to handwashing by soap and water (Boyce & Pittet, 2002).

Regardless of practice, hand hygiene compliance was persistently low, with an average of approximately 40% (Table 2.3). Overall, compliance was higher after completion of care and after direct contact with body substances (Harbath, Pittet, Grady & Goldmann, 2001; Novoa et al., 2007; O'Boyle, Henly & Larson, 2001; Raboud et al., 2004; Sharir et al., 2001). Kim and coworkers (2002) commented that when working on multiple body sites on the same patient, merely 7.9% of healthcare workers changed their gloves while barely 4.8% disinfected their hands after multiple exposures. Raboud et al. (2004) reported that patients may be revisited every 25 minutes on average but merely 53% of healthcare workers may wash their hands on the last of a series of visits. This requires attention as microbes may colonize one body site and become a pathogen at another.

Interestingly, healthcare workers tended to perceive that they have washed their hands more often than they actually did (Jenner et al., 2006; Larson, McGinley et al., 1986; Moret, Tequi & Lombrail, 2004; O'Boyle, Henly & Larson, 2001). Mostly, the self-reported rate was substantially higher than that observed (Alvaran, Butz & Larson, 1994; Ronk & Girard, 1994). Tibballs (1996) stated that the self-estimated rate prior to patient contact was 73%, but observed frequency was merely 9%. In the end, the best way to determine hand hygiene compliance is direct observation with a standardized methodology rather than self-reporting (Haas & Larson, 2007; Jenner, Watson, Miller, Jones & Scott, 2002).

Table 2.3 Baseline hand hygiene adherence by healthcare workers

Authors	Year	Setting	B / A/ *	Adherence baseline (%)
Albert & Condie	1981	ICU ICU	A A	41 28
Preston, Larson & Stamm	1981	ICU	A	16
Larson	1983	All wards	A	45
Kaplan & Guckin	1986	SICU MICU	A A	51 76
Mayer, Dubbert, Miller, Burkett & Chapman	1986	ICU	A	63
Conly, Hill, Ross, Lertzman & Louie	1989	MICU MICU	B/A B/A	14 / 28 26 / 23
Dubbert, Dolce, Richter, Miller & Chapman	1990	ICU	A	81
Graham	1990	ICU	A	32
Simmons, Bryant, Neiman, Spencer & Arheart	1990	ICU	B/A	22
Lohr, Ingram, Dudley, Lawton & Donowitz	1991	Paediatric OPDs	B	49
Raju & Kobler	1991	Nursery / NICU	B/A*	28
Doebbeling et al.	1992	ICU	Not stated	40
Larson et al.	1992	NICU / Others	A	29
Zimakoff, Stormark & Larsen	1993	ICUs	A	40
Meengs, Giles, Chisholm, Cordell & Nelson	1994	Emergency Room	A	32
Lund et al.	1994	All wards	A	32
Wurtz, Moye & Jovanovic	1994	SICU	A	22
Dorsey, Cydulka & Emerman	1996	Emergency Department	A	54
Tibballs	1996	PICU	B/A	12 / 11
Larson, Bryan, Adler & Blane	1997	ICU	B/A	56
Watanakunakorn, Wang & Hazy	1998	All wards	A	30
Bischoff, Reynolds, Sessler, Edmond & Wenzel	2000	MICU CTICU	B/A B/A	10/22 4/13
Muto, Sistrom & Farr	2000	Medical wards	A*	60
Pittet et al.	2000	All wards	B/A/*	48

Authors	Year	Setting	B / A/ *	Adherence baseline (%)
Earl, Jackson & Rickman	2001	MICU / SICU	B/A	6.7 8.6
Girard, Amazian & Fabry	2001	All wards	B/A	62
Harbarth, Pittet, Grady & Goldmann	2001	PICU / CICU / NICU	B/A	34
Sharir, Teitler, Lavi & Raz	2001	All wards	B/A	76
Hugonnet, Perneger & Pittet	2002	MICU / SICU / NICU	B/A/*	38
Karabey, Ay, Derbentli, Nakipoglu & Esen	2002	ICU	B/A	15
Salemi, Canola & Eck	2002	ICU / CCU	B/A	19
Brown et al.	2003	NICU	B/A/*	44
Pittet et al.	2003	PACU	B/A/*	19.6
Rosenthal, McCormick, Guzman, Villamayor & Orellano	2003	All wards (3 hospitals)	B/A	17
Gould	2004	ICUs Wards	A A	30 29
Lam, Lee & Lau	2004	NICU	B/A/*	40
Pittet et al.	2004	Doctors in all wards	B/A/*	57
Thomas et al.	2005	ICUs five hospitals)	B/A	20
Zerr, Allpress, Heath, Bornemann & Bennett	2005	Medical / surgical wards	B/A/*	62
Novoa, Pi-Sunyer, Sala, Molins & Castells	2007	All wards	B/A/*	20
Pessoa-Silva et al.	2007	NICU	B/A/*	42
Swoboda, Earsing, Strauss, Lane & Lipsett	2007	Intermediate care unit	B/A	16.9
Huang & Wu	2008	3 long term care	B/A	9.34
Korniewicz & El-Masri	2010	Medical-Surgical Oncology	B/A	41.7 / 72.1
Scheithauer et al.	2010	SICU	MRSA /ESBL group	47 / 54

ICU = intensive care unit; NICU = neonatal ICU; SICU = surgical ICU; MICU = medical ICU; PICU = paediatric ICU; CTICU = cardiothoracic ICU; PACU = post-anaesthesia care unit; OPD = outpatient department; B = before patient contact; A = after patient contact.
* After contact with inanimate objects.

2.5 Factors Affecting Compliance to Hand Hygiene Practices

Table 2.4 summarizes the factors that affect hand hygiene compliance (Pittet, 2001; WHO, 2009a). These factors will be discussed below.

2.5.1 Risk factors

Among all risk factors for noncompliance, male gender (Hugonnet & Pittet, 2000; Sharir et al., 2001; van de Mortel et al., 2000; van de Mortel, Bourke, McLoughlin, Nonu & Reis, 2001; Zimakoff et al., 1992) and physician status (Albert & Condie, 1981; Hugonnet & Pittet, 2000; Meengs et al., 1994; Pittet, Mourouga et al., 1999; Pittet et al., 2000; Raju & Kobler, 1991; Salemi et al., 2002; Sharir et al., 2001; van de Mortel et al., 2000; van de Mortel et al., 2001; Watanakunakorn et al., 1998) were frequently observed. These may be related to differences in the parental teaching of handwashing to sons and daughters (Day, Arnaud & Monsma, 1993), greater emphasis on the prevention of infection in the nursing curriculum than doctors (Rosenthal et al., 2003), greater compliance among females (Lindahl & Heimann, 1997), or the fact that majority of nurses are female (Sharir et al., 2001).

Another risk factor that links healthcare-associated infections and poor hand hygiene adherence is understaffing or overcrowding (Borg, 2003; Grundmann, Hori, Winter, Tami & Austin, 2002; Harbath, Sudre, Dharan, Cadenas & Pittet, 1999; Hugonnet, Harbarth, Sax, Duncan & Pittet, 2004; Nijssen et al., 2003; Pittet, Dharan et al., 1999). Fridkin,

Pear, WilDonaldsonson, Galgiani, and Jarvis (1996), after adjusting confounding factors in an outbreak for central venous catheter-associated bloodstream infections, found that patient-to-nurse ratio remained an independent risk factor for the infections. Studying the relationship between understaffing and the spread of methicillin-resistant *Staphylococcus aureus* (MRSA) in an intensive care unit, Vicca (1999) echoed that an imbalance between workload and staffing may lead to insufficient hand hygiene practice with the spread of microorganisms. Harbath et al. (2001), Borg (2003), and Clements et al. (2008) likewise supported the positive relationship between outbreak or new infections and increased levels of bed occupancy, resulting in overcrowding and increasing workload. Other predictors for noncompliance are working in intensive care units, during procedures that carry a high risk of bacterial contamination and when the intensity of patient care was high (Hugonnet & Pittet, 2000; Pittet, Dharan et al., 1999; Pittet, Mourouga et al., 1999; Pittet et al., 2003; Pittet et al., 2004).

2.5.2 Barriers

Among the barriers to handwashing reported by healthcare workers (Table 2.4), the most discouraging was skin irritation caused by the hand hygiene agents (Benton, 2007; Doebbeling et al., 1992; Kolari, Ojajarvi, Lauharanta & Makela, 1989; Kownatzki, 2003; Larson, 1985, 1999; Larson, Friedman et al., 1997; Larson & Killien, 1982; Larson, McGinley, Grove et al., 1986; Larson et al., 2006). Hand cleansing

reduces lipid content and increases transepidermal water loss (Kownatzki, 2003; Larson, 1985). Therefore, hand detergents may damage the skin if hand hygiene frequency runs up to 50 from regular 14.4 times during an 8-hour shift (Larson, McGinley, Grove et al., 1986).

Another important barrier to compliance was inaccessible hand hygiene supplies such as insufficient number of sinks (Gould, 2004; Larson & Killien, 1982; Voss & Widmer, 1997; Zimakoff et al., 1992); this is because locating a sink and complete handwashing requires a considerable amount of time (Pittet, Mourouga et al., 1999; Voss & Widmer, 1997). Hence, non-adherence was often attributed to "being too busy" (O'Boyle, Henly & Duckett, 2001; Zimakoff et al., 1992). However, it is unclear whether being busy is merely an excuse or if compliance is truly impossible because of emergencies or high workload (Gould, 2004; Pittet et al., 2004; Voss & Widmer, 1997). Without a doubt, an increased number of sinks or reduction in cleansing duration through waterless hand antiseptic at the point of care is the key to compliance (Butz, Laughon, Gullette & Larson, 1990; Cronin & Groschel, 1989; Jones, Rowe, Jackson & Pritchard, 1986; Pittet et al., 2004).

Improper use of gloves (Girou et al., 2004; Novoa et al., 2007; Thompson et al., 1997) or failure to remove them was another component, with further risk of microbial transmission. This was

demonstrated by the experimental study of Doebbeling, Pfaller, Houston and Wenzel (1988), which revealed that 4% to 100% of test organisms were recovered from used gloves while zero to 4.7 $\log_{10}$ bacterial counts were found on the hands after the removal of gloves.

Other determinants reported to affect one's hand hygiene behavior intrinsically include knowledge, attitudes, beliefs, perception and intention (Kretzer & Larson, 1998; O'Boyle, Campbell, Henry & Collier, 1994; Pessoa-Silva et al., 2005; Ronk & Girard, 1994; Sax, Uckay et al., 2007; Seto, 1995; Simon et al., 2004). Larson and Killien (1982) stated that the perception of whether the patient has an infection may affect the healthcare worker's hand hygiene practice. Pittet et al. (2004) likewise claimed that hand hygiene adherence was associated with not only work and system constraints but knowledge and cognitive factors as well, including awareness of being observed, belief of being a role model for others, and a positive attitude toward hand hygiene after patient contact.

Further perceived barriers to compliance were the lack of following: active participation in hand hygiene promotion, a role model for hand hygiene, institutional priority for hand hygiene, administrative rewarding or sanctions for compliers or non-compliers, and an institutional safety climate as identified by Pittet (2000).

Table 2.4 Barriers and risk factors for non adherence with hand hygiene

Observed risk factors • Physician and nursing assistant status (rather than a nurse) • Male gender • Working in critical care • Working during the weekdays • Wearing gowns or gloves • Automated sink • Activities with high risk of cross-transmission • High number of indications for hand hygiene per hour of patient care
Self reported barriers • Hand hygiene agents cause irritation and dryness • Sinks are inconveniently located or shortage • Lack of soap, paper and towels • Too busy or insufficient time • Understaffing or overcrowding • Patient needs take priority • Hand hygiene interferes with health care worker and patient relation • Low risk of acquiring infection from patients • Improper use or wearing of gloves • Lack of knowledge to or disagreement with the guidelines or protocols • Not thinking about if or forgetfulness • No role model from colleagues or superiors • Skepticism about the value of hand hygiene • Lack of scientific impact of improved hand hygiene on infection rates
Perceived barriers • Lack of active participation in hand hygiene promotion in individual or institutional level • Lack of role model for hand hygiene • Lack of institutional priority for hand hygiene • Lack of administration sanction or rewarding • Lack of institutional safety climate

(Pittet, 2001; WHO, 2009a)

Factors associated with noncompliance (Table 2.5) are also suggested to be related to the group and institution and not only the individual (Pittet, 2000), thus rendering hand hygiene promotion difficult.

Table 2.5 Factors associated with noncompliance with hand hygiene at different levels

Individual level
- Lack of education or experience
- Being a physician
- Male gender
- Lack of knowledge of guidelines
- Being a refractory non-complier

Group level
- Lack of education or performance feedback
- Working in critical care
- Understaffing
- Lack of encouragement or role model

Institutional level
- Lack of written guidelines
- Lack of suitable hand hygiene agents
- Lack of hand hygiene facilities
- Lack of culture
- Lack of administrative leadership, support, sanction or rewards

(Pittet, 2000)

2.6 Interventional Studies to Enhance Hand Hygiene Compliance

Common interventions used to enhance compliance include providing educational talk and feedback, increasing the number of sinks, providing access to waterless alcohol-based antiseptic, posting reminders, and extending institutional support (Boyce & Pittet, 2002; Kampf, 2004; Larson, Bryan, Adler & Blane, 1997; Larson et al., 2000; O'Boyle, Henly & Larson, 2001; Pittet, 2000). The aims of these interventions were to improve knowledge, reinforce behavior, and motivate one to act (Naikoba & Hayward, 2001). However, no

single intervention has achieved long-term success, thus multiple interventions were sequentially used or combined (Larson & Kretzer, 1995). Table 2.6 provides an overview of interventions used to enhance hand hygiene compliance. Among the selected studies, education was found to be the most common intervention used to enhance hand hygiene while the intensive care unit was the most common study setting. Four studies adopted interventions based on a model or theory approach (Larson, Bryan et al., 1997; Larson et al., 2000; Mayer et al., 2011; Zerr et al., 2005); meanwhile, four studies have control groups (Gould & Chamberlain, 1997; Huang et al., 2002; Larson, Bryan et al., 1997; Larson et al., 2000). The study by Columbo et al. (2002) was critiqued by Gould et al. (2010), who stated that the key weaknesses were the dissimilarities between the control and experimental sites and imbalances in baseline hand hygiene. In addition, because of the limited control group, the intervention was completely confounded by the study site, making it difficult to attribute any observed changes to the intervention rather than to other site-specific variables. Most studies improved hand hygiene by using the multifaceted approach. However, not all had long term-follow up results. Seemingly, studies with sustainable hand hygiene compliance adopted performance feedback (Chou, Kerridge, Kulkarni, Wickman & Malow, 2010; Larson, Bryan et al., 1997; Mayer et al., 2011; Pittet et al., 2000; Tibballs, 1996; van de Mortel et al., 2000; Zerr et al., 2005) and institutional support (Larson et al., 2000; Pittet et al., 2000). It was noted that alcohol-based handrub was mostly introduced in these studies to improve hand hygiene compliance as it is easier and convenient to use.

Table 2.6 Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Dubbert, Dolce, Richter, Miller & Chapman	1990	ICU	Nurses	Not stated	1. Education 2. Feedback	No	81	Eduction: 86 Feedback: 92	
Graham	1990	ICU	Nurses, Physicians, Physiotherapist Radiology staff Orderly staff	Not stated	1. Education 2. Alcohol handrub inttroduction (AHR)	No	32	45	
Dorsey, Cydulka & Emerman	1996	Emergency department	Emergency physicians (EP), Registered nurses (RN), Nurse practitioners (NP)	Not stated	1. Post HW indications at all sinks 2. Distribute HW publications	No	EP: 38 RN: 50 NP: 65	EP: 41 (p=0.826) RN: 63 (p=0.234) NP: 72 (p=0.416)	
Tibballs	1996	PICU	Medical officers	Not stated	Performance feedback	No	BP: 12.4 AP: 10.6	BP: 68.3 AP: 64.8	5 months BP: 54.6 AP: 54.9
Gould & Chamberlain	1997	Surgical wards	Nurses	Not stated	Education – ward based	Yes	Test: 13.94 Control: 13.13	Test: 12.75 Control: 14.86	

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Larson, Bryan, Adler & Blane (Quasi-experimental)	1997	ICU	Nurses	PRECEDE model	1. Focus group discussion 2. Automated sinks installation 3. Feedback	Yes	Test: 56 Control: 55 (p=0.95)	<u>Random phase</u> Test: 70, Control: 69 (p=0.18) <u>Automated phase</u> Test: 76, Control: 65 (p=0.004) <u>Sequenced phase</u> Test: 83, Control: 48 (p=0.004)	<u>12 months</u> Test: 76 Control: 65 (p=0.68)
Coignard et al.	1998	MICU, SICU	Nurses, Midwives, Physicians, Nurse's aids, Housekeepers	Not stated	Education talk supplemented with publication in hospital newsletter and posters	No	4.2 (426 staff)	18.6 (392 staff)	
Larson, Early, Cloonan, Sugrue & Parides	2000	MICU, NICU	Nurses	Schein's framework	Organizational culture changing intervention	Yes	<u>Soap-Dispensing Episodes / Patient-Care days:</u>		
							Test: 42.6 Control: 30.3 (RR 1.4)	Test: 43 Control: 39.2 (RR 2.1)	<u>6 months:</u> Test: 116.6 Control: 55.5 (RR 2.1)

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Maury et al.	2000	MICU	Nurses, Physicians, Residents	Not stated	AHR introduction	No	42.4	60.9 (p=0.001)	4 months: 51.3 (p=0.007)
Muto, Sistrom & Farr	2000	Medical wards	Nurses, Physicans, Technologists, Housekeepers	Not stated	Education talk on introduction of AHR	No	60	52 (p=0.26)	
Pittet et al.	2000	All wards	All healthcare workers	Not stated	1. Feedback 2. Use of AHR 3. Posters 4. Institutional support	No	47.6 (Dec 1994)	53.4 (Dec 1995) 61.8 (Dec 1996)	3 years: 66.2 (Dec 1997)
van de Mortel et al.	2000	ICU, HDU	All staff	Not stated	Yearly performance feedback	No	61	83 (p=0.001)	6 months: 76 (p=0.06) 12 months: 65 (p=0.000)
Earl, Jackson & Rickman	2001	MICU, SICU	All staff	Not stated	AHR introduction	No	39.6	52.6	10 to 14 wks: 57%

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	**Year**	**Setting**	**Sample**	**Theory / Model**	**Intervention**	**Control group**	**Adherence (%)**		
							Baseline	**Implementation**	**Follow-up**
Girard, Amazian & Fabry	2001	Rheumat-ology unit, Urology unit, Paed. unit, PICU	All staff	Not stated	AHR introduction with meeting to answer questions	No	62.2	66.5	
Huang et al.	2002	All wards	Nurses	Not stated	Education	Yes	BP Test: 51 Control: 53.1 AP Test: 75.5 Control: 75.5	BP Test: 85.7 Control: 53.1 AP Test: 91.8 Control: 71.4	
Hugonnet, Perneger & Pittet	2002	MICU, SICU, PICU	All staff	Not stated	1. Feedback 2. Posters 3. Distribution of AHR	No	38.4	54.5	

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Brown et al.	2003	NICU	All staff	Not stated	1. Use of AHR 2. Review data 3. Identify opinion leaders 4. Post up colonization incidence rates 5. Feedback	No	44.2	48	
Rosenthal, McCormick, Guzman, Villamayor & Orellano	2003	All wards in 3 hospitals	Nurses, Physicians, Ancillary staff	Not stated	1. Education alone 2. Education and feedback	No	BP: 17	Education alone: BP: 44 ($p<0.001$) Education with feedback BP: 58 ($p<0.001$)	
Lam, Lee & Lau	2004	NICU	All staff	Not stated	1. Education 2. Use of AHR 3. HAI surveillance	No	BP: 40 AP: 39	BP: 53 ($p<0.0001$) AP: 59 ($p<0.0001$)	

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
McGuckin, Taylor, Martin, Porten & Salcido	2004	Rehabilit-ation unit	All staff	Not stated	Patient education model	No	Hand hygiene per resident-day: 5	6.7 ($p<0.001$)	3 months: 7 ($p<0.001$)
Swoboda, Earsing, Strauss, Lane & Lipsett	2004	Inter-mediate care unit	All staff	Not stated	1. Electronic monitoring 2. Add in Voice prompts	No	19.1	Electronic monitoring: 27.3 Add in voice prompts: 24.4	
Won et al.	2004	NICU	All staff	Not stated (quasi-experimental)	1. Education 2. Instructions, reminders 3. Incentives 4. Feedback	No	43	80	
Aragon, Sole & Brown	2005	Critical care, Progressive care, Medical, Surgical	All staff	Not stated	1. Education 2. AHR introduction 3. Posters	No	BP: 30 AP: 71	BP: 36 AP: 75	12 months: BP: 41 AP: 74

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Thomas et al.	2005	Trauma ICU, PICU, MICU, SICU, Emergency department	All staff	Not stated	1. Focus group discussion 2. Posters	No	20	37	
Zerr, Allpress, Heath, Bornemann & Bennett	2005	Paed. medical and surgical	Nurses Parent of patients	Social Cognitive theory	1. Education with AHR introduction and parents empowerment 2. Hospital wide program with intensive education, mailing, signs, articles and feedback	No	62 (Dec 2001)	64 (Mar 2002) 74 (Oct 2002) 83 (Mar 2003)	2 years: 81 (Dec 2003)
Pessoa-Silva et al.	2007	NICU	All staff	Not stated	1. Posters 2. Focus group with education and feedback	No	42	55	9 months: 54

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	**Year**	**Setting**	**Sample**	**Theory / Model**	**Intervention**	**Control group**	**Adherence (%)**		
							Baseline	**Implementation**	**Follow-up**
Raskind, Worley, Vinski & Goldfarb	2007	NICU	All staff	Not stated	Education with verbal reminders	No	89	100	3 months: 89
Trick et al.	2007	ICUs (4 hospitals), Medical + Surgical (Hospital A, B, C), Skilled-care unit (Hosp. A), Rehab. unit (Hosp. D)	All staff	Not stated	Test Hospitals A, B, C: 1. AHR introduction 2. Education 3. Poster campaign Control Hosp. D - AHR Introduction	Yes	Hospital A: 23 Hospital B: 30 Hospital C: 35 Hospital D: 32	Hospital A: 46 (p=0.002) Hospital B: 50 (p=0.02) Hospital C: 43 (p=0.27) Hospital D: 32 (p=0.4)	
Huang & Wu	2008	Long-term care facilities	Nurse assistants	Not stated	Education talk with hands-on training	No	9.34	30.36 (p<0.001)	

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	**Year**	**Setting**	**Sample**	**Theory / Model**	**Intervention**	**Control group**	**Adherence (%)**		
							Baseline	**Implementation**	**Follow-up**
Saint et al.	2009	5 units (Cardiology, Emergency, Geriatrics, Infectious diseases, Ophthalmology)	Nurses, doctors	Not stated	1. Intense education 2. Identify champions 3. AHR introduction 4. Wear green buttons that read *"Ask me if I have washed my hands"*	No	Nurses: 33.7 Doctors: 27.5 Overall: 31.5	Nurses: 47.9 Doctors: 46.6 Overall: 47.4	
Chou, Kerridge, Kulkarni, Wickman & Malow	2010	All wards	All staff	Not stated	1. Education 2. Performance feedback 3. Recruit hand hygiene liaisons 4. Implement violation letters and compliance incentives	No	34	60	2 years: > 90

Table 2.6 (ctd) Interventions aimed at improving compliance with hand hygiene

Authors	Year	Setting	Sample	Theory / Model	Intervention	Control group	Adherence (%)		
							Baseline	Implementation	Follow-up
Mayer et al.	2011	Hospital wide	All staff	Theory of Planned Behavior	1. Education 2. Performance feedback 3. Position AHR in convenient locations 4. Encourage staff involvement and ownership 5. Positive reinforcement	Yes	19 to 41	73-84	6 years: 59-81

ICU = intensive care unit; NICU = neonatal ICU; SICU = surgical ICU; MICU = medical ICU; PICU = paediatric ICU; HDU = high dependency unit; PAED: Paediatric; BP = before patient contact; AP = after patient contact; AHR: Alcohol-based handrub; HW: Handwashing.

2.6.1 Interventions Aimed at Increasing Knowledge

Educational talk

Educational talk has been emphasized as the most vital component to improve knowledge and increase awareness (Pittet & Boyce, 2003). The content for hand hygiene promotion must include the role of the hands in transmitting organisms to patients, activities that require hand hygiene with explanation of its rationale, hand hygiene guidelines and hospital policy, as well as exploration of obstacles to hand hygiene practices. However, teaching presentation is only associated with improving knowledge and not attitudes, thus limiting long-term success unless complemented with other interventions (Conly et al., 1989; Dubbert, Dolce, Richter, Miller & Chapman, 1990; Graham, 1990; Larson & Kretzer, 1995). Seto (1995) commented that education must be conducted in the way that can motivate the staff to comply through exercising informational and expert power, inviting full participatory decision-making, and involving an opinion leader or a liaison in the education process.

2.6.2 Interventions Aimed at Enabling Behavior

Introduction of a waterless alcohol-based handrub

Handwashing requires time, energy, and motivation. Additionally, harmful effects of handwashing on skin contributed to poor hand hygiene compliance. Larson and

Killien (1982) invited staff to apply skin protectants or provided staff with hand hygiene products that minimize skin irritation and dryness. At present, many European countries have adopted alcohol-based hand antiseptics because these are efficacious in removing bacterial flora from the hands, having less irritating potential because emollients have been added (Brown et al., 2003; Colombo et al., 2002; Dharan, Hugonnet, Sax & Pittet, 2003; Larson, Eke & Laughon, 1986; Mody, McNeil, Sun, Bradley & Kauffman, 2003; Rotter, 2001). A point to note is the quality of technique in applying waterless handrubs (Widmer & Dangel, 2004), as low reduction of bacterial counts on the contaminated hands can be attributed to poor technique (Ojajarvi, 1991). Another concern is the flammable quality of the alcohol-based handrubs (Boyce & Pittet, 2002; Brown et al., 2003; Conrad, 2001; Girard et al., 2001; Naikoba & Hayward, 2001; Rao et al., 2002). Hence, it may be advisable to provide 100 ml individual pocket-sized containers (Myers & Parini, 2003; Pittet et al., 2000) in lieu of the conventional ones to facilitate staff accessibility.

2.6.3 Interventions Aimed at Reinforcing Behavior

Performance feedback

Multiple reports (Conly et al., 1989; Dubbert et al., 1990; Gould & Chamberlain, 1997; Larson, Bryan et al., 1997; Mayer, Dubbert, Miller, Burkett & Chapman, 1986; Naikoba &

Hayward, 2001; Rosenthal et al., 2003; van de Mortel et al., 2000) mentioned that when education is incorporated into performance feedback, compliance increases significantly. Nevertheless, it quickly reverts back to the baseline once feedback stops. This indicated that constant reminders are essential for successful application of the program. However, duration of required feedback needs to be determined further as intense feedback can be very time-consuming, expensive, and impractical. Moreover, feedback is likely to produce an effect only when individuals are aware of being observed.

Role modeling

Wurtz, Moye and Jovanovic (1994) emphasized that simple material changes such as increased sink access will not improve hand hygiene compliance. By contrast, compliance may be enhanced when positive attitude toward hand hygiene is promoted (Kaplan & Guckin, 1986; Lankford et al., 2003; Pittet et al., 2004). This suggests that role modeling or group behavior may affect compliance, specifically by how one perceives the opinions of others toward hand hygiene (Clark & Houston, 2004; Larson & Kretzer, 1995; Muto et al., 2000; Saloojee & Steenhoff, 2001). Nevertheless, one must be cautious that while peer influence can motivate hand hygiene behavior, this should not be created by force.

Managerial commitment

If healthcare workers do not perceive their role in cleaning their hands, managerial responsibility is required to change the culture by regarding hand hygiene as an important event throughout the institution. This will encourage the staff to follow recommendations according to hospital policy. This means that nurse managers must actively support, emphasize, and reinforce hand hygiene by providing supplies, revisiting guidelines, monitoring technique, and following up on changes to ensure compliance (Boyce, 1999; Kelen et al., 1991; Larson et al., 2000; Richard, 2004).

Patient empowerment

The National Health Service Plan (Department of Health, 2000) has promoted patient empowerment as one of the competencies of clinical governance. In 2001, McGuckin et al. used this innovative approach to empower patients to enquire whether healthcare workers have washed their hands before touching them. However, this may bring uneasiness among patients and offend healthcare workers.

Others

Several scholars were in favor of recording individual hand hygiene adherence in the annual evaluation (Boyce, 1999; Kelen et al., 1991) while others attempted to use electronic monitoring

system and voice prompts (Arroliga, Budev & Gordon, 2004; Swoboda et al., 2004) to reinforce compliance.

Additionally, social cognitive models have been applied to improve hand hygiene behavior (Sheeran, Conner & Norman, 2001) with the assumption that perception can strongly affect behavior (Conner & Norman, 1995). In the reports, Larson et al. (1991) used the PRECEDE (an acronym for predisposing, reinforcing, and enabling factors) model to test the effect of an automated sink on handwashing practices and attitudes, with findings that single intervention will be ineffective unless it is part of the program that considers predisposing, enabling, and reinforcing factors. O'Boyle et al. (1994) associated the health belief model (HBM) with healthcare workers' self-reported compliance with universal precautions, proposing that the staff will not practice precautions if they do not perceive personal risk or the seriousness of diseases. Subsequently, O'Boyle, Henly, and Larson (2001) adopted the theory of planned behavior (TPB) to explain that hand hygiene is not only dependent on the internal motivation of staff but on available resources as well; this further supported the proposition if repetitive hand hygiene is transformed into habit, it can influence behavior independently from cognitive factors (Ajzen, 2001). Jenner et al. (2002) applied TPB to address the internal factors that motivate the staff; they concluded that attitude is a

> predictor of the intention to perform and demonstrated the importance of accountability and ownership in maintaining a high rate of hand hygiene compliance. Overall, hand hygiene behavior is observed to be a complex interaction of many factors. Thus, it is not easy to predict using a single behavioral theory.

In summary, majority of interventions used to promote hand hygiene were multimodal and multidimensional, with different levels of involvement (Pittet & Boyce, 2003). Nevertheless, in the recent Cochrane review on the effectiveness of interventions to increase hand hygiene compliance, only two studies were included for the year 2007 (Gould, Chudleigh, Moralejo & Drey, 2007) while only four were included for the year 2010 (Gould, Moralejo, Drey & Chudleigh, 2010). Other studies were excluded mainly due to methodological problems. A number of studies intended to be interrupted time-series analyses (ITS) were excluded from the review because they reported complicated before-and-after designs in which two or more sequential interventions had taken place; but with only one or two episodes of data collection after the application of each new intervention, so they could not be analyzed as ITS studies. This group included the studies conducted by Pittet et al. (2000) and Hugonnet et al. (2002). Other studies were excluded because careful reading suggested the absence of any clear intervention (Snow, White Alder & Stanford, 2006), and there were studies being excluded because data were collected mainly by self-reporting (Rykkje, Heggelund & Harthug, 2007).

The two studies in the initial review in 2007 used education as intervention with one randomized controlled trial study, and the results found an increase in hand hygiene compliance (Huang et al., 2002). Meanwhile, the other controlled before-and-after study did not find any significant differences between the control and experimental groups (Gould & Chamberlain, 1997). In 2010, two ITS analysis studies (Vernaz et al., 2008; Whitby, McLaws, Slater, Tong & Johnson, 2008) were reviewed. Both studies examined similar campaigns based on the Swiss campaign (Pittet et al., 2000), and included the use of alcohol-based handrubs, reminders, and performance feedback. Whitby et al. (2008) likewise examined simple substitutions of products with minimal education, as well as a second multifaceted campaign where the additional component was the application of social marketing theory as well as staff involvement in the change process. Both ITS analysis studies revealed an increase in product use in certain areas, including units with the social marketing campaign (Vernaz et al., 2008) and staff involvement (Whitby et al., 2008). From the recent review (Gould et al., 2010), there was a move toward measuring product use in addition to observing hand hygiene directly, which may help to eliminate the Hawthorne effect. Gould et al. (2010) commented in the review that there remains a dearth of methodologically robust studies to explore the effectiveness of interventions to increase hand hygiene compliance. In several studies, a decline in quality was observed, with too few data collection points. It was noted in the review that as certain study findings were so mixed, the authors found it difficult to determine whether the interventions were associated with sustained increase in hand hygiene compliance.

Gould et al. (2010) concluded that soundly designed studies are still required to evaluate the effectiveness of interventions intended to improve hand hygiene compliance and reduce healthcare-associated infections. It was suggested that adequately powered cluster randomized trials or well-designed ITS studies with at least 12-month follow-up would provide the optimal study design. However, it is worth noting that different research questions must be answered using different methodologies and that all have a valid contribution to lend to the overall knowledge base in hand hygiene. For example, certain studies are excluded based merely on the dissimilarities between the control and experimental sites or imbalances in hand hygiene (Bittner, Rich, Turner & Arnold, 2002; Colombo et al., 2002; Larson et al., 1991; Larson, Bryan et al., 1997; Larson et al., 2000; Mayer et al., 1986). In reality, cluster randomized trials are difficult to implement. Clearly, a research protocol should not be adopted simply for the ease with which it can be conducted; similarly, other research designs should not be dismissed on the same assumption. The review by Gould et al. (2010) emphasized that soundly designed studies are still required to evaluate the effectiveness of interventions to improve hand hygiene compliance and reduce healthcare-associated infections. Moreover, it was suggested that from the reviewed studies (Vernaz et al., 2008), social marketing or staff input may improve hand hygiene, though the evidence is not strong in terms of drawing a conclusion on which aspects of a campaign are effective.

2.7 Concluding Remarks

Effective hand hygiene practices are essential to the prevention of healthcare-associated infections. Nevertheless, overall adherence with hand hygiene recommendations was persistently lower than 40%. In addition, compliance was usually higher after completion of care and after direct contact with body substances. Healthcare workers seldom washed their hands after multiple exposures or before touching their own face, eyes, nose, and mouth.

Reasons for non-compliance included lack of time, inconveniently placed sinks, drying of the skin by soap, forgetfulness, or disagreement with the recommendations. Therefore, adherence can be motivated by increased knowledge, accessibility of hand hygiene agents, and awareness of personal and peer performance. Most interventions designed to promote hand hygiene include education, feedback, use of waterless hand antiseptic, role modeling, or creation of a culture of compliance and support. Review of literature likewise revealed that it is time to move beyond single interventional studies designed to improve hand hygiene. Process improvement and multimodal approaches have been effective.

Overall, study results, given the frequent limitations to their research rigor, may not demonstrate a strong relationship between hand hygiene interventions and compliance. Although a randomized controlled trial is the most robust study design, performing it in this field is challenging for several reasons. For example, it is very challenging to conduct a randomized control trial at the hospital unit level, because of the possibility of communication between units.

Furthermore, adequately powered sample sizes are not easy to obtain. When the number of additional factors that influence the comparability of one setting to another is considered – including but not limited to variability in organizational policies, staffing practices, patient characteristics, and facility design – the task of finding valid comparison controls can be difficult. Though the number of publications on hand hygiene interventions is impressively large, the development of hand hygiene intervention using action research model is limited. In this study, an action research model with collaboration and participant involvement was used to reach the goal of integrative science, encourage staff participation in the process, and ultimately develop evidence-based practical knowledge related to hand hygiene.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter is divided into three sections. The first provides the methodological framework for the study, the second describes the context, and the third describes the data collection and analysis process for the action research, followed by methods for ensuring validity and reliability of the study.

3.2 Action Research

It is a challenge to observe proper hand hygiene and change one's current practice. Cruickshank (1996) stated that many of the problems identified may be overcome by the involvement of participants in the research process. This has led to the suggestion that action research is the ideal approach, with collaboration and involvement of participants in the research process (Webb, 1989).

As a form of inquiry, action research enables researchers to improve their own learning, create new knowledge, and at the same time influence the learning of others. It involves a cyclical process of planning, acting, observing, and reflecting (Greenwood & Levin, 1998; Kemmis & McTaggart, 1988; Stringer & Dwyer, 2005).

3.2.1 Development of Action Research

As a research approach, action research has been used within the social science context since the 1940s (Rapoport, 1971). This approach was first examined by Kurt Lewin (1946), who believed that people would be more motivated if they were involved in decision-making. Lewin's work was followed by Stephen Corey and other US scholars who applied this methodology in researching on educational issues. However, action research experienced a decline in the US during the late 1950s. It then took hold in Britain, mainly through the influence of Lawrence Stenhouse, who advocated the view that teachers should be in charge of their own practice. This theme subsequently was developed further by John Elliot and Jack Whitehead from different perspectives, namely, interpretive and self-study, respectively. Since then, educationalists have embraced action research as a way of instigating change in practice and of bridging the theory-practice gap (Carr & Kemmis, 1986; McNiff & Whitehead, 2006). Today, action research is more prominent in health and social care research such as nursing, which is set within a complex social setting (Hart & Bond, 1995; Winter & Munn-Giddings, 2001).

3.2.2 Underpinning Assumptions of Action Research

Action research differs from more conventional research paradigms in that it acknowledges more than one way of obtaining knowledge, and that knowledge generation occurs as a result of many ways of being in the world (McNiff & Whitehead, 2006). Action research differed in

how the positioning of the researcher is perceived (ontological), the relationship between the knower and what is known (epistemological), the processes of generating knowledge (methodological), and the goals of research in terms of how the knowledge will be used (social).

Ontological

Action research is value-laden and morally committed, as action researchers view themselves as attempting to live in a way that is consistent with their values and commitments. In this manner, action research aims to understand what I/we am/are doing and not only what 'they' are doing, demonstrating a shared commitment and containing a hope that the other will hold the same view.

Epistemological

The object of enquiry in action research is not other people, but the 'I' in relation with the other 'it'. Questions asked would be 'What am I doing?' and 'How do I improve it?' In this manner, the aim is to demonstrate how the action researchers hold themselves accountable for what they do.

Methodological

Action research is performed by practitioners who perceive themselves as agents who can act and instigate change in terms of their own values and objectives. They do not do research on others but on themselves in the company of others, thus action research is participatory and collaborative. When asking 'How do I improve what I am doing', process questions must be raised;

such questions include ‘What is going on out there?’ and ‘What is going on in here?’ Therefore, methodologies in action research are open-ended and developmental with cycles of action and reflection so that action researchers are able to investigate their own practice and improve learning. Action research is a complex research approach where issues and problems are not merely isolated but worked with in real life situations as well to effect change. The benefit of working with this complexity within practice is that knowledge gained is from and within those involved in practice. Therefore, it may be more relevant to real practice situations.

Social purposes

The main social purposes of action research are as follows: to improve workplace practices through improved learning; to promote ongoing evaluation of learning and practices without need for ‘external’ evaluation; and to create good social order by influencing or encouraging people to reflect on what they are doing and to hold themselves responsible for their own thoughts and actions.

3.2.3 Definitions of Action Research

In the seminal work Becoming Critical (Carr & Kemmis, 1986), action research was viewed as an integral part of professional development with five particular features listed as a methodology for practitioners. Their sentiments were reflected in the following definition: “A form of

enquiry undertaken by participants in social situations in order to improve rationality and justice of their own social or educational practices, as well as their own understanding of these practices and situations in which these practices are carried out" (p. 162). Similarly, Badger (2000: 202) defines action research as "collective, self-reflective inquiry of participants in a situation to improve the rationality of their practices, while developing understanding of both the situation and their practices".

Action research opens up opportunities for practitioners to engage in the research process, benefit from the research experience, and create examples of good practice. Elliott (1991: 69) defined action research as "the study of a social situation with a view to improving the quality of action within it." Hopkins (2002: 41) maintained that "action research combines a substantive act with a research procedure; it is action disciplined by enquiry, a personal attempt at understanding while engaged in a process of improvement and reform".

The action of action research leading to personal or professional development is participatory in nature, involving self-reflective spirals of plan, act, observe, and reflect. Hart and Bond (1996: 454) described action research as "problem focused, context specific, participative, involves a change intervention geared to improvement, and a process based on a continuous interaction between research, action, reflection, and evaluation". Reason and Bradbury (2001:1) likewise defined action

research as “a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people”.

Clearly, the definitions revealed that action research is an approach to understand how people interact with one another and how people respond to events and situations. While other forms of research are concerned only in findings, action research is concerned in the process of inquiry and its long-term impact on relationships. More importantly, action research emphasizes the value of insights derived from practical involvement in an event, so the study is not conducted by an outsider but an insider. Action research also seeks to bridge the gap between ‘theory’ and practice by placing value on the experiential basis for knowledge and emphasizing the practical drive for developing one’s understanding (Winter & Munn-Giddings, 2001).

3.2.4 Action Research as a Methodology

Action research differs from more conventional (quantitative and qualitative) research paradigms in three ways: in its understanding and use of knowledge, its relationship with research participants and the introduction of change into the research process (Hockley, 2006). Both quantitative and qualitative research paradigms seek to answer

questions through manipulation of variables or identification of categories and themes in texts. Action research acknowledges that there is more than one way of knowing things, and the generation of knowledge occurs as a result of many ways of being in the world. Unlike traditional research paradigms where the people who provide the data are variously seen as subjects or respondents, the underpinning philosophy of action research is not research "on" people, but rather "with" people. Action research is a complex research process where issues and problems are not just isolated, but worked with in real life situations to effect change. The benefit of working with this complexity within practice, as commented by Reason and Bradbury (2001), is that knowledge gained is from and with those involved in the practice.

The presence of non-compliance with hand hygiene in the healthcare setting does raise questions on the effectiveness of interventions to enhance hand hygiene. Human action is intentional, so one will bring desirable behavior only when it is consistent with one's values, interests, and motives (Langford, 1973). Therefore, even knowing the reasons for non-compliance may not automatically lead to a solution. O'Boyle et al. (1994) emphasized that an integrated approach was needed to enhance compliance with infection prevention strategies. Recent attempts (Larson et al., 2000; Pittet et al., 2000) using multimodal and multidisciplinary approach have met certain success. However, behavioral change in hand hygiene practice was not easy for there was a deficit between theory and practice. Thus, one should not only look at

the outcomes but the process and context of change as well (East & Robinson, 1994). With these, an action research approach may be a methodology to facilitate change in healthcare workers' hand hygiene practice.

Rationales for undertaking action research in this study are as follows. Firstly, enhancing hand hygiene is situational. Thus, with action research, the practical problems are addressed within a specific context (Cohen, Manion & Morrison, 2000; Dinkelman, 1997). Secondly, when the action researcher is the participating member of the situation being investigated, he or she will not be an outsider but an insider understanding the study participants' response (Hart & Bond, 1995; Koshy, 2005; Morton-Cooper, 2000). This co-participation (Hecker 1997; Moch, Roth, Pederson, Groh-Demers & Siler, 1994) creates an environment for the action researcher and study participants in identifying the problem, in collaborating to plan action, and in assessing the planned change as well as the change process itself (Stringer, 1996). Thirdly, the action research provides a model for evaluation to occur systematically within the process of implementation, thus bridging the 'theory' and 'practice' gap (Hart & Bond, 1995, Henson, 1996; Knight, Wiseman & Cooner, 2000). Fourthly, through action research, the study can lead to open-ended outcomes, and the researcher can bring a story to life (Koshy, 2005).

3.3 Research Context

The study was performed in a 1,600-bed university-affiliated teaching hospital in Hong Kong. This teaching hospital, first opened in 1937 with 546 beds, is now an acute regional hospital providing a full range of comprehensive healthcare services, from 24-hour accident and emergency services through different specialties and subspecialties to rehabilitation. The study hospital is a tertiary and quaternary referral center for complex and advanced technology services such as transplant, neonatal intensive care, pediatric surgery, assisted reproduction, oral maxillofacial surgery and dental surgery, burns and reconstructive surgery, and neurosurgery for the entire territory.

3.3.1 Settings

Hospitalized patients were distributed mainly in medical and surgical wards while critical patients were admitted in the intensive care unit. With these, stratified random sampling was used to partition the hospital wards into medical, surgical, and intensive care. To maintain a homogenous sample with study wards in the same hospital block, stratified random sampling with drawing lot was used; this allowed the selection of six study wards, with two each from the medical (n=6), surgical (n=5), and intensive care (n=4). Lastly, the two study wards of each department were selected randomly through drawing lot to be the experimental and control.

In the end, the 30-bed female medical ward A, 34-bed male colonic surgical ward C, and 20-bed mixed medical and surgical intensive care

ward E served as the experimental wards. The controls included the 30-bed male medical ward B, 32-bed male hepatic surgical ward D, and the six-bed mixed neurosurgical intensive care ward F. All study wards were located in the old wing of the hospital. Among all these, only intensive care ward E has completed renovation in the first quarter of 2004, making their sink-to-bed ratio optimal with 28 wash basins (hands-free operation with infrared automatic sensor) for 20 beds. Conversely, the remaining study sites have limited wash basins positioned in the middle of hallway, in the treatment room and sluice room. Sink-to-bed ratio was suboptimal, ranging from one in five to one in ten (Ward A, 1:6; Ward B, 1:10; Ward C, 1:9; Ward D and intensive care ward F, 1:5).

3.3.2 Subjects

All healthcare workers with direct patient contact in the study sites were potential subjects of this study. They included the medical staff, nursing staff, healthcare assistants, and other staff such as physiotherapists. With reference to the recommendations from the WHO First Patient Safety Challenge, the sample proportion of healthcare workers in hand hygiene observation was stratified according to their intensity of patient care activities. Thus according to the WHO recommendations, 65% of the observations would be conducted on the nursing staff, 20% on the medical staff, 10% on the healthcare workers, and the remaining 5% on other healthcare workers. As for hand hygiene promotion interventions, all staff members in the

study sites with direct patient contact were welcome to participate (Table 3.1).

Table 3.1 Numbers of healthcare workers in the six study wards

	Nurses (n)	Doctors (n)	Healthcare assistants (n)
Ward A (Medical)	19	6	7
Ward B (Medical)	16	6	7
Ward C (Surgery)	21	10	6
Ward D (Surgery)	18	8	5
Ward E ((Intensive Care)	67	17	15
Ward F (Intensive Care)	37	15	10

3.4 Research Cycles and Timeline

Initially, current hand hygiene practices and intention to manifest hand hygiene behavior would be examined in the exploratory phase. Subsequent interventions to promote hand hygiene would be devised and refined through action research cycles in the facilitation and evaluation phase.

In total, three action research cycles were conducted. The first cycle began in April 2006 and ended in December 2006 (Table 3.2). It consisted of the exploratory, facilitation, and evaluation phases. The exploratory phase aimed to (a) identify baseline compliance through hand hygiene observation and (b) discuss the determinants of hand hygiene compliance through questionnaire survey. The facilitation phase was aimed at developing a hand hygiene program in the experimental wards through literature review, performance

feedback and small group conference that yielded problems of staff with regard to hand hygiene compliance. The evaluation phase aimed to evaluate the impact of the hand hygiene program on compliance in the three experimental wards and three control wards.

Table 3.2 Timeline of first action-research cycle

Cycle One	**Data collection methods**	**Interventions**	**Experimental wards** *(Medicine, Surgery, Intensive care)*	**Control wards** *(Medicine, Surgery, Intensive care)*
Exploratory phase (Apr. – Aug. 2006)	Direct hand hygiene observation	First hand hygiene observation	✓	✓
	Using questionnaire	Questionnaire survey	✓	✓
Facilitation phase (Sep. – Oct. 2006)	Discussion points collection	Small-group conference	✓	✕
		Performance feedback to nursing, medical and supporting staff	✓	✕
		Ward-based educational talks to nursing, medical, supporting staff	✓	✕
		Provision of alcohol-based handrub (AHR)	✓	✕
		Slogan competition	✓	✕
Evaluation phase (Oct. – Dec. 2006)	Direct hand hygiene observation	Second hand hygiene observation	✓	✓

The second cycle (Table 3.3) continued from January to May 2007, consisting of the facilitation and evaluation phases. The objective of the facilitation phase was to extend the hand hygiene program to the whole hospital, including the three control wards, in light of findings from the results of cycle one. Meanwhile, the evaluation phase was aimed at appraising the sustainability of hand hygiene practice in the experimental wards and the effectiveness of the hand hygiene enhancement program in the control wards.

Table 3.3 Timeline of second action-research cycle

Cycle Two	**Data collection methods**	**Interventions**	**Experimental wards** *(Medicine, Surgery, Intensive care)*	**Control wards** *(Medicine, Surgery, Intensive care)*
Facilitation phase (Jan. – Feb. 2007)	Discussion points collection	Individual Consultation	✓	✕
		Performance feedback to nursing, medical and supporting staff	✓	✕
		Hospital-based educational talk to nursing, medical, supporting staff	✓	✓
		Provision of AHR	✓	✓
		Posters display	✓	✓
Evaluation phase (Mar. – May 2007)	Direct hand hygiene observation	Third hand hygiene observation	✓	✓

The third cycle (Table 3.4) continued from May 2007 to February 2008, consisting of the facilitation and evaluation phases. The objective of the facilitation phase was to improve the hand hygiene program, taking into account the outcomes obtained in cycle two. Meanwhile, the evaluation phase was aimed at appraising the overall effectiveness of the hand hygiene enhancement program to the six study wards through observation and evaluation survey.

Table 3.4 Timeline of third action-research cycle

Cycle Three	**Data collection methods**	**Interventions**	**Experimental wards** *(Medicine, Surgery, Intensive care)*	**Control wards** *(Medicine, Surgery, Intensive care)*
Facilitation phase (May – Oct. 2007)		Performance feedback to nursing and supporting staff	✓	✓
		Mandatory intensive educational talks with scenario description	✓	✓
		Provision of AHR (cont'd)	✓	✓
		Poster display (cont'd)	✓	✓
Evaluation phase (Oct. 2007 – Feb. 2008)	Direct hand hygiene observation	Fourth hand hygiene observation with concurrent clarification	✓	✓
	Using evaluation form	Program evaluation survey	✓	✓

3.5 Data Collection

3.5.1 Direct Hand Hygiene Observation

Direct observation of healthcare workers during work is one of the methods to evaluate hand hygiene practices as it can generate the most accurate data on staff compliance. The main disadvantages of this method are the potential influence of the observer on the behavior of healthcare workers as the latter may be aware of being observed, and the impact of the observer's interpretation of the definitions and the actual situation on the reliability of the data. Therefore, a structured observation form should be used in direct observation so that the frequency of behaviors to the list of opportunities can be recorded accurately and accordingly (Sax, Allegranzi et al., 2007). Nonetheless, the observation form as an audit tool for hand hygiene compliance is valid when its findings actually reflect the extent to which the healthcare workers adhered to the hand hygiene guidelines. Moreover, the audit tool is reliable if the same results were produced regardless of the person applying it (Lacey, 2006).

Hand hygiene observation form

The observation form (Appendix I) used in this study was provided by the WHO First Global Safety Challenge in early 2006. This form is well designed for clear and easy documentation of the practice and product use. Essentially, the form consists of the following: (a) who collected data; (b) place, duration, and timing of observation; (c) who was observed; and

(d) what was observed in terms of handwashing with soap and water, handrubbing with alcohol-based handrub, or no action performed. In addition, the form contains recorded action to hand hygiene opportunities that is set according to standard definitions and published guidelines (Boyce & Pittet, 2002; Larson, 1995; Pittet, Mourouga et al., 1999). Thus, opportunities requiring hand hygiene action are prepared according to the concept of "My five moments for hand hygiene" (Sax et al., 2009).

Hand hygiene opportunity is the "moment during health-care activities when hand hygiene is necessary to interrupt germ transmission by hands" (WHO, 2009b, p.4). This includes the moment before patient contact (BEF-PAT), after contact with patient's skin (AFT-PAT), after contact with patient's gown or linen (AFT-PAT), after contact with inanimate objects in the patient's room (AFT-SURR), before IVD care (BEF-ASP), after IVD care (AFT-BFL), before IVD insertion (BEF-ASP), after IVD insertion (AFT-BFL), before wound contact (BEF-ASP), after wound contact (AFT-BFL), before mucous membrane contact (BEF-ASP), after mucous membrane contact (AFT-BFL), before body fluid contact (BEF-ASP), and after body fluid contact (AFT-BFL). Opportunities for hand hygiene are described as hand hygiene between patients and between a dirty and clean body site in the same patient. Hence, failure to

remove gloves after patient contact, and between a dirty and clean body site in the same patient are considered as noncompliance with hand hygiene.

Reliability of observation

Prior to actual observation, two observers received three half-hour training sessions provided by the principal investigator to ensure that all would interpret guidelines and use the observation form consistently. More importantly, the concept of "My Five Moments for hand hygiene" must be understood and be able to distinguish between hand hygiene indications and opportunities. Hand hygiene indication is the "reason for a hand hygiene action" (WHO, 2009b, p. 4). Meanwhile, hand hygiene opportunity is the "moment during health-care activities when hand hygiene is necessary to interrupt germ transmission by hands. It constitutes the denominator for calculating hand hygiene compliance, i.e. the proportion of times that healthcare workers perform hand hygiene of all observed moments when this was required" (WHO, 2009b, p.4). Hence, the opportunity determines the need to observe hand hygiene, whether the reason (indication leading to the action) is single or multiple. Subsequently, two half-hour discussion meetings were held among the observers to identify and clarify the indications for hand hygiene in the course of a variety of activities.

To test for inter-observer reliability, the observers including the principal investigator completed the observation form separately while observing the same healthcare worker and the same care sequence. This validation process was the same as that reported by Sax et al. (2009). Results were compared to confer whether the same opportunity was being observed. In total, five one-hour validation sessions were performed at the bone marrow transplantation unit until concordance was reached in all observed opportunities, with a Kappa 0.8 achieved.

Scope of observation

To compare results among observation periods, control for potential confounding factors is needed. Thus, the target number of opportunities by wards and professional category must be predefined. Sample numbers of hand hygiene observation to each study site (three experimental and three control) were determined to be at least 200 through the use of Epistat statistical package by setting the following: (a) significant level, 0.05; (b) power, 0.8; (c) population rate of the study characteristic, 40% (Pittet et al., 2000); and (d) smallest difference between the test group and controls, 10%. These determined sample size of at least 200; according to Sax et al. (2009), 200 opportunities per observation period and per unit of observation were needed to compare results in a reliable manner. In terms of allocation of proportions of staff to be observed, workforce of each professional category in the study setting

must be referred. The allocation in this study was further supported by Sax et al. (2009), with 65% of the professional category to be observed allocated to the nurses, whereas 20% for medical doctors, 10% for healthcare assistants, and the remaining 5% for other healthcare workers.

How observation was conducted

The observers planned observation sessions during weekdays, during daytime (9:00 a.m. to 5:00 p.m.), the time with a high density of care and the time participants routinely conduct surveillance; this was to allow them to gather a greater number of opportunities more quickly and to avoid the potential influence on the compliance if the healthcare worker was aware of being observed. As for selection of healthcare workers to be observed, random convenience sampling was adopted to minimize selection bias. Therefore, when the first healthcare worker involved in direct patient care activity on the study site was noted, he or she was observed unobtrusively for approximately 20 minutes on any action that would lead to hand hygiene opportunity.

The observer recorded only actions that could be clearly seen, and did not assume that an action had taken place if it was not observed clearly. The main focus of the observer was the identification of the indication to hand hygiene according to the five moments for hand hygiene (WHO, 2009b), and whether the

healthcare workers responded positively or negatively. More importantly, the observers did not interfere with the healthcare activities and no observation was performed in emergency situations.

How observation was reported

Hand hygiene compliance is the ratio of the number of performed actions to the number of opportunities. Therefore, the observers when reporting data on hand hygiene practices will identify the following: (a) at least one indication for hand hygiene must be observed to define an opportunity; (b) each opportunity requires one hand hygiene action; (c) one action may apply to more than one indication; (d) a documented action may be positive or negative provided it corresponds to an opportunity; and (e) observation of a positive action does not always imply the presence of an opportunity (WHO, 2009b). The above thus reflects the degree of compliance by healthcare workers with hand hygiene during activities in line with the five indications for hand hygiene.

3.5.2 Use of Questionnaire

The use of questionnaires enabled the investigator to collect a variety of information with ease and within a short period of time. Moreover, questionnaires are suitable for collecting information on attitudes and perceptions. Nonetheless, responses to the questions may be influenced

by what the respondents believe that the investigator wants to hear (Koshy, 2005).

The self-reported questionnaire used in the study was developed by the World Health Organization. It was adopted with no modification after face validity review by three local experts in the area of infection control. The questions contain elements of social cognitive theories applied to health-related behaviors, notably the theory of planned behavior, collecting data on cognitive factors related to hand hygiene behavior. This theory postulates that a given behavior is precipitated by intention that is predicted directly by enabling variables of attitudes *(positive or negative feelings or affective regard for the behavior)*, perceived behavioral control *(perceptions of having sufficient or insufficient control to perform the behavior)*, and subjective norms *(perception about whether a person important to him or her thinks the behavior should be performed)*. These enabling factors in turn are predicted by beliefs on outcomes of the behavior, control beliefs, and normative beliefs, respectively (Ajzen, 1988).

Among the items in the questionnaire, Sections A to C addressed demographic characteristics and perception of healthcare-associated infections and hand hygiene. Meanwhile, Section D explored the respondents' judgment of the effectiveness of promotion interventions, which were measured using a seven-point bipolar scale. Multi-item questions related to different types of care *(contact with intact skin,*

contact with biological fluids, contact with animate object, vascular tract care, removal of gloves, dirty to clean site care and between contact two patients sequentially) in Section E assessed the self-reported hand cleansing performance and the perception in (a) effectiveness of cleansing hands (attitudes), (b) difficulty or ease to cleanse hands (perceived behavioral control), and (c) how much their superiors want them to cleanse their hands (subjective norms). Response to each item of the latter three variables (perception scores) was evaluated by a seven-point bipolar Likert-type scale (Ajzen & Fishbein, 1980; Conner & Norman, 1995) with opposite answers at each end (e.g., not all effective and extremely effective). Meanwhile, the outcome variable (self-reported hand cleansing performance) was measured with scale values ranging from zero to 100% in 10% increments. Additionally, two other factors measured not by scale but by personal perception were assessed as possible explanatory variables for hand hygiene adherence, including one's perception of the importance and impact of healthcare-associated infection. Participants were invited to rate the effectiveness of interventions to increase hand hygiene compliance by a seven-point bipolar scale, which here represented the motivation to improve hand hygiene.

In the exploratory phase, all staff members in the six study wards were invited to accomplish the questionnaire. Approximately 200 questionaires were placed in the nursing station of the study sites by the principal investigator, inviting approximately 160 nurses, 30 doctors,

and 23 healthcare assistants. They were all provided with a set of questionnaire (Appendix II), information letter (Appendix III), and consent form (Appendix IV). All were invited to complete the anonymous questionnaire (Appendix II) at their convenience during work hours. The information letter detailed the aims of the study, the invitation to complete the questionnare and participation of intervention, and the signing of the consent form; it ensured confidentiality of responses. Additionally, respondents were informed fully that they have the right to participate or withdraw from the study, which would not affect their performance review. Sample size for questionnaire completion ranged between 120 and 140, as calculated by PASS 6.0 to achieve power of 0.8 (Pessoa-Silva et al., 2005). A total of 158 questionnaires (132 nurses, 13 physicians, and 13 healthcare assistants) were returned in July 2006, for an overall response rate of 74.2% (158/213).

3.5.3 Small Group Conference

Small group conference is an important part of action research as it attempts to address the issues of participation from "users" of research, alongside the integration of change into the research process. Furthermore, it is valuable for participants to learn and respond to the thoughts of their colleagues (Johnson, 2008).

A total of four small group conferences were held in the three experimental wards (one in medicine ward A, one in surgery ward C,

and two in intensive care ward E) in the last two weeks of October 2006. The ward manager, nursing officer, infection control link nurse, and any staff member working on the day of the small group conference were invited to participate. During the conference, staff members were encouraged to discuss topics related to their current hand hygiene practice, perceived obstacles to compliance, and possible means of improvement, including the use of waterless hand antiseptic product. At the same time, the upcoming interventions to enhance hand hygiene were discussed and agreed upon while opportunity was sought to clarify misconceptions related to the system change of using the alcohol-based handrub.

3.5.4 Individual Consultation

In January 2007, individual participants of the experimental wards during work hours were invited by the investigator to a short discussion of their views on the hand hygiene promotion program. This open-ended exchange encouraged the participants to express freely their impressions or insights into what they were currently working on. Individual consultation was likewise an effective way for the investigator to connect with the participants to establish rapport, clarify doubts, and provide encouragement (Johnson, 2008; Polit & Hungler, 1995).

As discussion time was limited to approximately five minutes, only items deemed important were recorded. Topics discussed focused on

the system change of using the waterless alcohol-based handrub, such as acceptance of the use of alcohol-based handrub, any increased usage of the waterless antiseptic product and the reasons behind it, recommendations to improve the product, ways to facilitate the use of alcohol-based handrub in their daily work, and their views on adoption of the "WHO Guidelines of Hand Hygiene in Health Care".

3.6 Implementation of Hand Hygiene Program

Interventions to enhance hand hygiene were conducted to the experimental wards in the first cycle, and subsequently to the control wards in the second cycle. The interventions were further refined in the third cycle.

3.6.1 Cycle One: Experimental Wards

In early September 2006, the principal investigator together with the supervisors of the three experimental wards discussed hand hygiene compliance with the staff. Barriers to compliance were identified and a consensus on ways to enhance hand hygiene compliance was agreed upon.

Framework of interventions to enhance hand hygiene

Feedback from the small group conference revealed that the interventions adopted to motivate performance of positive behavioral patterns, such as hand hygiene, were mostly those that could provide a rationale for the behavior *(predisposing factors)* to allow motivation to be realized through the

availability and accessibility of resources *(enabling factors)*. Others that could provide an incentive for the persistence of behavior *(reinforcing factors)* were used as well (Green & Kreuter, 1991). With these, the PRECEDE model of health behavior (Green et al., 1980) was suggested to be the useful framework for implementing interventions in this action research study in the facilitation phases (Table 3.5).

Table 3.5 Framework of interventions to enhance hand hygiene

PRECEDE Model		
Factors	**Strategies**	**Purpose**
Predisposing	Knowledge Educational talk to healthcare workers	a) To provide knowledge in • hand hygiene and its relationship to healthcare-associated infections • baseline current hand hygiene compliance b) To provide feedback of results of questionnaire
	Attitude Performance feedback to healthcare workers	a) To raise awareness of the importance of hand hygiene b) To answer any misconception
Enabling	Provision of alcohol-based handrub and Installation of dispenser	• To save time spending in hand hygiene
	Changing of anti-microbial soap at all washing basins to ordinary soap	• To reduce skin damage
Reinforcing	• Slogan competition • Poster display	To continue reminding the staff to perform hand hygiene
Action Research Cycle		
Components	**Strategies**	**Purpose**
Involvement and collaboration with staff	Participation of staff	Ownership with commitment to the program
Investigator as 'Insider' and not 'Outsider'	Reflection	Continuous improvement of the program

The program consisted of the following components:

Educational talk with feedback

Among all interventions, education is the first component as this is the basic element in enhancing awareness and providing predisposing factors such as knowledge or enabling factors such as skills (Benton, 2007; Colombo et al., 2002; Lawton, Turon, Cochran & Cardo, 2006; Raskind et al., 2007; Rosenthal et al., 2003; Wisniewski, Kim, Trick, Welbel & Weinstein, 2007).

A series of eight educational classes in group sessions were provided to the nursing and support staff of the experimental wards by the principal investigator from September 25 to October 6, 2006. Nevertheless, with the busy workload, the teaching session was conducted in the workplace during the 30-minutes break. All staff members on duty were instructed by their supervisors to attend. Elements incorporated in the teaching presentation were as follows: reinforce the importance and frequency of hand hygiene; increase staff awareness; provide knowledge; and enhance understanding toward healthcare-associated infections and hand hygiene. In addition, feedback on their performance and findings from the questionnaire that they completed were provided. Topics included in the talk were the following:

- Worldwide need to reduce healthcare-associated infections

- Importance and impact of healthcare-associated infections
- Importance of observing hand hygiene
- Average hand hygiene compliance reported
- Self-reported factors for poor adherence with handwashing
- Ways to overcome problems associated with handwashing
- Advantages of using alcohol-based handrub
- Tips on how to wash hands effectively
- Tips on how to use alcohol-based handrub effectively
- Indications for hand hygiene
- Performance feedback of hand hygiene observation
- Feedback of questionnaire survey findings

Theoretical and practical information provided in the educational talk could assist staff members in understanding why, how, and when to observe hand hygiene. The key message was providing the rationale of system change in disinfecting hands with waterless alcohol-based handrub when hands were not physically soiled (Pittet, 2001; Voss & Widmer, 1997). Another point to note was the non-use of soap and alcohol-based handrub concomitantly to prevent skin damage. Additionally, staff members were assured that they could call on the principal investigator or the infection control team members at any time during work hours should there be any reaction or difficulties in applying the waterless antiseptic product.

For the medical staff, providing education by their peers (another medical staff) was desired. Therefore, additional three 30-minute talks with similar content were provided to the doctors in their workplace by the Infection Control Officer from October 11 to 13, 2006.

Provision of waterless alcohol-based handrub product

Time constraint was an important factor identified by healthcare workers during the group conference, as their busy workload did not permit sufficient time to locate a basin for handwashing. Pittet (2002) stated that system change was required to make hand hygiene easy and convenient so as to provide healthcare workers with a perception of behavioral control.

With these, alcohol-based handrub as an enabling factor was delivered to the experimental wards a week after the educational sessions. The principal investigator discussed and confirmed with the staff the proper location for the alcohol-based handrub to ensure that the dispensers would be installed according to the 2006 International Fire Code:

- The maximum capacity of each dispenser shall be 2 liters.
- The minimum separation between dispensers shall be 48 inches.
- The dispensers shall not be installed directly adjacent to, or directly above or below an electrical receptacle, switch, appliance, device, or other ignition source.

- Dispensers shall be mounted so that its bottom is a minimum of 42 inches and a maximum of 48 inches above floor.

As the staff may perform handwashing with soap and water while at the same time practicing handrubbing with the alcohol-based product, all antimicrobial soap dispensers at the washing basin were changed to ordinary soap to prevent skin irritation. Moreover, pictorial steps on how to observe hand hygiene were posted all around the washing basins at eye level for easy reference. Furthermore, powder gloves were changed to powder-free ones to facilitate handrubbing with alcohol-based handrub after glove removal.

Slogan competition

Staff members of experimental wards were encouraged to initiate a slogan competition to enhance awareness and boost enthusiasm to observe hand hygiene.

3.6.2 Cycle Two: Experimental and Control Wards

Performance feedback

After implementation of interventions in the experimental wards in the first cycle, performance feedback as a reinforcing factor was provided in the workplace by the principal investigator in mid-January 2007. During the feedback session, hand hygiene compliance in relation to the professional category and the indications for hand hygiene were shown in colored charts for

easy reference. Concurrently, clinical situations that warranted hand hygiene practice, but were missed, were recounted.

Hospital-based hand hygiene educational talk, provision of alcohol-based handrub and poster display

Based on the evaluation obtained in cycle one, educational talks to promote hand hygiene practice were provided to the whole hospital, including the control wards. A total of two one-hour hospital-based educational talks with similar content were provided by the Hospital Infection Control Officer and the Senior Nursing Officer of the Infection Control Unit at the Lecture Theatre on January 24 and 30, 2007.

Following the educational talk was the provision of alcohol-based handrub to the whole institution. As in the first cycle, infection control nurses visited all clinical areas by phases to inspect, monitor, establish, and ensure that antimicrobial soap at all washing basins would be changed, handrub dispenser would be installed, steps on how to observe hand hygiene would be posted, and powder-free gloves with alcohol-based handrub would be provided. Staff members were reminded to call on the infection control team member at any time should there be problems or difficulties related to the adoption of the new waterless hand antiseptic product.

In February 2007, carton posters, as a reinforcing factor that reminded one to observe hand hygiene, were delivered to all clinical areas in three versions and different sizes. Ward managers were advised to display the posters at eye level in hand cleansing areas. Additionally, the staff was advised to change the poster regularly, such as on a monthly basis, so that different messages could be delivered. Simultaneously, other instruction posters such as "The FIVE indications for hand hygiene" and "Six hand hygiene steps" were posted for easy reference as well.

3.6.3 Cycle Three: All Study Wards

Mandatory intensive educational talk with performance feedback

Cycle three was conducted because evaluation of the six study wards in cycle two yielded less than satisfactory results. Brief discussion among staff revealed that not all healthcare workers possessed knowledge and understanding of the importance of hand hygiene. Thus, the two hospital-based educational talks provided were inadequate. In May 2007, the principal investigator called on all department operation managers (DOMs) to explain the necessity of providing mandatory intensive hand hygiene talks to all nursing and supporting staff. All DOMs supported the proposal, with several preferring the talk to be conducted during the work shift and a few suggesting its conduct after duty or between shifts. A total of 57

educational sessions for eight departments *(surgery, 17; orthopedic, 10; pediatric, 8; medicine, 7; intensive care, 7; accident and emergency, 4; obstetric and gynecology, 2; private and mixed, 2)* were delivered between late May and October 2007.

As staff members were busy day and night, the educational sessions were arranged with a duration of 30 minutes. Approximately 92% of colleagues attended the talk. Basically, the teaching content included the following: guidelines for hand hygiene; hand hygiene indications during daily patient care; potential risks of transmission of microorganisms to patients or vise versa; average hand hygiene compliance among healthcare workers; appropriateness, efficacy, and understanding of the use of hand hygiene and skin care protection agents; and reasons for the institutional choice of hand hygiene. One important take-home message was to highlight the benefit of hand hygiene in protecting one's self and others from infection. Topics included in the teaching session were as follows:

- Why emphasize on hand hygiene?
- Why is it difficult to perform handwashing taught in the past?
- Why does the WHO promote the "Clean Care is Safer Care" campaign?
- Why does the hospital have to promote hand hygiene?
- Why should one be encouraged to use alcohol-based handrub?

- How can handrubbing with the alcohol-based handrub be performed?
- When should good hand hygiene be observed?
- What should be considered when using alcohol-based handrub?
- How can skin irritation be prevented?
- What was the compliance ratio?
- In which situations is hand hygiene commonly missed?
- How can success in enhancing hand hygiene be achieved?

Scenario description

In addition to the mandatory intensive educational talk, a total of 22 scenarios of common patient practice were developed for staff clarification on when and why hand hygiene should be performed. The scenarios, though not exhaustive, were the commonly encountered activities in their daily work. These included administration of intravenous fluid, taking vital signs, checking blood glucose, providing oral or enteral feeding, touching inanimate objects and equipment in patient surroundings, napkin changing, collecting and disposing of urine, bedmaking, donning of gloves, blood taking, inserting intravenous device, administering chest physiotherapy with suctioning, and taking portable radiograph. Figure 3.1 shows when and why hand hygiene should be performed.

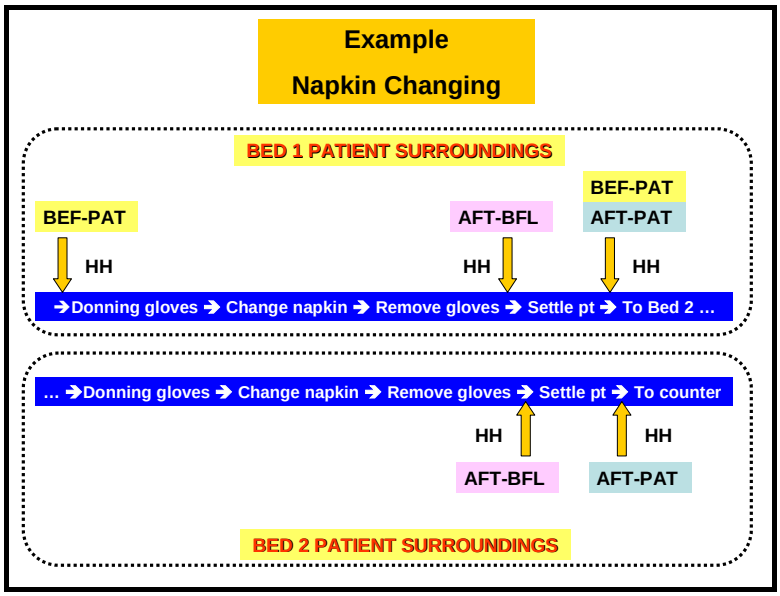

Figure 3.1 Example of scenario description

Concurrent clarification immediately after observation

Clarification as reinforcing factor was provided immediately after the observations in cycle three when the provider's concept appeared to deviate on when to observe hand hygiene.

Program evaluation survey

The program evaluation survey (Appendix V), with both closed response and open response questions, facilitated the participants' appraisal of the program in terms of effectiveness, while at the same time eliciting any necessary suggestions. Discussion among the supervisors was conducted while preparing the evaluation survey form. The key point was to make the questions clear, short, concise, and reader-friendly.

In February 2008, all participants in the six study wards were invited to evaluate the hand hygiene promotion program. Overall, the closed and open response questions explored the following:

- How important is hand hygiene educational talk in helping one to understand the risk of transmitting hospital-acquired infection?
- Which elements of the talk convince one to observe good hand hygiene?
- How effective is feedback in increasing your hand hygiene practice?
- How useful are posters in reminding one to observe hand hygiene?
- How useful is “scenario description” in improving practice?
- How often do the supervisors remind one to observe hand hygiene?
- How often do the patients remind one to observe hand hygiene?
- How much of one’s own hand hygiene performance can affect others?
- What is the biggest barrier preventing one from observing good hand hygiene?
- Which incentive would increase hand hygiene in ward unit?
- What can one learn from participation in the hand hygiene program?

3.7 Data Analysis

Quantitative data obtained from hand hygiene observation and self-reported questionnaire were computed and analyzed with the use of the Statistical package for Social Sciences (SPSS) version 15 software (SPSS Inc., Chicago). Descriptive statistics was used to describe the sample characteristics and their correlation. Categorical variables were compared using the chi-square test or Fisher exact test when expected values in either cell were less than 5, whereas continuous variables were compared using the Student *t* test. All statistical tests were two-tailed and *P* values less than 0.05 were considered statistically significant (Munro, 1997; Puri, 2002).

For hand hygiene observation, compliance determined by the ratio of the number of performed actions to the number of opportunities was computed in each observation period according to the professional category and indications of hand hygiene. For the self-reported questionnaire, Cronbach's alpha coefficient was used to estimate the reliability of each scale. Mann-Whitney U and Kruskal-Wallis tests were employed to determine differences among demographic factors and self-reported behavior, whereas Pearson correlation coefficients were computed to establish whether there was any relationship between the three perception scores and self-reported behavior.

Multiple regression analysis was applied to explore the relationship between hand hygiene performance and other independent variables or predictors (Pallant, 2005). Variables that entered into a multiple regression were based on the theory of planned behavior; this included the predisposing factor (gender,

age, profession, department, years since completion of basic professional training, years in present institution, past experience in hand hygiene promotional campaign, perception of the effectiveness of cleansing hands to reduce healthcare-associated infections), enabling factor (formal education in hand hygiene after basic training, perception of the difficulty or ease to cleanse hands), and reinforcing factor (perception of how much the superiors require hand cleansing). In terms of the discussion and suggestion points obtained during small group conferences, individual consultation and evaluation survey; inductive analysis (Johnson, 2008) will be used to organize items into categories. Recurring themes or patterns will then be sought.

3.8 Ethical Considerations

For protection of human rights, ethical approval was obtained from the studied hospital and the University Research Committee prior to initiation of the study. To ensure confidentiality and conduct observation as unobtrusively as possible, participants' names were not recorded and only the Head of the Department was informed during observation. In terms of self-reported questionnaire and participation in interventions, informed written consent was obtained from the participants, with explanation of the purpose, procedures of the study, and their right to participate or withdraw, which would not affect their performance review. All obtained data were guaranteed anonymity and confidentiality.

CHAPTER FOUR

RESULTS OF FIRST ACTION RESEARCH CYCLE

4.1 Introduction

The study began with the concern that although hand hygiene remains the single most important measure to prevent healthcare-associated infections, the importance of this simple procedure is not sufficiently recognized by healthcare workers and poor compliance has been documented repeatedly. To improve sustained hand hygiene compliance in Hong Kong, it was explored in light of the context of activities situated in an acute hospital. Data from this study made visible distinctive systems of shared knowledge, values, and beliefs that shaped the contemporary hand hygiene practice and built the practice framework in which the hand hygiene practice of healthcare professionals was embedded.

This chapter describes the results of the first cycle, including the exploratory phase that aimed to understand current hand hygiene practices and independent predictors of hand hygiene compliance in the six study wards through baseline hand hygiene observation and questionnaire, respectively. Secondly, it discusses the facilitation phase, including planning, developing, and implementing the program for the three experimental wards with regard to the analysis of issues highlighted in the exploratory phase, feedback from participants and review of literature. Thirdly, it examines the evaluation phase,

which assessed the impact of the enhancement program on hand hygiene compliance in the six study wards through direct observation.

The next chapter will explore cycles two and three, in which the program was extended to the whole hospital, including the three control wards, in light of findings from the first cycle.

4.2 Findings in the Exploratory Phase

Baseline hand hygiene compliance, attitude toward hand hygiene, and determinants of compliance were important findings in the exploratory phase for the planning and implementation of interventions.

4.2.1 Baseline Hand Hygiene Compliance

From April to May 2006, baseline hand hygiene observation was conducted in 118 observation sessions, for a total of 51 hours. A total of 1,309 opportunities warranting hand hygiene were identified in the six study wards, with nurses contributing 62.9% of all opportunities; doctors, 19.7%; healthcare assistants, 10.9%; and other healthcare workers, 6.5%. Baseline hand hygiene compliance was 22% (288/1309). Of 288 hand hygiene actions, 95.5% were handwashing with soap and water while the remaining percentage using alcohol-based handrub was in the intensive care ward E.

Observation and professional category

Hand hygiene compliance differed among healthcare workers (Table 4.1). Overall, healthcare assistants (HCAs) have the lowest compliance at 11.9%. Compared with other professional categories, compliance of HCAs was significantly lower than that of the nurses at 22.5% (χ^2 7.6, $p<0.001$) and doctors at 26% (χ^2 10.2, $p<0.05$), but not of the other healthcare workers at 22.4% (χ^2 3.6, $p=0.056$).

TABLE 4.1 Baseline hand hygiene compliance among professional categories

% Compliance (Action / Opportunities)			
Nurses (n=141)	Doctors (n=72)	HCAs (n=28)	Others (n=26)
22.5 (185/823)	26.0 (67/258)	11.9 (17/143)	22.4 (19/85)

HCAs = Healthcare assistants.

Observation and the indications for hand hygiene

Within the five indications for hand hygiene (Table 4.2), the lowest frequency of hand hygiene among all professional categories was in 'before touching a patient' (9.5%). Meanwhile, the highest was in 'after body fluid exposure risk' (44.3%).

TABLE 4.2 Baseline compliance among the indications for hand hygiene

Indication	% Compliance with hand hygiene				
	Nurses	Doctors	HCAs	Others	Overall
BEF-PAT	10.2	14.3	2.2	3.9	9.5
BEF-ASP	12.1	10.9	0.0	14.3	11.3
AFT-BFL	45.5	45.6	28.6	54.6	44.3
AFT-PAT	21.9	26.7	13.0	17.4	21.3
AFT-SUR	30.0	0.0	0.0	-----	22.2

HCAs = Healthcare assistants; BEF-PAT = Before touching a patient; AFT-PAT = After touching a patient; BEF-ASP = Before clean / aseptic procedure; AFT-BFL = After body fluid exposure risk; AFT-SUR = After touching patient surroundings.

Observation and ward specialty

Average compliance differed among ward specialties (Table 4.3). Overall, nurses of intensive care wards (38.3%) practiced hand hygiene significantly more than the nurses in medical wards (18.9%, χ^2 24.9, p=0.000) and surgical wards (8%, χ^2 60.4, p=0.000). Compliance of doctors in the intensive care wards (38.9%) was significantly higher than that of their peers in the surgical wards (9.5%, χ^2 18.6, p<0.001) but not the medical wards (28.6%, χ^2 1.6, p=0.2).

TABLE 4.3 Baseline hand hygiene compliance according to professional categories and ward specialties

	% Compliance (Action / Opportunities)			
	Nurses	Doctors	HCAs	Others
Medicine	18.9% (49/261)	28.6% (24/84)	11.8% (6/51)	13.3% (4/30)
Surgery	8% (21/262)	9.5% (8/84)	11.1% (6/54)	20.0% (5/25)
Intensive Care	38.3% (115/300)	38.9% (35/90)	13.2% (5/38)	33.3% (10/30)

HCAs = Healthcare assistants.

Intensive care wards, compared with medicine and surgery, have lower patient-to-nurse ratio (one to two) and no round care procedures (Table 4.4). In connection to this, nurses of intensive care ward E showed higher compliance (32.2%) than those of medical ward A (12.2%; χ^2 14.4, p<0.005), surgical ward C (11.5%, χ^2 15.8, p<0.005), and surgical ward D (4.6%, χ^2 32.1, p=0.000). Similarly, nurses of intensive care ward F have higher compliance (40%) than those of medical ward A (12.2%, χ^2 33.1

p=0.000), medical ward B (25.4%, χ^2 9.9, p<0.005), surgical ward C (11.5%, χ^2 34.9, p=0.000), and surgical ward D (4.6%, χ^2 55.4, p=0.000). Examples of round care procedures are shown in Table 4.5.

TABLE 4.4 Hand hygiene compliance by study wards with or without round care procedures

Ward	Patient-to-Nurse Ratio	Hand hygiene opportunities per hour with no round care procedures		Hand hygiene opportunities per hour with round care procedures		Nurses hand hygiene percent compliance	Overall hand hygiene percent compliance
		Range	Average	Range	Average		
A *(MED)*	6 to 8	5 – 18	9	18 – 45	30	12.2	14.5
B *(MED)*	6 to 8	6 – 20	9	18 – 26	23	25.4	24.5
C *(SRG)*	6 to 8	5 – 15	9	20 – 32	24	11.5	11.6
D *(SRG)*	6 to 8	5 – 15	9	20 – 54	40	4.6	7.3
E *(IC)*	1	6 – 38	14			32.2	29.0
F *(IC)*	2	6 – 30	15			44.0	41.8

MED = Medicine; SRG = Surgery; IC = Intensive care.

Observation and use of gloves

Observed scenario in Tables 4.5 and 4.6 illustrated that healthcare workers did not practice proper hand hygiene upon removal of gloves nor have gloves been removed after dirty interactions between patients and within the same patient from dirty and clean body sites.

TABLE 4.5 Examples of round care procedures

Staff	Period (min.)	Opportun-ities	Action	Round care procedures
Nurse	30	17	1 hand-washing	Consecutively checked into eight patients' blood glucose with the same pair of gloves
HCA	35	18	2 hand-washing	Monitored vital signs one after the other for 9 patients with in-between activities of napkin changing and bedpan giving
Phlebo-tomist	20	7	None	Performed blood sampling continuously to three patients with the same pair of gloves

TABLE 4.6 Hand hygiene and glove use

Healthcare workers	Examples of hand hygiene and glove use
Nurse and Healthcare assistants	Continued the bedmaking with the same pair of gloves after napkin changing
Nurse	No hand hygiene on gloves removal after topical treatment for scabies but continued enteral feeding to the same patient
Physiotherapist	Continued limb physiotherapy with the same pair of gloves after respiratory suctioning
Doctor	Continued electrocardiogram with the same pair of gloves after blood sampling

4.2.2 Attitudes toward Hand Hygiene and Determinants of Hand Hygiene Compliance

A total of 158 questionnaires (132 nurses, 13 physicians, and 13 healthcare assistants) were returned in July 2006, for an overall response rate of 74.2% (158/213). Overall, the questionnaire had good internal consistency with Cronbach's alpha (0.92), whereas the alpha coefficient range for all multi-item scales was 0.81–0.89. Among the respondents, 83.5% were nurses, 77.8% were female, 60.8% were ages 31–50 years, and 74.7% have completed basic professional training for more than five years. In terms of hand hygiene promotion experience and formal hand hygiene education training, 57.6% of respondents had participated in the former while 75.9% had received the latter (Table 4.7).

TABLE 4.7 Demographics of respondents participated in questionnaire survey

Variables	Total (n=158) n (%)
Gender	
Male	35 (22.2)
Female	123 (77.8)
Age (years)	
21-30	62 (39.2)
31-40	64 (40.5)
41-50	32 (20.3)
Years since completion of basic professional training	
≤ 5	40 (25.3)
6 - 10	58 (36.7)
11 - 15	28 (17.7)
> 15	32 (20.3)
Years in present institution	
≤ 5	46 (29.1)
6 - 10	56 (35.4)
11 - 15	39 (24.7)
> 15	17 (10.8)
Profession	
Nurse	132 (83.5)
Doctor	13 (8.2)
Healthcare assistant	13 (8.2)
Department	
Medicine	62 (39.2)
Surgery	57 (36.1)
Intensive Care	39 (24.7)
Past experience of hand hygiene promotional campaign	
Yes	91 (57.6)
No	67 (42.4)
Formal education in hand hygiene after basic training	
Yes	120 (75.9)
No	38 (24.1)

Importance and impact of healthcare-associated infections

22.8% of respondents perceived that percentage of patients with healthcare-associated infections would be less than 16%. A total of 20.3% estimated that healthcare-associated infections would result in less than six hospital days. Moreover, 19.6% of participants believed that less than 5% of patients with healthcare-associated infections would die as a result of infection (Table 4.8).

TABLE 4.8 Perception of respondents to importance and impact of healthcare-associated infections

Importance and impact of healthcare-associated infections (HCAI) (n=158)	n (%)
% of hospitalized patients will suffer from HCAI	
Don't know	7 (4.4)
<=15	36 (22.8)
16-30	53 (33.6)
31-50	41 (25.9)
>50	21 (13.3)
% of patients with an HCAI will die due to the infection	
Don't know	9 (5.7)
<5	31 (19.6)
5-9	36 (22.8)
10-20	48 (30.4)
>20	34 (21.5)
Additional days that HCAI patients have to stay in hospital because of their infection	
Don't know	14 (8.9)
<=5	32 (20.3)
6-10	59 (37.3)
11-20	31 (19.6)
>20	22 (13.9)

Effectiveness and importance of hand hygiene

49.4% of respondents acknowledged that more than 75% of healthcare-associated infections could be prevented by good

hand hygiene practice. A total of 59% of nurses, 92.3% of doctors, and 46.2% of healthcare assistants perceived that frequency of hand hygiene actions during patient care was less than five times per hour, whereas 26.5% of nurses, 7.7% of doctors, and 46.2% of healthcare assistants claimed that it was six to 10 times per hour. In terms of average hand hygiene compliance at the hospital, 50.8% of nurses, 15.4% of doctors, and 23.1% of healthcare assistants perceived it to be greater than 75%. Comparatively, more nursing respondents (40%–45%) perceived that hand hygiene would be ranked as the top priority among all patient safety issues by top management at their hospital, their respective departments, and themselves (Table 4.9).

TABLE 4.9 Ranking of hand hygiene among all patient safety issues

Ranking of hand hygiene among all patient safety issues by top management of	Nurses	Doctors	HCAs
Your hospital			
Top priority	54 (40.9%)	4 (30.8%)	3 (23.1%)
Among 2-5 top priorities	73 (55.3%)	8 (61.5%)	10 (76.9%)
Lower than 5th priority	5 (3.8%)	1 (7.7%)	
Your department			
Top priority	47 (35.6%)	3 (23.1%)	3 (23.1%)
Among 2-5 top priorities	78 (59.1%)	8 (61.5%)	10 (76.9%)
Lower than 5th priority	7 (5.3%)	2 (15.4%)	
Yourself			
Top priority	59 (44.7%)	1 (7.7%)	6 (46.2%)
Among 2-5 top priorities	71 (53.8%)	12 (92.3%)	7 (53.8%)
Lower than 5th priority	2 (1.5%)		

HCAs = Healthcare assistants.

Effective interventions to increase hand hygiene compliance

As perceived by the respondents, the three most effective interventions for enhancing hand hygiene compliance were the following: (1) healthcare worker performs hand hygiene each time it is required; (2) an alcohol-based handrub is easily available at each point of patient care; and (3) each healthcare worker receives basic training in hand hygiene (Table 4.10). By contrast, empowering patients to remind healthcare workers to observe hand hygiene was mostly rated to be the least effective intervention.

TABLE 4.10 Ranking of effectiveness of interventions in enhancing hand hygiene compliance

Interventions	Mean Score (SD)
You perform hand hygiene each time this is required (being a perfect example)	5.49 (1.04)
The healthcare facility makes alcohol-based handrub easily available at each point of patient care	5.42 (1.30)
Each healthcare worker receives basic training in hand hygiene	5.42 (1.18)
Clear, easily understandable hand hygiene guidelines are easily accessible for each health care worker	5.15 (1.25)
Your preferred superior performs hand hygiene each time this is required (being a perfect example)	5.10 (1.25)
A promotional campaign for hand hygiene featuring most of the elements mentioned here	5.03 (1.18)
Hand hygiene posters are displayed in patient care areas of the healthcare facility as reminders	4.87 (1.32)
The head of your department regularly includes this topic in his/her main messages to staff	4.87 (1.25)
Healthcare workers receive regular feedback on their compliance with recommended hand hygiene practices	4.82 (1.32)
Revision of common patient care protocols to reduce the frequency of mandatory indications for hand hygiene	4.82 (1.10)
Patients are educated about the importance of hand hygiene during care by healthcare workers and remind them to perform it	4.76 (1.39)

SD = Standard deviation.

Self-reported performance according to types of contact and clinical situations

Perceptions related to hand hygiene according to types of contact and clinical situations were computed by summing up the item responses and dividing by the number of items answered by each participant to achieve scores for each of the variables. Overall, the mean score for self-reported hand cleansing practice was 76.4% (range 30%–100%). A high rate of self-reported hand cleansing practice was reported after exposure to patients' body fluids (97.1 %) and a low rate before touching a patient (57.7 %) (Table 4.11).

TABLE 4.11 Perceptions of hand hygiene according to type of contact and clinical situations

Cognitive Factor	Mean score in the clinical situations (SD)							
	Before touching a patient	After touching a patient	Immediately before touching a clean site during patient care	After exposure to a patient's body fluids	After removing gloves used for patient care	After touching an object in a patient surroun-ding	Between touching two patients sequent-ially	Between touching a patient's groin and subsequent examining his/her eye
Self-reported hand cleaning #	57.7 (2.90)	78 (2.28)	72.8 (2.63)	97.1 (0.93)	88 (1.69)	65.4 (2.54)	63 (3.15)	89.3 (1.67)
Attitude * toward hand hygiene	5.22 (1.40)	5.96 (1.05)	5.73 (1.22)	6.58 (0.84)	6.04 (1.12)	5.13 (1.38)	5.29 (1.54)	6.2 (1.03)
Perception * of ease to comply with hand hygiene	4.75 (1.51)	5.5 (1.26)	5.38 (1.38)	6.18 (1.07)	5.8 (1.22)	4.94 (1.47)	4.79 (1.65)	5.87 (1.26)
Subjective * norms toward hand hygiene	5.24 (1.62)	5.69 (1.31)	5.66 (1.43)	6.48 (0.94)	5.94 (1.26)	5.16 (1.55)	5.4 (1.64)	6.24 (1.08)

0 to 100% in 10% increments; * 7-point bipolar Likert-type scale; SD: Standard deviation.

On the other hand, response scores regarding self-reported hand cleansing performance in different contact and clinical situations revealed concordance with the three perception variables *('attitude toward hand hygiene', 'perception of ease to comply with hand hygiene', and 'perception of superiors toward hand hygiene')*

Variables associated with hand hygiene compliance

Mean scores in clinical situations of (a) perception of the effectiveness of cleansing hands to reduce healthcare-associated infections, (b) perception of the difficulty or ease to cleanse hands, and (c) perception of how much superiors require hand cleansing were calculated into numeric expression. Using Pearson correlation coefficients test, the three perception variables ($p<0.001$) were all associated with the self-reported hand cleansing performance (Table 4.12).

TABLE 4.12 Association between perception variables and samples' self-reported hand cleansing performance

Factor (n=157)	Mean (SD)	Pearson Correlation	*P*-value
Perception of the effectiveness of cleansing your hands to reduce healthcare-associated infections in the clinical situations	5.77 (0.852)	0.502	0.000
Perception of the difficulty or ease to cleanse your hands in the clinical situations	5.40 (0.999)	0.553	0.000
Perception of how much your superiors want you to cleanse your hands in the clinical situations	5.73 (1.041)	0.527	0.000

SD = Standard deviation.

Next, demographics associated with self-reported hand hygiene performance were computed using the Mann-Whitney U and Kruskal-Wallis tests (Table 4.13).

TABLE 4.13 Comparison of samples' demographics with self-reported performance

	Total (n=158)		Test	
Variables	n (%)	Mean ± SD	Statistics	*P*-value
Gender				
Male	35 (22.2)	7.5±1.2	1937.00^{+}	0.367
Female	123 (77.8)	7.7±1.6		
Age (years)				
21-30	62 (39.2)	7.3±1.5	8.725^{++}	0.013
31-40	64 (40.5)	7.6±1.7		
41-50	32 (20.3)	8.3±0.9		
Years since completion of basic professional training				
≤ 5	40 (25.3)	7.1±1.4	14.437^{++}	0.002
6 - 10	58 (36.7)	7.5±1.7		
11 - 15	28 (17.7)	8±1.3		
> 15	32 (20.3)	8.3±1.1		
Years in present institution				
≤ 5	46 (29.1)	7.2±1.3	8.667^{++}	0.034
6 - 10	56 (35.4)	7.7±1.7		
11 - 15	39 (24.7)	7.8±1.6		
> 15	17 (10.8)	8.3±1.1		
Profession				
Nurse	132 (83.5)	7.7±1.6	2.415^{++}	0.299
Doctor	13 (8.2)	7.2±1.2		
Health care assistant	13 (8.2)	7.6±1.3		
Department				
Medicine	62 (39.2)	7.9±1.5	12.224^{++}	0.002
Surgery	57 (36.1)	7.1±1.6		
Intensive Care	39 (24.7)	8.1±1.2		
Past experience of hand hygiene promotional campaign				
Yes	91 (57.6)	7.5±1.5	2754.50^{+}	0.301
No	67 (42.4)	7.8±1.6		
Formal education in hand hygiene after basic training				
Yes	120 (75.9)	7.5±1.6	1733.00^{+}	0.026
No	38 (24.1)	8.2±1.3		

$^{+}$, Mann-Whitney U test; $^{++}$, Kruskal-Wallis test; SD = Standard deviation.

These included age (p=0.013), years since completion of basic training (p=0.002), years in present institution (p=0.034), department (p=0.002), and formal education on hand hygiene after basic training (p=0.026).

Further one-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of age, department, years since completion of basic professional training, and years in present institution on self-reported hand hygiene performance.

Firstly, participants were divided into three groups according to their age (Group 1: 21–30 years; Group 2: 31–40 years; Group 3: 41–50 years). There was a statistically significant difference at the $p<0.05$ level in the self-reported hand hygiene performance score for the three age groups [$F(2, 155)=4.43$, $p=0.013$]. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 1: age 21–30 years ($M=7.3$, $SD=1.5$) was significantly lower ($p=0.008$) from Group 3: age 41–50 years ($M=8.3$, $SD=0.9$). Meanwhile, Group 2: age 31–40 years did not differ significantly from either Group 1 or 3.

Secondly, participants were from three departments (Group 1: Medicine; Group 2: Surgery; Group 3: Intensive care). There was a statistically significant

difference at the $p<0.05$ level in the self-reported hand hygiene performance score for the three departments [$F(2, 155)=7.227$, $p=0.001$]. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 2: Surgery ($M=7.1$, $SD=1.6$) was significantly lower from that of Group 1: Medicine ($M=7.9$, $SD=1.5$, $p=0.008$) and Group 3: Intensive care ($M=8.1$, $SD=1.2$, $p=0.002$).

Thirdly, participants were divided into four groups according to years since completion of basic professional training (Group 1: $\leq$ 5 years; Group 2: 6–10 years; Group 3: 11–15 years; Group 4: > 15 years). There was a statistically significant difference at the $p<0.05$ level in the self-reported hand hygiene performance score for the four-year group since completion of basic professional training [$F(3, 154)=4.92$, $p=0.003$]. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 1: $\leq$ 5 years ($M=7.1$, $SD=1.4$) was significantly lower from that of Group 3: 11–15 years ($M=8$, $SD=1.3$, $p=0.042$) and Group 4: > 15 years ($M=8.3$, $SD=1.5$, $p=0.003$). Meanwhile, Group 2: 6–10 years did not differ significantly from Group 1, 3, or 4. Fourthly, participants were divided into four groups according to

years in the present institution (Group 1: ≤ 5 years; Group 2: 6–10 years; Group 3: 11–15 years; Group 4: > 15 years). There was no significant difference at the $p<0.05$ level in the self-reported hand hygiene performance score for the four-year group in the present institution [$F(3, 154)=2.427$, $p=0.068$].

With these one-way between-groups ANOVA, participants of age group 21 to 30 years, with less than six years post basic training and working in the department of surgery, have a significant lower self-reported hand hygiene performance as compared with the other groups.

A final multiple regression analysis (Table 4.14) was conducted to determine the independent contribution of each factor. All factors that have a significant association with self-reported hand hygiene performance as computed with Pearson correlation coefficients test, Mann-Whitney U test, and Kruskal-Wallis test were included in the model. The model, which included years since completion of basic professional training ($p = 0.021$), perception of difficulty or ease to cleanse hands ($p = 0.001$), and perceptions of how much superiors require hand cleansing in the clinical situation ($p = 0.004$), explained 44% of the variance in the self-reported hand hygiene performance. Of these three independent variables, perception of difficulty or

ease to cleanse hands makes the largest unique contribution (beta=0.286), although years since completion of basic professional training (beta=0.272) and perceptions of how much superiors require hand cleansing in the clinical situation (beta=0.256) likewise made a statistically significant contribution.

TABLE 4.14 Factors associated with samples' self-reported hand hygiene performance (Multiple Regression Analysis), n=156

Factors	Standardized coefficients *Beta*	*Sig.*	95% CI
Characteristics			
Age	-0.41	0.668	-0.464 – 0.298
Years since completion of basic professional training	0.272	**0.021***	0.06 – 0.718
Years in present institution	-0.54	0.596	-0.402 – 0.232
Department	-0.28	0.657	-0.294 – 0.186
Formal education in hand hygiene after basic training	0.12	0.056	-0.11 – 0.866
Perception of the effectiveness of cleansing your hands to reduce healthcare-associated infections in the following clinical situations	0.129	0.148	-0.083 – 0,544
Perception of the difficulty or ease to cleanse your hands in the following clinical situations	0.286	**0.001****	0.19 – 0.682
Perception of how much your superiors want you to cleanse your hands in the following clinical situations	0.256	**0.005****	0.121 – 0.629

* $p < 0.05$; ** $p < 0.001$.

4.3 Findings in the Facilitation Phase

The facilitation phase involved implementation of the hand hygiene program. Based on the results of the exploratory phase, measures were undertaken to improve hand hygiene compliance of healthcare professionals. It consisted of ward-based educational talks (the details of the content were described in Chapter 3), small group conference, slogan competition, and provision of alcohol-based handrub.

4.3.1 Ward-based Educational Talks

A series of eight educational classes in group sessions were provided to the nursing and support staff of the experimental wards by the principal investigator. Details were described in chapter three. Elements incorporated in the teaching presentation were as follows: to reinforce the importance and frequency of hand hygiene; increase staff awareness; provide knowledge; and enhance understanding of healthcare-associated infections and hand hygiene. It was emphasized that staff members were not to use soap and alcohol-based handrub concomitantly to prevent skin damage. During educational talks, it was found that feedback on the findings of the questionnaire and discussion were effective instructional methods as the participants expressed their feelings and attitudes toward hand hygiene practice. It was observed that support from supervisors, involvement of participants, and resistance toward system change were factors pertinent to the conduct of educational talks.

Support

With the supervisors' support, the educational talk was arranged during the staff's 30-minute tea break in their workplace. Over 80% of nursing and support staff of medical ward A and surgical ward C were able to attend. For intensive care ward E, which faced demanding intensive care and unexpected emergencies, attendance reached 63%. In addition, 84% of the medical staff, including their physician-in-charge, attended the educational talk.

Involvement

During the educational sessions, front-line colleagues were invited to be partners in reducing healthcare-associated infections by practicing hand hygiene. No great opposition was noted after the invitation, though several staff members of intensive care ward E claimed, *"We are extremely busy so why choose our ward to be the pilot"*.

Resistance

The facial expression and gesture of several participants during the educational talks communicated their disbelief toward the effectiveness of alcohol-based handrub. A few stayed behind explaining their perception of "clean" hands:

Nurse-A: "I feel my hands are clean after washing with soap and water."

Nurse-B:"Washing hands makes me feel fresher and cleaner."

HCA-A:"Hands are cleaner after washing with soap and water."

Surgeon-A: "It is important to see any increase of infection rate after changing the use of antimicrobial soap to alcohol-based handrub."

The positive part about knowing how colleagues felt about the change of practice to alcohol-based handrub enabled the researcher to maintain a sharper focus on concerns of the staff and clarified information and misconception with an explanation of why change was necessary.

4.3.2 Small group conference

Four small group conferences were conducted with the staff in the three study wards to identify issues that they deemed important to improve hand hygiene and the barriers to the practice. These included the following: (a) difficulties and barriers in the practice of hand hygiene; (b) engagement and cohesiveness; and (c) fear. The need for staff support was perceived during the small group conferences, which were held in the last two weeks of October 2006.

Difficulties and barriers in the practice of hand hygiene

Only the ward manager and infection control link nurse of medical ward A participated in the small group conference. They expressed difficulty in complying with hand hygiene because of understaffing and heavy workload. Time was needed

to perform handwashing; however, there was high workload demand. For example, almost all patients required four hourly vital signs monitoring, and most diabetic patients required four hourly blood glucose checking. Given the intense workload, they perceived the difficulty in hand hygiene compliance. If hand disinfection, which consumed less time than handwashing, was implemented, the handrub dispenser must be installed. However, environmental design and ward congestion made installation of the dispenser difficult.

Engagement and cohesiveness

Seven out of nine (77%) healthcare workers who were on the morning shift in surgical ward C joined the small group conference. Important leaders such as the ward manager, nursing officer, and infection control link nurse participated in the discussion and actively addressed the obstacles to hand hygiene compliance. They agreed that round-care procedures (e.g., changing of napkin, taking of vital signs, and checking of blood glucose) would be their main obstacle to hand hygiene compliance. Participants suggested the need to reorganize the ward routine to maximize individualized patient care and facilitate compliance. The nursing officer commented, "*This is a good chance for us to learn and to improve patient care"*. This illustrated the nursing officer's commitment to improve hand hygiene practice. The engagement and participation of the staff enabled discussion of hand hygiene-related issues, as well as

greater openness in communicating ways to improve the practice.

Fear, the need for staff support

Fourteen nurses and two doctors of intensive care ward E joined the morning and afternoon small group conferences. They expressed concerns related to the replacement of handwashing with alcohol-based handrub. Majority disliked the odor of the alcohol-based handrub. In addition, they worried about potential skin irritation and dryness despite being informed of the addition of the protective ingredient (glycerol). They expressed fear and anxiety toward pocket contamination and fire hazard brought about by carrying the 100 ml alcohol-based handrub in their pocket. Two nurses even attempted to light up the alcohol-based handrub to demonstrate the hazard despite receiving literature provided by the principal investigator on ways to prevent fire incidents. In the end, a number of staff members consented to use the handrub (*Let's us give it a try*") while others claimed that *"No matter what happens, we still have to use the alcohol-based handrub"*.

4.3.3 Slogan Competition

Healthcare workers of both surgical ward C and intensive care ward E participated actively in the slogan competition. Eventually, the slogan

“護理前後要潔手, 愛人愛己要遵守” (“Clean hands before and after care to love oneself and others”) was adopted as a reminder.

4.3.4 Provision of Waterless Alcohol-based Handrub

Ward managers of the experimental wards expressed their appreciation for the benefits of using the alcohol-based handrub. However, they were reluctant to place the alcohol-based handrub within close proximity to the patients for fear of accidental ingestion and fire hazard. After ample explanation and persuasion, the alcohol-based handrub was introduced to the medical ward A and surgical ward C, and simultaneously reintroduced into the intensive care ward where it is used in times of outbreaks.

4.4 Findings in the Evaluation Phase

4.4.1 Second Hand Hygiene Observation

The three raters in the first baseline hand hygiene observation continued to participate in the second hand hygiene observation of the control wards in late October and the experimental wards in early November. A total of 1,297 opportunities warranting hand hygiene were recorded in 94 sessions in 36 hours. Nurses contributing 63.8% of all opportunities while doctors, 20.2%; healthcare assistants, 10.1%; and other healthcare workers, 5.9%. Of 389 actions, 60.7% were handwashing with soap and water while the remaining 39.3% were handrubbing with alcohol-based handrub.

Following interventions such as educational talk, feedback, provision of alcohol-based handrub, slogan competition, and small group conferences in the experimental wards, overall compliance increased significantly (χ^2 80.5, p=0.000) from 18.31% (115/628 opportunities) to 41.6% (265/637 opportunities). For the control wards without intervention, overall compliance decreased significantly (χ^2 8.1, p<0.05) from 25.4% (173/681 opportunities) to 18.78% (124/660 opportunities) (Table 4.15).

TABLE 4.15 Second hand hygiene observation compliance of the experimental and control wards as compared with baseline compliance

Experimental wards	First	Second	Control wards	First	Second
Ward A (Medicine)	14.5	30.2 ** (χ^2 16)	Ward B (Medicine)	24.5	17.5 (χ^2 2.8)
Ward C (Surgery)	11.6	48.3 ** (χ^2 82.7)	Ward D (Surgery)	7.3	12.5 (χ^2 2.7)
Ward E (Intensive care)	29.0	46.2 * (χ^2 5.3)	Ward F (Intensive care)	41.8	26.2 ** (χ^2 11.9)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square.

Compared with baseline observation, nurses (49%, χ^2 79.9, p<0.001) and HCAs (40.6%, χ^2 11.6, p<0.001) of the experimental wards improved hand hygiene practice significantly. Conversely, compliance of nurses (18.7%, χ^2 5.7, p<0.05) and doctors (16.5%, χ^2 9.9, p<0.05) of the control wards decreased significantly (Table 4.16).

TABLE 4.16 Second hand hygiene observation compliance among professional categories of the experimental wards and control wards as compared with baseline compliance

Experimental wards	First	Second	Control wards	First	Second
Nurses	19.0	49.0 ** (χ^2 79.9)	Nurses	25.8	18.7 * (χ^2 5.7)
Doctors	17.5	23.3 (χ^2 0.9)	Doctors	34.1	16.5 * (χ^2 9.9)
Healthcare assistants	11.9	40.6 ** (χ^2 11.6)	Healthcare assistants	11.9	14.9 (χ^2 9.1)
Others	23.7	26.3 (χ^2 0)	Others	21.3	34.2 (χ^2 1.2)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square.

When exploring the professional categories in the experimental wards in comparison to the baseline observation, intensive ward E exhibited the greatest improvement (Table 4.17).

Table 4.17 Comparison of hand hygiene compliance among professional categories of the experimental wards

	% Compliance							
	Nurses		Doctors		HCAs		Others	
	First	Second	First	Second	First	Second	First	Second
Ward A (MED)	12.2	33.9** (χ^2 16)	20.9	11.9 (Fisher's exact)	16.0	30.8 (Fisher's exact)	13.3	50.0* (Fisher's exact)
Ward C (SRG)	11.5	66.9** (χ^2 82.7)	7.3	11.4 (Fisher's exact)	8.7	42.3** (Fisher's exact)	33.3	0.0* (Fisher's exact)
Ward E (ICU)	32.2	46.2* (χ^2 5.3)	23.8	46.5* (χ^2 3.8)	9.1	58.3* (Fisher's exact)	27.3	30.0 (Fisher's exact)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square; MED = Medicine; SRG = Surgery; ICU = Intensive care; HCAs = Healthcare assistants.

Compared with baseline observation, the indications for hand hygiene compliance were enhanced significantly in the experimental wards (Table 4.18), but not in the control wards (Table 4.19).

TABLE 4.18 Second observation compliance among the indications for hand hygiene in the experimental wards as compared with baseline compliance

	% Compliance in Experimental wards				
	BEF-PAT	AFT-PAT	BEF-ASP	AFT-BFL	AFT-SUR
First	10.4	18.8	9.9	34.2	7.1
Second	34.9** (χ^2 30.5)	48.6** (χ^2 34.7)	24.7** (χ^2 6.8)	50.7** (χ^2 7.5)	50.0* (Fisher's exact)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square; BEF-PAT = Before touching a patient;
AFT-PAT = After touching a patient; BEF-ASP = Before clean / aseptic procedure;
AFT-BFL = After body fluid exposure risk; AFT-SUR = After touching patient surroundings.

TABLE 4.19 Second observation compliance among the indications for hand hygiene in the control wards as compared with baseline compliance

	% Compliance in Control wards				
	BEF-PAT	AFT-PAT	BEF-ASP	AFT-BFL	AFT-SUR
First	8.7	23.3	12.9	53.5	28.5
Second	5.8 (χ^2 0.7)	18.3 (χ^2 1.1)	4.7* (χ^2 3.9)	37.7** (χ^2 8.7)	30.0 (Fisher's exact)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square; BEF-PAT = Before touching a patient;
AFT-PAT = After touching a patient; BEF-ASP = Before clean / aseptic procedure;
AFT-BFL = After body fluid exposure risk; AFT-SUR = After touching patient surroundings.

4.4.2 Handrubbing Practice

Among all hand hygiene actions, the percentage of practicing handrubbing increased significantly in all experimental wards after the system change with the use of the waterless alcohol-based hancrub product (Table 4.20).

TABLE 4.20 Percentage of handrub practice among all hand hygiene actions in the experimental wards

	No. of Hand hygiene actions				% of Handrubbing among hand hygiene actions	
	Handwashing		Handrubbing			
	First	Second	First	Second	First	Second
Ward A	31	30	0	34	0	53.13** (Fisher's exact)
Ward C	24	23	0	82	0	78.10** (Fisher's exact)
Ward F	55	66	6	30	9.83	31.25* (χ^2 8.5)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square.

4.5 Summary of Findings

The first action research cycle revealed low baseline hand hygiene compliance and the perception of healthcare workers toward healthcare-associated infections and hand hygiene. The program, which included ward-based education, change in the practice of using alcohol-based handrub, small group discussion, and slogan competition provided to the experimental wards, resulted in significantly improved hand hygiene compliance. Throughout the interventions, support and engagement from supervisors and participants were perceived. Meanwhile, disbelief, worries, and fear of the use of alcohol-based handrub were identified.

CHAPTER FIVE

RESULTS OF SECOND AND THIRD RESEARCH CYCLES

5.1 Findings in the Second Action Research Cycle

In the second action cycle, the program was extended to the whole hospital, including the three control wards, in light of the findings from the first cycle.

Similar to cycle one, the hand hygiene program in the facilitation phase consisted of conducting talks to the staff; in cycle two, instead of ward-based teaching, the talks were given to all hospital staff. Alcohol-based handrub was supplied to all hospital staff and, based on the slogan of the previous cycle, carton posters were displayed at eye level in hand cleansing areas. In the evaluation phase, the program aimed to evaluate the sustainability of hand hygiene in the experimental wards and overall effectiveness of the hand hygiene enhancement program in the six study wards.

5.1.1 Individual Consultation

In January 2007, a total of 34 respondents (29 nurses, four HCAs, and one doctor) representing one quarter of the staff in the experimental wards participated in the individual consultation during work hours when they were available. They were asked regarding their perception of the program, particularly on the use of alcohol-based handrub.

Acceptance on the use of new alcohol-based handrub

Twenty-two participants (64.7%) claimed that their acceptance of using alcohol-based handrub increased to over 50%, while 19 (56%) reported increased usage. The main reasons for acceptance and usage were accessibility (31, or 91.2%) and less time consumed (22, or 64.7%).

Quality improvement of the hand antiseptic product

Twenty-eight respondents (82.4%) commented that the alcohol-based handrub could be improved in terms of odor (41.2%), drying effect (29.4%), and texture (2.94%). Several were concerned about pocket contamination when 100 ml alcohol-based handrub was placed in their pocket, and expressed their preference for a spray nozzle (17.7%). Moreover, they would like the volume to be reduced to 50 ml (23.5%) or the bottle to become thinner and taller (8.8%).

Ownership of the hand hygiene promotion project

Twenty-three respondents (67.6%) understood that the patient care process must be readjusted to enhance hand hygiene practice. This included placing the alcohol-based handrub at the point of care (29.4%), breaking round care procedures (20.6%), grouping caring activities (17.6%), reorganizing ward routine (2.9%), delineating providers' roles and responsibilities (2.9%), and improving patient-to-nurse ratio (2.9%). Nonetheless, almost all believed that these changes required advice from

supervisors and support from top leaders. Moreover, cultivating a culture of appropriate hand hygiene practice required time.

5.1.2 Third Hand Hygiene Observation

From March to May 2007, hand hygiene observation was continued by the same raters in the six study wards (three experimental and three control groups), as these wards have the baseline and follow-up observation data for comparison. A total of 1,294 opportunities were recorded in 138 sessions within 46 hours and 25 minutes. Similarly, nurses contributing 63.2% of all opportunities while doctors, 20.2%; healthcare assistants, 11%; and other healthcare workers, 5.6%. Of 389 actions, percentage of using alcohol-based handrub to disinfect the hands increased to 41.3 while the remaining 58.7 were handwashing with soap and water.

Differences in hand hygiene compliance among study sites

Compared with the baseline observation, compliance in the experimental wards improved steadily (p=0.000) to 44.4% (293/660 opportunities). After provision of hospital-based educational talk and alcohol-based handrub, compliance of control wards was enhanced slightly to 25.6% (162/634 opportunities). Notably, the experimental surgical ward C consistently yielded the best performance at 48.9% (114/233). It must be noted that among the control wards, only the intensive ward F recorded compliance that improved significantly (χ^2 17.9,

p<0.001) from 26.2% to 46.2% (Table 5.1). The other two wards did not exhibit any significant differences.

TABLE 5.1 Third hand hygiene observation compliance among the six study wards

	% Compliance						
Experimental wards	First	Second	Third	Control wards	First	Second	Third
Ward A	14.5	30.2	36.6 (χ^2 1.7)	Ward B	24.5	17.5	19.4 (χ^2 0.68)
Ward C	11.6	48.4	48.9 (χ^2 0.0004)	Ward D	7.3	12.5	10.7 (χ^2 0.18)
Ward E	29.0	46.2	47.4 (χ^2 0.02)	Ward F	41.8	26.2	46.2** (χ^2 17.89)

** $p < 0.001$; χ^2 = Chi-square.

No significant improvement was observed in the experimental wards when compared with compliance among professional categories in the second hand hygiene observation. For the control wards, significant improvement was found in the nurses' group, which climbed from 18.7% to 25.7% (χ^2 p<0.05) (Table 5.2).

TABLE 5.2 Third hand hygiene observation compliance among professional categories as compared with the second observation

	% Compliance						
Experimental wards	First	Second	Third	Control wards	First	Second	Third
Nurses	19.0	49.0	53.0 (χ^2 0.28)	Nurses	25.8	18.7	25.7* (χ^2 5.4)
Doctors	17.5	23.3	22.4 (χ^2 0.98)	Doctors	34.1	16.5	26.6 (χ^2 3.3)
HCAs	11.9	40.6	37.7 (χ^2 0.85)	HCAs	11.9	14.9	16.9 (χ^2 0.005)
Others	23.7	26.3	41.7 (χ^2 0.25)	Others	21.3	34.2	36.1 (χ^2 0.005)

* $p < 0.05$; χ^2 = Chi-square; HCAs = Healthcare assistants.

Compliance varied by indication for hand hygiene (Table 5.3). When compared with the second hand hygiene observation, experimental wards performed well in "after blood fluid exposure risk" (62.4%), while control wards exhibited significant improvement ($p<0.05$) "before touching a patient" (15.1%), "after touching a patient" (29.5%), and "before clean/aseptic procedure" (13.6%).

TABLE 5.3 Third hand hygiene observation compliance among the indications for hand hygiene as compared with the second observation

	% Compliance						
Experimental wards	First	Second	Third	Control wards	First	Second	Third
BEF-PAT	10.4	34.9	31.6 (χ^2 0.31)	BEF-PAT	8.7	5.8	15.1* (χ^2 6.3)
AFT-PAT	18.8	48.6	43.2 (χ^2 1.06)	AFT-PAT	23.3	18.3	29.5* (χ^2 4.2)
BEF-ASP	9.9	24.7	35.6 (χ^2 2.0)	BEF-ASP	12.9	4.7	13.6* (χ^2 4.7)
AFT-BFL	34.2	50.7	62.4 (χ^2 3.8)	AFT-BFL	53.5	37.7	39.6 (χ^2 0.07)
AFT-SUR	7.1	50.0	66.7 (Fisher's exact)	AFT-SUR	28.5	30.0	23.1 (Fisher's exact)

$p < 0.05$; χ^2 = Chi-square; BEF-PAT = Before touching a patient; AFT-PAT = After touching a patient; BEF-ASP = Before clean / aseptic procedure; AFT-BFL = After body fluid exposure risk; AFT-SUR = After touching patient surroundings.

After the provision of alcohol-based handrub to all clinical areas that never adopted it previously, with the exception of intensive care wards in times of outbreak, hand hygiene practice increased significantly in the control wards (Table 5.4) and was practiced continuously in the experimental wards (Table 5.5)

TABLE 5.4 Percentage of handrub practice among all hand hygiene actions in the control wards

Control wards	No. of Hand hygiene actions						% of Handrubbing among hand hygiene actions		
	Handwashing			Handrubbing					
	First	Second	Third	First	Second	Third	First	Second	Third
Ward B	52	39	36	0	0	6	0	0	14.3* (Fisher's exact)
Ward D	1	27	16	0	0	6	0	0	18.2* (Fisher's exact)
Ward F	93	51	65	8	7	33	7.9	12.1	33.7* (χ^2 7.8)

* $p < 0.05$; χ^2 = Chi-square.

TABLE 5.5 Percentage of handrub practice among all hand hygiene actions in the experimental wards

Exper-mental wards	No. of Hand hygiene actions						% of Handrubbing among hand hygiene actions		
	Handwashing			Handrubbing					
	First	Second	Third	First	Second	Third	First	Second	Third
Ward A	31	30	36	0	34	43	0	53.1	53.3
Ward C	24	23	34	0	82	80	0	78.1	70.2
Ward E	55	66	80	5	30	20	9.8	31.3	20.0

5.1.3 Summary of Findings in the Second Action-Research Cycle

Overall, the control wards after interventions such as hospital-based educational talk, provision of alcohol-based handrub, and poster display did not produce a considerable improvement in hand hygiene compliance. This phenomenon enlightened the principal investigator

that even increasing the availability and accessibility of hand hygiene facilities will not automatically lead to compliance.

Conversely, through individual consultation with participants of the experimental wards, acceptance of the use of alcohol-based handrub, ownership of the project, and suggestions to improve the quality of antiseptic product were found to be the main factors that can assist in sustaining compliance.

5.2 Findings in the Third Action Research Cycle

Due to poor outcome in the study wards as shown in Table 5.1, the implementation process of the enhancement program was reexamined. With feedback obtained from the staff, another cycle was undertaken.

In the facilitation phase, after a discussion with the participants, the rate of attendance of the educational talk was found to be less than satisfactory as it was hospital-based. Therefore, the principal investigator visited all department operational managers (DOMs) and explained to them the necessity of providing mandatory intensive hand hygiene talk to all nursing and support staff. All DOMs supported the proposal; several preferred the talk to be conducted during the working shift while a few suggested holding it after duty or between shifts.

A total of 57 educational sessions for eight departments *(surgery, 17; orthopedic, 10; pediatric, 8; medicine, 7; intensive care, 7; accident and emergency,*

4; obstetric and gynecology, 2; private and mixed, 2) were delivered between late May and October 2007. The hand hygiene program was conducted again; details of the mandatory intensive hand hgyiene talk, scenario description, and concurrent clarification immediately after observation were described in Chapter 3. For assessment in the evaluative phase, it was conducted by means of observation and evaluation survey.

5.2.1 Fourth hand hygiene observation

From October to December 2007, hand hygiene observation was continued by the same raters in the six study wards. A total of 1,342 opportunities warranting hand hygiene were recorded in 145 sessions in 39 hours and 20 minutes. Nurses contributing 63.6% of all opportunities while doctors, 19.6%; healthcare assistants, 10.9%; and other healthcare workers, 5.9%. Overall hand hygiene compliance was 54% (725/1342). Among 725 actions, 520 (71.7%) were completed by rubbing hands with alcohol-based handrub.

Hand hygiene compliance was significantly improved ($p<0.001$) in Wards A, B, D, and F when compared with the third hand hygiene observation (Table 5.6).

TABLE 5.6 Fourth hand hygiene observation compliance among the six study wards as compared with third observation

	% Compliance			
Study wards	First	Second	Third	Fourth
Ward A (experimental)	14.5	30.2	36.6	53.6 * (χ^2 4.4)
Ward B (control)	24.5	17.5	19.4	37.1 * (χ^2 8.8)
Ward C (experimental)	11.6	48.4	48.9	53.8 (χ^2 0.3)
Ward D (control)	7.3	12.5	10.7	52.7 ** (χ^2 43.2)
Ward E (experimental)	29.0	46.2	47.4	50.3 (χ^2 0.06)
Ward F (control)	41.8	26.2	46.2	72.4 * (χ^2 8.1)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square.

With pooled results, overall hand hygiene compliance of the experimental wards was significantly improved (p<0.001) in the second third and fourth observations when compared with the first observation. For the control wards, only the fourth observation result was remarkably improved and significantly increased (p<0.001) when compared with the baseline observation (Table 5.7).

TABLE 5.7 Hand hygiene compliance among the experimental and control wards

	% Compliance			
Study wards	First	Second	Third	Fourth
Experimental wards	18.3	41.6 ** (χ^2 80.5)	44.4 ** ($\chi^2$99.9)	52.6 ** (χ^2 162.1)
Control wards	25.4	18.8 * (χ^2 8.1)	25.6 (χ^2 0.000003)	55.3 ** (χ^2 126.4)

* $p < 0.05$ (significantly decreased); ** $p < 0.001$ (significantly increased); χ^2 = Chi-square.

Change in hand hygiene compliance among professional categories of all study wards is shown in Table 5.8. Compared with the third observation result, significant improvement was noted mostly in the

nursing and support staff of the study wards, as these two groups received the mandatory intensive educational talk.

TABLE 5.8 Fourth hand hygiene observation compliance among professional categories of the six study wards as compared with the third observation

		% Compliance			
Ward	Professionals	First	Second	Third	Fourth
A	Nurses	12.2	33.9	46.6	54.4 (χ^2 1.3)
	Doctors	20.9	11.9	4.6	23.1* (Fisher's exact)
	HCAs	16.0	30.8	25.0	93.3** (Fisher's exact)
	Others	13.3	50.0	69.2	47.1 (Fisher's exact)
B	Nurses	25.4	18.1	20.8	41.8** (χ^2 12.9)
	Doctors	36.6	4.7	27.7	18.0 (χ^2 0.6)
	HCAs	7.7	24.0	0.0	53.9** (Fisher's exact)
	Others	13.3	45.5	20.1	13.3 (Fisher's exact)
C	Nurses	11.5	66.9	64.1	69.6 (χ^2 0.7)
	Doctors	7.3	11.4	23.4	18.0 (χ^2 0.2)
	HCAs	8.7	42.3	28.1	82.8** (χ^2 16.5)
	Others	33.3	0.0	25.0	23.8 (Fisher's exact)
D	Nurses	4.6	10.0	11.5	62.9** (χ^2 72.2)
	Doctors	11.6	18.6	7.5	15.0 (Fisher's exact)
	HCAs	12.9	6.9	8.7	57.1** (Fisher's exact)
	Others	7.7	28.6	16.7	60.0* (χ^2 18.2)
E	Nurses	32.2	46.2	47.9	50.4 (χ^2 8.9)
	Doctors	23.8	46.5	39.5	35.9 (χ^2 0.01)
	HCAs	9.1	58.3	76.5	70.0 (Fisher's exact)
	Others	27.3	30.0	27.3	80.0 (Fisher's exact)
F	Nurses	44.0	27.0	43.1	81.7** (χ^2 52.2)
	Doctors	52.1	25.5	43.9	54.8 (χ^2 0.2)
	HCAs	14.8	15.4	69.2	61.9 (Fisher's exact)
	Others	36.8	30.8	64.3	32.0 (χ^2 2.6)

* $p < 0.05$; ** $p < 0.001$; χ^2 = Chi-square; HCAs = Healthcare assistants.

TABLE 5.9 Fourth hand hygiene compliance among the indications for hand hygiene in the six study wards as compared with the third observation

		% Compliance			
Ward	Indications	First	Second	Third	Fourth
A	BEF-PAT	6.3	25.8	20.8	21.3 (χ^2 0.03)
	AFT-PAT	14.3	32.8	37.8	58.1* (χ^2 5.3)
	BEF-ASP	0.0	14.7	25.0	56.1* (χ^2 5.3)
	AFT-BFL	34.6	42.6	70.0	77.2 (χ^2 0.3)
	AFT-SUR	0.0	0.0	50.0	14.3 (Fisher's exact)
B	BEF-PAT	7.7	3.3	11.3	13.2 (χ^2 0.0007)
	AFT-PAT	10.0	12.5	25.0	43.3* (χ^2 3.9)
	BEF-ASP	10.7	5.0	8.1	35.0* (Fisher's exact)
	AFT-BFL	70.0	47.4	30.9	47.1 (χ^2 2.3)
	AFT-SUR	33.3	0.0	0.0	43.8 (Fisher's exact)
C	BEF-PAT	3.0	46.1	36.1	48.7 (χ^2 1.7)
	AFT-PAT	9.3	50.6	46.3	60.2 (χ^2 2.1)
	BEF-ASP	12.1	33.3	39.0	62.9 (χ^2 3.4)
	AFT-BFL	28.3	57.1	65.8	73.0 (χ^2 0.3)
	AFT-SUR	0.0	66.7	75.0	46.2 (Fisher's exact)
D	BEF-PAT	0.0	0.0	1.8	32.6** (Fisher's exact)
	AFT-PAT	5.2	7.3	10.5	59.7** (Fisher's exact)
	BEF-ASP	0.0	1.9	7.0	46.3** (Fisher's exact)
	AFT-BFL	24.5	29.1	20.9	61.9** (χ^2 16.9)
	AFT-SUR	0.0	0.0	0.0	60.9 (Fisher's exact)
E	BEF-PAT	25.0	29.6	44.7	43.1 (χ^2 2.8)
	AFT-PAT	35.4	59.7	45.7	61.8 (χ^2 3.5)
	BEF-ASP	15.6	29.0	42.9	54.4 (χ^2 0.4)
	AFT-BFL	38.6	55.3	53.3	65.4 (χ^2 1.2)
	AFT-SUR	20.0	50.0	0.0	25.0 (Fisher's exact)
F	BEF-PAT	19.4	13.5	34.7	63.5* (χ^2 10.4)
	AFT-PAT	45.2	31.3	43.3	70.7* (χ^2 10.6)
	BEF-ASP	28.6	9.1	30.0	66.7* (χ^2 4.7)
	AFT-BFL	64.2	39.7	66.2	100.0** (Fisher's exact)
	AFT-SUR	66.7	33.3	37.5	0.0 (Fisher's exact)

$p < 0.05$; χ^2 = Chi-square; BEF-PAT = Before touching a patient; AFT-PAT = After touching a patient; BEF-ASP = Before clean / aseptic procedure; AFT-BFL = After body fluid exposure risk;
AFT-SUR = After touching patient surroundings.

Table 5.9 presents compliance in different indications for hand hygiene. Sustained improvement was noted in “before clean/aseptic procedure”, “after body fluid exposure risk”, and “after touching a patient”. On the contrary, poor hand hygiene was persistently found in the indication of “before touching a patient”.

Using alcohol-based handrub to disinfect the hands increased significantly in all study wards in the fourth hand hygiene observation and was currently the main hand hygiene practice (Table 5.10).

TABLE 5.10 Percentage of handrub practice among all hand hygiene actions in the six study wards

	No. of Hand hygiene actions								% of Handrubbing among hand hygiene actions			
	Handwashing				Handrubbing							
Ward	First	Second	Third	Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth
A	31	30	36	35	0	34	43	78	0	53.1	54.4	69 (3.64)
B	52	39	36	35	0	0	6	47	0	0	14.3	** 57.3 (19.3)
C	24	23	34	12	0	82	80	115	0	78.1	70.2	** 90.6 (14.9)
D	1	27	16	28	0	0	6	79	0	0	18.2	** 73.8 (15.6)
E	55	66	80	49	5	30	20	53	9.83	31.2	20	** 52 (20.9)
F	93	51	65	46	8	7	33	148	7.92	12.1	33.7	** 76.3 (48.4)

** $p < 0.001$; ( ) = Chi-square.

5.2.2 Program Evaluation Survey

Around 200 program evaluation survey forms were placed by the principal investigator on the nursing counter of the six study wards. The participants were instructed to complete and return the accomplished survey forms to the ward managers during their working shift, and the forms were collected in person by the principal investigator. In the end, a total of 142 healthcare workers (109 nurses, 10 doctors, and 23 healthcare assistants) participated in the program evaluation survey, with a response rate of 78.9% (142/180).

Results of feedback on participation of the hand hygiene promotion program were shown in Table 5.11.

TABLE 5.11 Evaluation Results of the hand hygiene promotion program

Items of questionnaire	Results
How important is hand hygiene educational talk in helping one to understand the risk of transmitting hospital-acquired infection?	Mean Score 5.48 (seven-point bipolar scale)
Which elements of the talk convince one that alcohol-based handrub is better?	1. Effectiveness of alcohol in bacterial reduction (69%) 2. Solution to time constraint obstacle (56.3%) 3. Ways of transmission of pathogens via hands (44.4%) 4. Why, what, when and how to perform hand hygiene (39.4%) 5. Major obstacle for hand hygiene (30.3%)
How effective is feedback in increasing your hand hygiene practice?	Mean Score 4.99 (seven-point bipolar scale)
How useful are posters in reminding one to observe hand hygiene?	Mean Score 4.3 (seven-point bipolar scale)
How useful is “scenario description of when to perform hand hygiene” in improving practice?	Mean Score 4.8 (seven-point bipolar scale)

How often do the supervisors remind one to observe hand hygiene?	Mean Score 59.9 (0 to 100%)
How often do the patients remind one to observe hand hygiene?	Mean Score 9.3% (0 to 100%)
How much of one's own hand hygiene performance can affect others?	Mean Score 60.9% (0 to 100%)
What percentage of handrubbing is used in performing hand hygiene after introduction of handrub?.	Mean Score 68.5% (0 to 100%)
How important do alcohol-based handrub make hand hygiene easier to practice?	Mean Score 5.3% (seven-point bipolar scale)
What is the biggest barrier preventing one from performing hand hygiene?	1. Perception of acquiring skin damage (32%) 2. Busy workload (26.8%)
Which incentive would increase hand hygiene in ward unit?	1. Reducing infection (59.6%) 2. Increased accessibility (16.7%) 3. Quality of hand hygiene facilities (8.3%) 4. Encouragement and support (8.3%) 5. Money reward (4.8%) 6. Adequate manpower (2.4%)
What can one learn from participation in the hand hygiene program?	1. Importance of hand hygiene practice to prevent transmission of infection to protect themselves and patients (40.1%) 2. Change in increasing the use of AHR and perform more HH (28.9%) 3. Advantages of performing handrubing with AHR (21.2%)
Comments or suggestions	1. Supply hand cream (30.3%) 2. Need time to cultivate the hand hygiene practice into a habit (24.2%)

Factors that drive or restrain the hand hygiene practices were identified as follows:

Understanding

A total of 107 (75.35%) participants stated that the hand hygiene educational talk (mean score of 5.48) was important in assisting their understanding of the risk of transmitting

healthcare-associated infections. The information that persuaded the participants to practice handrubbing with alcohol-based product were its effectiveness in bacterial reduction (69%) and bypass time constraint factor (56.3%); these made hand hygiene easier to practice (mean score of 5.31). Ninety-seven (68.3%) participants claimed that they were currently practicing handrubbing with the alcohol-based product in patient care. Additionally, 94 (66.2%) participants considered performance feedback (mean score of 4.99) effective in enhancing hand hygiene practice.

Reinforcing hand hygiene through reminders

Respondents claimed that "scenario description" (60.6%, mean score of 4.8) and poster display (44.4%, mean score of 4.3) were useful interventions in reminding one to observe good hand hygiene. Eighty (56.3%) participants stated that their supervisors and peers frequently (>50%) advised, reinforced, motivated, and reminded them to observe hand hygiene in their daily work. By contrast, 92 (64.8%) respondents claimed that patients never reminded them to cleanse hands before touching them.

'Skin damage', the main barrier to hand hygiene practice

The main barrier that prevented one from observing good hand hygiene was the perception of acquiring skin damage (32%), followed by a busy workload (26.8%). Basically, 48% of the

barriers were at the individual level (e.g., lack of knowledge, personal preference), 36.7% at the group level (e.g., understaffing, working in critical care), while the remaining percentage was at the institutional level (e.g., lack of suitable hand hygiene agents, lack of hand hygiene facilities).

‘Provide skin lotion’, the request to prevent skin damage

Forty-three (30.3%) respondents appealed for access to moisturizing lotion to protect their hands while actively complying with hand hygiene recommendations. This request correlated with the barrier to and incentive in preventing and motivating one to act, respectively. Twenty-six participants (18.3%) claimed that using an alcohol-based handrub was a good concept, but quality of the actual product provided to them required improvement in terms of odor, dryness, and texture. Moreover, the skin-care lotion should be readily available, accessible, and be free of charge.

‘Reduce infection’, the great incentive to practice hand hygiene

The major incentive that motivated one to observe good hand hygiene was its effectiveness in reducing infection (59.6%). Other incentives included increased accessibility (16.7%), improved quality of hand hygiene facilities to protect hands (8.3%), encouragement and support (8.3%), monetary rewards (4.8%), and adequate manpower (2.4%).

‘Importance of practicing hand hygiene’

Fifty-seven (40.1%) respondents stated that the most salient message learnt throughout the program was the increased understanding of the ‘importance of good hand hygiene practice’ to prevent transmission of infection to protect themselves, patients, and others. Among them, 41 respondents (28.9%) accepted the system change of using the alcohol-based handrub, with 15 (28.9%) integrating the change of practice into new patterns of hand hygiene practice.

‘Time to cultivate’, the promising note to enhance hand hygiene

Thirty-four participants (24%) claimed that the program was effective and advantageous for both the staff and patients in terms of safety. These participants encouraged the program coordinators to reinforce the new patterns of hand hygiene behavior until the practice is consolidated. In addition, 17 respondents (12%) suggested that education and performance feedback interventions should be pursued as a reminder on hand hygiene compliance.

5.2.3 Summary of Findings in the Third Action-Research Cycle

The following was effective in sustaining and enhancing hand hygiene behavior of both the nursing and support staff: revision of interventions such as mandatory intensive educational talk, ‘scenario description’, and concurrent clarification immediately after observation when the

provider's concept appeared to deviate from when to observe hand hygiene. The program evaluation results revealed the importance of education and scenario description in enhancing the understanding of what, why, how, and when to observe proper hand hygiene. Furthermore, performance feedback and poster display interventions were evaluated as effective in reminding one to observe proper hand hygiene.

5.3 Outcome Measures

The primary outcome of this study was to enhance healthcare workers' hand hygiene compliance. With the initial promotion of hand hygiene to the three experimental wards and subsequently to the whole hospital, overall institutional hand hygiene compliance as sampling from the six study wards improved from 24.3% in 2006 to 57.8% in 2008 and 67.5% in 2009.

The secondary outcome was the alcohol-based handrub usage. The annual amount of alcohol-based handrub solution used rose markedly from 2 liters per 1,000 patient-days in 2006 to 19 liters in 2007, 25 liters in 2008, and 27 liters in 2009. Additionally, the use of alcohol-based handrub was proved to be less costly than the existing use of anti-microbial soap. Table 5.12 illustrates that the introduction of alcohol-based handrub in lieu of anti-microbial soap resulted in savings of approximately US$12,800 in 2007, US$31,000 in 2008, and US$20,500 in 2009.

TABLE 5.12 Cost effectiveness over existing alternatives

Cost Effectiveness						
	Cost (HKD)					
Year	Anti-microbial soap	Hand detergent	Alcohol-based handrub	Paper towel	Total Cost HKD (US$)	Save HKD (US$) as compared with year 2006
2006	448,800	54,000	38,066	1,208,529	1,749,395 (224,281)	-------
2007	78,600	156,336	245,091	1,169,622	1,649,649 (211,493)	99,746 (12,788)
2008	-------	149,310	326,347	1,032,534	1,508,191 (193,358)	241,204 (30,923)
2009	-------	168,396	357,174	1,063,999	1,589,569 (203,791)	159,826 (20,490)

HKD = Hong Kong dollars; US = United States.

5.4 Summary

The continuous spiral processes in the three action research cycles have resulted in significant improvement in hand hygiene compliance with increased usage of alcohol-based handrub. Furthermore, cost savings in Table 5.12 has demonstrated that investment in infection control is highly cost-effective.

CHAPTER SIX

DISCUSSION

6.1 Introduction

The study was undertaken with the purpose of understanding the process of improving hand hygiene compliance among healthcare workers in an acute hospital setting using an action research framework. This chapter will discuss the findings and expound on the practical, theoretical, and research implications of the study. The discussion examined the contributions of the research and objectives of the study to the field of hand hygiene. The second section established the importance of this study to action research as a methodology.

6.2 Overview of Significant Findings

6.2.1 Baseline Hand Hygiene Compliance before Intervention

Baseline hand hygiene compliance among healthcare workers was 22%. Compared to a Hong Kong study conducted by Lam et al. (2004), with a compliance rate of 40%, the compliance rate of the present study was considerably lower. There were two plausible reasons behind the differences between the present one and Lam's study. First, the setting for the latter was the neonatal intensive care unit (NICU) while that for the former included medical, surgical, and intensive care unit (ICU). Second, patient-to-nurse ratio varied. Internationally, our baseline hand hygiene compliance was comparable with most countries such as the

following: Argentina, where average compliance in three hospitals was 16.5% (Rosenthal et al., 2003); United States of America, where baseline compliance in shock trauma ICU yielded 20% (Thomas et al., 2005); Spain, where mean compliance in a tertiary hospital was 20% (Novoa et al., 2007); Tuscany, where overall compliance in five hospital units was 31.5% (Saint et al., 2009); and Australia, where compliance in the ICU was 33% (Rose et al., 2009).

Compliance rates among professionals were quite similar, except for healthcare assistants who have a lower rate of compliance (11.9%) compared to other healthcare workers such as doctors (26%), nurses (22.5%), and others (22.4%). Another point that merits concern was compliance to hand hygiene performance "before touching a patient" (9.5%) and "before clean/aseptic procedure" (11.3%), which were comparatively low among different procedures. According to Whitby et al. (2007), a possible explanation was that first contact with a patient, such as shaking hands or taking observations, was perceived to be a common social interaction.

Low compliance was observed in areas with high patient-to-nurse ratio, high intensity of patient care, and procedures performed in rounds such as napkin rounds and observation rounds. These round care procedures in particular invited non-compliance as one may not be keen on walking a distance to wash hands and return to the next bed patient to resume their work. In fact, these round care procedures were performed

mostly by healthcare assistants who explained further why they have lower hand hygiene compliance compared with other professionals.

6.2.2 Determinants of Hand Hygiene among Healthcare Workers

From the questionnaire survey, the three independent variables with the most significant association with self-reported hand hygiene practice were found to be the following: (a) years since completion of basic professional training; (b) perception of difficulty or ease to cleanse hands; and (c) perception of how much superiors expect one to cleanse hands in the clinical situation.

Of these variables, perception of difficulty or ease to cleanse hands makes the largest unique contribution demonstrating that system change through introducing the use of alcohol-based handrub is important in enhancing behavioral control (Pessoa-Silva et al., 2005; Pittet et al., 2004). The other independent variable, subjective norms, have been supported vastly as well (Pessoa-Silva et al., 2005; Pittet et al., 2004; Sax, Uckay et al., 2007; Tai, Mok, Ching, Seto & Pittet, 2009; Whitby et al., 2007) as an important cognitive factor influencing one to manifest good hand hygiene behavior. Based on the same questionnaire studying four acute hospitals in Hong Kong including the present context, the principal investigator and others (Tai et al., 2009) have postulated that autonomy of physicians in the Hong Kong society and nurses as females were more influenced by their superior's expectations, were the plausible explanation of why subjective norms were the

consistent factor identified in both the doctors' and nurses' groups. With these, the intention of healthcare workers was influenced much by how they perceived the hand hygiene antiseptics at the point of care for easy control and, how they perceived the opinions of important referent others toward the practice. Another independent variable, years since completion of basic professional training in especially less than or equal to five years, may reflect a knowledge deficit or a lack of right attitude toward hand hygiene (Tai et al., 2009). Thereby, education, system change and role modeling in influencing others were integral part of the program in promoting hand hygiene.

6.3 Effective Strategies to Change Hand Hygiene Behavior

Interventions are required to advance the application of evidence by healthcare workers to improve hand hygiene. In this study, educational talk, feedback, system change through provision of alcohol-based handrub, and poster display were conducted initially to the experimental group to test for effectiveness before being rolled out to other hospital areas. The rationale in adopting these interventions was that these interventions encompassed the predisposing, enabling, and reinforcing factors of the PRECEDE model (Green et al., 1980) to motivate, facilitate, and sustain behavioral change. Likewise the study findings supported that factors affecting behavior fall under three categories, each of which had a different type of influence on behavior. The first category, comprising predisposing factors, was described by Green and Kreuter (1991) as antecedents to behavioral change, providing the rationale or motivation for the behavior; these included knowledge, attitudes, beliefs, values, and

perceived needs and abilities. This was reflected when hand hygiene compliance varies significantly among healthcare workers within the same ward, suggesting that individual factors such as social cognitive and psychological determinants (i.e., knowledge, attitude, intentions, beliefs, and perceptions) could play a role in determining behavior. Enabling factors constituted the second category, being antecedents to behavioral or environmental change that allowed a motivation or environmental policy to be realized; these included the availability, accessibility, and affordability of resources. In this study, hospital support in providing alcohol-based handrub for the whole hospital showed institutional priority for hand hygiene. Moreover the time-saving effects and access to acceptable alcohol-based handrub did affect change in hand hygiene behavior. Reinforcing factors accounted for the third category, being factors that follow a behavior that provided reward or incentive for the persistence of behavior; these included peer influence, and advice and feedback from healthcare providers.

Larson, Bryan et al. (1997) used the PRECEDE model to design multifaceted interventions with significant improvements during the study. However, compliance rate reverted to the baseline within two months. In the current study, multimodal interventions based on the PRECEDE model appeared to improve in experimental wards but not in control wards despite the extension of interventions to the whole institution. With further intensive and ongoing efforts addressing the components of PRECEDE model (predisposing, enforcing, reinforcing), sustained improvement in experimental wards and significant improvement in the control wards were recorded. In particular,

active involvement of the staff was of crucial importance to the success of the program. All these illustrated that application of the PRECEDE model was effective when planning the multimodal interventions in improving hand hygiene behavior. This was because with the use of PRECEDE model, the investigator appraised both objective and subjective findings to identify priorities and to justify the hand hygiene intervention for promotion. Secondly from the findings, planning of the hand hygiene program was complex because of the interaction of many variables and the different target groups that need to be the recipients of the interventions; thus the model provided a useful checklist for the investigator to address into many of the main components that have to be considered during program planning. Thirdly, the model as well as facilitating the planning process also assisted the evaluation process in monitoring the progress to achieve the objectives of the program.

A point to note was the interventions conducted initially to the experimental group were correspondingly to the three most effective interventions rated by the survey participants: (1) hand hygiene is observed each time it is required; (2) the healthcare facility makes alcohol-based handrub easily available at each stage of patient care; and (3) each healthcare worker receives basic training in hand hygiene. This self-reported questionnaire administered to the healthcare workers was based on the theory of planned behavior (Ajzen, 1985; Ajzen & Madden, 1986). According to the theory, behavior can be predicted from intention, which in turn is shaped by personal attitude, perceived behavioral control, and subjective norms. The findings in the questionnaire survey revealed that healthcare workers perceived more knowledge through basic

training, which may change attitude toward hand hygiene compliance as attitude toward a given behavior is determined by beliefs on the consequences of behavior and evaluation of results. As such, the educational talk has to clearly illustrate the hand hygiene compliance rate together with health care-associated infections. Next, participants have to be provided with perceived behavioral control over the hand hygiene behavior through the belief that alcohol-based handrub is easily available and accessible. Then having everyone performing hand hygiene each time when required may reflect personal perception that social expectation dictates the adoption of good hand hygiene behavior.

6.3.1 Acceptance of Using Alcohol-based Handrub

Based on findings of the individual conference held for the staff of experimental wards, accessibility (91.2%) and less time consumed (64.7%) were the main reasons for the increasing acceptance and usage of alcohol-based handrub in lieu of handwashing with soap and water. These reasons have been published vastly on the introduction of alcohol-based handrub (WHO, 2009a). Additionally, ownership of the project was noted in the small group conference for staff members were actively involved in the discussion on reengineering the patient care process. Likewise, their awareness of the importance and effectiveness of hand hygiene enhanced the program implementation.

6.3.2 Educational Talk

Lack of hand hygiene compliance at the baseline observation together with the low rate of self-reported hand cleansing practice in "before touching a patient", served as the cornerstone of the educational program for healthcare workers. This was because they might not be sufficiently aware of the importance of hand hygiene and its relation to healthcare-associated infections. Another point that required clarification during the talk was the perception that gloved hands were equivalent to clean hands, which made wearing the same pair of gloves acceptable when attending to multiple patients. Such perception may likely be caused by lack of knowledge (Girou et al., 2004; Weinstein & Kabins, 1987), lack of right attitude (Doebbeling et al., 1988; Lynch, Cummings, Stamm & Jackson, 1991), or perceived lack of control arising from high workload (Thompson et al., 1997).

Evaluation from the second cycle clearly suggested that merely providing education without careful planning, direct feedback from participants and support from leadership in terms of staff attendance would fail to have an impact on changing hand hygiene behavior. In addition, Green and Kreuter (1991) stated that knowledge is necessary but not sufficient in changing individual or collective behavior. Moreover, behavior may not be modified immediately in response to new knowledge. Only the cumulative effects of heightened awareness, improved understanding, and recognition and recall of facts can affect beliefs, values, attitudes, and eventually behavior. Gould et al. (2007,

2010) in their review stated that education intervention previously thought to be ineffective is now modestly successful in promoting hand hygiene only if it is well-designed and well-implemented.

Elements of the two educational talk sessions were alike. These focused on increasing staff awareness and knowledge, clarifying misconceptions, identifying the relationship between healthcare-associated infections and hand hygiene practice, and finally developing skills on how to perform handwashing and handrubbing effectively. Compared with educational talks in the first cycle, the only differences were the teaching format and speaker. The ward-based educational talk was spread out in a series comprising eight sessions. All were conducted by the principal investigator to the staff of experimental wards in their workplace to encourage attendance and participation, facilitate interaction during discussions, and establish rapport. Meanwhile, the hospital-based educational talk was conducted in two open staff forums by another speaker, who could only disseminate information to the group of attendants. In the context of this type of big group education forum, challenges were encountered in enhancing communication, establishing a supporting relationship, and releasing more healthcare workers from their workplace to the venue to receive basic hand hygiene information. Equally, the lack of interaction in the forum did not provide opportunity for clarification of misconception. All these implied that educational talk conducted in a big group was largely ineffective in changing the attitude of healthcare workers. The

contributing factor to the deterioration of hand hygiene practices in control wards may be similar to that discovered by Conly et al. (1989): a lack of interaction or ongoing education. Conversely, in the third cycle, use of targeted teaching in the vigorous mandatory and intensive talk was comparable to the method employed by Colombo et al. (2002) and Wisniewski et al. (2007), which generated positive impact.

6.3.3 Use of Alcohol-based Handrub

In this study, low baseline hand hygiene compliance may be related to poor sink-to-bed ratio. This was because noncompliance may occur if busy staff members were to walk away from the patient and head to a wash basin to cleanse their hands. This association has been supported by various studies (Lam et al., 2004; Pittet, Mourouga et al., 1999; Voss & Widmer, 1997), with Pittet (2000, 2003) stressing that a system change is necessary to make hand hygiene easy, convenient, and less time-consuming. The second cycle of the present study was designed to address the time-constraining factor in hand hygiene with the introduction of alcohol-based handrub to all wards, hence improving hand hygiene behavior.

Unfortunately, the second cycle failed to meet its goal, as flooding hospital staff with alcohol-based handrub did not lead to improved hand hygiene behavior. Borg et al. (2009) and Gould (1994) reported that providing staff with improved facilities did not always translate into better practices. Carlene et al. (2000) and Saint et al. (2009) reported

similar challenges, as the alcohol-based handrub was not used frequently after its introduction. In the present study, lack of improvement in control wards after provision of alcohol-based handrub in the second cycle may be related to the two brief hospital-based education forums, as this teaching format was less likely to enhance communication and ensure engagement. Moreover, staff members who failed to attend the talk may not comprehend the benefits of using the alcohol-based handrub in place of soap and water.

According to feedback obtained during the educational talk, hands cleansed using soap and water were perceived to be cleaner than those cleansed with alcohol-based handrub. This suggested that a number of healthcare workers preferred handwashing with soap and water, therefore presenting an obstacle to the introduction of alcohol-based handrub. Allegranzi et al. (2009) discussed that how one defines the meaning of "visibly dirty" is exceedingly important as it can reflect external impurity as well as an internal perception of what is "impure".

Improvement was observed in the experimental group, though it is unclear whether this may be attributed to the introduction of the alcohol-based handrub. Such improvement may have possibly resulted from continual interactions between the principal investigator and the staff; these established a two-way communication that allowed the investigator to clarify any misconception or misunderstanding, allay

fear and worries, handle complaints, assist in solving difficulties, and encourage participation to achieve success.

6.3.4 Performance Feedback

Performance feedback has been studied extensively as an intervention for improving hand hygiene compliance. van de Mortel and Heyman (1995) assessed the effect of weekly feedback over a five-month period and found that hand hygiene compliance increased to 90% from baseline rates of 20% to 60%. Tibballs (1996) after demonstrating the results of handwashing audits to physicians, found that handwashing frequency increased from 32% to over 60%. Although benefits obtained from performance feedback were shown, most authors (Moongtui, Gauthier & Turner, 2000; Naikoba & Hayward, 2001; Tibballs, 1996; van de Mortel et al., 2000) claimed that improvement was temporary if feedback was not provided on a regular basis. van de Mortel et al. (2000) suggested that feedback should be repeated within 12 months to maximize handwashing rates with minimum intervention.

In this study, regular six-month feedback of actual practices was provided to the experimental group with continuous improvement. Our feedback was provided in a respectful manner with recognition, praise, and encouragement; for feedback may not be desirable among all healthcare workers as they may perceive lack of freedom and a sense of being placed under the microscope. This feedback method was

emphasized by Billings, Kowaiski, Cleary and Walter (2010) as being effective in promoting learning and improvement.

6.3.5 Poster Display

Identifying the effects of poster display was not easy, though this method was commonly used in hand hygiene campaign to improve performance. In this study, persuasive posters carrying message messages such as “Show your care – protect everyone with hand hygiene”, in addition to training charts illustrating the “six-step technique” were displayed in all clinical areas during the second and third cycles.

Jenner et al. (2005a) cautioned that posters should not be confused with training charts as the latter, though necessary for training, may be insufficient in prompting behavioral change. Jenner et al. (2005b) likewise stated that people must be persuaded to be open to change in attitude and behavior, and posters could serve as a means of exposing people to a persuasive message.

The persuasive poster used in this study was targeted to influence staff intention to practice hand hygiene to show their care and ensure protection against the transfer of diseases by hand. However, this type of persuasive poster may not be equally effective for all staff members, as certain individuals may regard themselves healthy and less risky. Jenner et al. (2002) claimed that increased use may be achieved through

appeals that instill minimal fear, but messages in posters that underscore possible gains which explicitly outline personal responsibility may be more effective. However, one must exercise caution as even though attitudes may be changed through awareness, behavior may be unaffected unless personal acceptance is attained. Moreover, people may respond or perform only when they perceive themselves to be at risk.

6.4 Environmental Constraints

Findings from the small group conference suggested that barriers to hand hygiene practice were understaffing and heavy workload. Participants deemed hand hygiene inferior to other patient care practices. Moreover, it was not a priority in light of the limited time available. Other barriers mentioned included institutional safety climate, care delivery model, and manpower ratio.

6.4.1 Institutional Safety Climate

In this study, promoting easy access to the alcohol-based handrub targeted the barrier of failure to practice hand hygiene because of excessive workload. However, the staff expressed dislike over using the alcohol-based handrub because of intense fear and worries related to accidental ingestion or fire hazard if the handrub dispenser was placed at the foot of the patient's bed. After these concerns were addressed with further clarification that the alcohol-based handrub would not

cause potential skin damage, the staff perceived safety in using the product to protect self and others.

Safety climate is defined as shared perceptions of workers regarding the level of safety of their work environment (Grosch, Gershon, Murphy & DeJoy, 1999). Pittet (2001) mentioned that promoting an institutional safety climate was a parameter that could potentially be associated with successful promotion of hand hygiene. Rosen et al. (2010) stated that strengthening safety climate is a necessary strategy for improving patient safety. With these, the institutional safety climate must be promoted and shared by all parties to enhance and reinforce hand hygiene.

6.4.2 Care Delivery Model

In Hong Kong, hospitals adhere to different care delivery models (Hospital Authority, 2003). The present study through direct observation found that the most common model used was team nursing, with basic patient care procedures delivered horizontally from one patient to another such as taking observations and changing napkins. This care delivery model was deemed efficient, though it entailed potential contacts and thereby increased the risk of acquiring healthcare-associated infections. Historically, functional nursing was practiced by dividing the work among nurses and assistants based on complexity of tasks and competency of the provider (Makinen, Kivimaki, Elovaino & Virtanen, 2003). This task-orientated approach

resulted in speedy yet fragmented delivery of care (Tiedeman & Lookinland, 2004; Yam & Rossiter, 2000), with increased number of contact between patients and nurses. Team nursing, which evolved from functional nursing, involved a host of various providers collectively caring for a group of patients on a shift-by-shift basis. Though this model offers greater quality of care, it remains to be fragmented (Hall & Doran, 2004; Tiedeman & Lookinland, 2004).

Chan, Chung, Wong and Yang (2006) evaluated the nursing practice in the context of the severe acute respiratory syndrome epidemic in Hong Kong. They identified that current cubicle nursing approaches with skill mix, though remaining entrenched in the efficiency-based task-orientated culture, is able to conceptualize a vertical approach to individualize patient care rather than a horizontal one that focuses on task completion across a number of patients. In real practice, however, the horizontal approach rather than vertical one remains to be observed.

6.4.3 Manpower Ratio

On average, patient-to-nurse ratio in our study setting was 7:1; the worst was recorded at 10:1. Increased workload likely resulted in job dissatisfaction, burnout, and high turnover. Moreover, it emerged as an important determinant of healthcare-associated infections and cross-transmission of microorganisms, which have been reported widely by other studies (Aiken, Clarke, Sloane, Sochalski & Silber, 2002; Borg, 2003; Grundmann et al., 2002; Hugonnet et al., 2004; Lam et al., 2004;

Pittet, Mourouga et al., 1999). Though the causal pathway between understaffing and infection is complex, Hugonnet et al. (2004) stated that understaffing, high staff turnover and high patient-to-nurse ratio may lead to lack of time to comply with infection control recommendations, including proper hand hygiene.

Based on the low number of healthcare workers in each ward, such as three to four registered nurses with one to two healthcare assistants caring for over 30 patients, the qualified nurse in our study would have approximately 10 sets of drugs to administer. Meanwhile, the healthcare assistants would have 15 to 30 rounds of observations to carry out. On top of this workload, they must meet the demands of practicing good hand hygiene and caring for newly admitted and acutely ill patients. In their study, Cho et al. (2003) urged leaders to consider appropriate staffing to reduce adverse events, morbidity, mortality, and medical costs.

6.5 Improvement in Hand Hygiene Compliance after the Hand Hygiene Intervention Programs

In the first cycle, compliance in experimental wards with interventions increased from 18.3% to 41.6%. However, performance “before touching a patient” (34.9%) and “before clean/aseptic procedure” (24.7%) required greater reinforcement. Nurses and healthcare assistants’ overall average compliance improved to 49% and 40.6%, respectively. Only doctors of Ward E (ICU) exhibited enhanced

compliance at 46.5%. As for control wards with no intervention, compliance declined to 18.8%. Improvement could further confirm that multimodal approaches were effective in enhancing hand hygiene compliance. This was likewise confirmed by findings of Pittet et al. (2000), Salemi et al. (2002), Zerr et al. (2005), Trick et al. (2007), and Helms et al. (2010). The multimodal program was planned in response to the reported reasons for not washing hands indicated by the results of the questionnaire and small group conference. Because of the multimodal nature of the intervention, it was not possible to speculate how individual strands of intervention (education, performance feedback, poster, staff participation, use of alcohol-based handrub) may have contributed to the overall compliance shift that occurred. However, the results revealed that to effect behavioral change, attention must be paid to all factors that predispose, reinforce, and enable behavior.

In the second cycle, when educational talks and other interventions were extended, hand hygiene compliance was sustained in the experimental wards. However, no overall significant improvement was noted in the control wards. Despite the hospital-wide talk conducted, not all members of the frontline staff were able to attend because they could not spare the time. Similarly, when alcohol-based handrub was provided to the whole hospital, not all colleagues used it because information dissemination and provision of products did not necessarily translate into compliance. Evaluation by small group conference and individual consultation revealed that lack of knowledge arising from

non-attendance of educational talks, lack of motivation, and misconception were among the reasons for non-compliance. This finding was supported by Larson, Bryan et al. (1997), who found that change in practice was unlikely without multidisciplinary efforts and explicit administration support. This study confirmed that the institution's provision of educational talk and structural change, such as provision of alcohol-based handrub, did not guarantee change in practice. The fact that staff members were not mandated to attend the educational talk and not invited to participate actively in the process of change resulted in non-significant improvement in hand hygiene compliance. Efforts to bridge the gap were conducted in the third cycle. After a total of 57 scenario-based sessions conducted to various wards, performance feedback, clarification, and provision of other reinforcing factors, hand hygiene compliance was improved.

Findings of the study revealed that contributing factors to success, particularly in the control wards in the third cycle, were the multimodal and multidisciplinary approach. This approach included scenario-based mandatory educations, posters as reminders in the work environment, active participation of staff, performance feedback at both individual level and in the educational workshops, involvement of leaders such as department operational managers and consultants, and provision of alcohol based handrub that required less time to practice hand hygiene. Furthermore, being an action research study, participation of staff members was ensured by allowing them to express concerns and

difficulties with appropriate actions taken. Environmental constraints were another factor that needed to be dealt with, though the most specific finding was that staff members need to be aware of their professional values and responsibilities. Finally, decrease in MRSA transmission rates strengthened the results that our intervention was beneficial to patients.

In the end, overall compliance to hand hygiene has increased to more than 50%. This compliance rate was comparable to findings in most studies published over the last ten years (Lam et al., 2004)) except the rate 37.1% in control medical ward after three cycles of action research when compared with their baseline 24.5%. It might be contributed to the high patient-to-nurse ratio (6-8 patients per nurse) and caring procedures delivered horizontally such as napkin or observation rounds. These round care procedures in particular invited non-compliance as one might not walk for a distance to perform handwashing and then back to the next bed patient to continue the round procedures. Moreover, the ward manager and the staff of this ward did not actively participate in the program due to intense workload. Without the change of the delivery of care and role modeling of the ward managers and senior staff, the impact of the program was minimal.

6.6 Action Research Methodology to Enhance Hand Hygiene

The current study used action research as the study approach in the clinical inquiry of hand hygiene compliance. The premise of action research was to

gain knowledge from practice and to understand the context better as a result of attempting to generating change. Action research is unique in its principle of bridging the theory and practice gap. This is achieved with the important focus on collaboration, encouraging practitioners to participate in the research process. Based on findings, a summary table was depicted (Table 6.1) to illustrate how the theory and practice could be integrated at three levels in the process of improvement of hand hygiene compliance in the acute hospital.

Table 6.1 The three level process in promoting hand hygiene

Key issue	**Multi-modal interventions to improve hand hygiene**		
	Level One **Theory and practice** **(Exploratory phase: Plan)**	**Level Two** **Tasks and processes** **(Facilitation phase: Act)**	**Level Three** **People and context** **(Evaluation phase: Observe and Reflect)**
Behavioral change based on PRECEDE model	Predisposing factors: *Knowledge, beliefs and attitudes*	• Conduct educational talks	Have to be • mandatory, • scenario-based, • problem focused with clarification of misconception
	Enabling factors: *Accessibility of facilities, new skills*	• Provision of alcohol-based hand-rub	Essential to • clarify its effect on skin • improve the quality of the product
	Reinforcing factors: *Feedback*	• Remind • Enforcement	Important to have • Peers involvement to provide positive reinforcement
Organizational climate	Supervisors Peers Specialty nurses	• Administrative support • Care delivery model • Manpower ratio	Vital to have • Supervisors responsibility to support the subordinates • Peers ownership of the intervention programme • Specialty nurses reflection to OPEN one's awareness
Professional value	Value-based education	• Safety climate	• Awareness and acceptance of responsibility

The table describes the process of change as applied to the hand hygiene compliance program. Level one summarized the theory and evidence on which the intervention program was based, the phase of facilitation and management of behavioral change. It dealt with the gap between evidence of efficacy among the hand hygiene program and evidence of best practice in enabling behavioral change among healthcare workers using psychological models. Level two defined the essential tasks and processes required for operating the hand hygiene programs at a generalization level. Meanwhile, level three discussed the observation and evaluations specific to the research setting.

6.7 Personal Constraints

Findings of the study expanded previous knowledge that showed parameters associated with compliance. Hand hygiene recommendations were not only at the individual level (intrapersonal) but at the group level as well (interpersonal). Those involved included supervisors, peers, and specialty nurses (e.g., infection control nurses) who were crucial in promoting hand hygiene compliance.

6.7.1 Supervisors' Responsibility to Support the Subordinates

Findings of the study demonstrated that a significant predictor of hand hygiene compliance is active involvement and commitment of the direct supervisors and higher level administration. The direct supervisors in this study were ward managers or advanced practice nurses. They had an important role in facilitating, monitoring and reinforcing hand hygiene practice. In addition, when superiors

explicitly urge subordinates to practice hand hygiene to protect both themselves and the patients, subordinates are more likely to follow. Another key person, the Department Operational Manager (DOM), though not directly supervising the subordinates but holding accountability for the whole department, was in control of resources. For example, as shown in the study, support from the DOM to attend the educational talk was an effective means leading the clinical teams in the prevention of healthcare-associated infections; this provided frontline colleagues with the support they needed to improve themselves and develop and resolve clinical issues related to infection control. Dunham-Taylor (2000) stated that leaders should maintain values consistent with the organization, matched among all partners to optimize organizational outcomes.

To conclude, a responsible supervisor should support frontline colleagues by encouraging them to attend the ward-based educational talk during office hours, providing advice on grouping care procedures, ensuring the appropriate hand hygiene facilities was available and accessible at the point of care, and facilitating access at the clinical level to conduct the educational talk. In the end, supervisors' support, reinforcement and motivation were felt, as evaluated by the subordinates. In this method of "support", as stated by Hill and Hadfield (2005), supervisors should assist the clinical teams in assuming ownership over infection control issues, particularly in sharing the responsibility over infection control.

6.7.2 Peers Involvement to Provide Positive Reinforcement

In the small group conference, staff of experimental ward C (SRG) was found actively dealing with the obstacles of hand hygiene compliance. They understood the importance of hand hygiene and sought means for improvement by reorganizing the ward activities. Their enthusiasm and ownership were perceived while they persevered in reminding others to practice hand hygiene with the new slogan that they created. With these, they were commended as good exemplars in the evaluation survey. These good examples demonstrated that all staff members irrespective of rank and category should be involved in reminding, reinforcing and modeling the importance to practice hand hygiene to prevent transmission of infection. Wright, Kem, Kolodner, Howard and Brancati (1998) commented that the attributes of excellent physician role models were not only related to the acquisition of skills, but to the modifiable behavior under the control of their faculty members as well. Lankford et al. (2003) stated that healthcare workers were significantly less likely to practice good hand hygiene if they were in a room with a peer or higher ranking staff who did not observe hand hygiene.

6.7.3 Specialty Nurses or Nurse Teachers' Critical Reflection to plan, implement and evaluate the intervention

Education, a key element in multifaceted intervention, raises healthcare workers' awareness that their hand hygiene habits can prevent infection. Infection control nurses, as nurse teachers or specialty nurses should throughout the research process, observe the hand hygiene practice,

provide constructive feedback, educate their colleagues on the essential knowledge, and critically self-evaluate the process of implementation to ensure continuous quality improvement of the program.

6.8 People and Context

Compliance is the degree to which a person adheres to advice (Evans & Haynes, 1990). Results of the study revealed that compliance to hand hygiene remained varied among different hospital wards and professional categories of healthcare workers despite interventions targeting the predisposing, enhancing, and reinforcing factors.

6.8.1 Nature of Ward

Pittet, Mourouga et al. (1999) stated that across all clinical settings, critical care units usually have higher noncompliance as the intensity of their patient care was high, with increased opportunities of care per hour so has a higher demand for hand cleaning. This was not the case in our study, as both intensive care units (E and F) recorded better performance than the general medicine and surgery units. Evidently, this variance may be explained by the better patient-to-nurse ratio in the ICUs and ownership of the project as shown by Ward F; therefore, working in high-risk areas may not be reported as having poor hand hygiene compliance. Saint et al. (2009) claimed that variation in compliance may be a result of unit-specific norms related to hand hygiene, system-level barriers, and leadership commitment to infection prevention rather than the area with high-intensity patient care.

6.8.2 Target Population

Our findings were consistent with those reported previously (Aragon, Sole & Brown, 2005; Larson et al., 2000, Pittet et al., 2000) in that low adherence to recommendations has been described in doctors compared with nurses. Given the results, our nurses' and healthcare assistants' hand hygiene compliance improved significantly. For doctors, however, only those working in ICUs exhibited significant improvement. This may be due to the lack of role modeling of senior doctors that may affect the practice of their junior colleagues. This assumption of lack of role modeling or heterogeneity was supported by various scholars (Cantrell et al., 2009; Larson et al., 2000; Pittet et al., 2004, Whitby, McLaws & Ross, 2006). As suggested by Pittet (2001), another reason was that members of the medical staff would generally accept scientific evidence asserting that taking pulse or blood pressure was similar to many common social interactions such as shaking hands. Therefore, they tend to consider practicing proper hand hygiene as unnecessary.

Another plausible reason was the complex duties of medical officers and the rotation of house officers between or among units and institutions. These hindered their involvement in the interventions provided by the infection control team. There is a need to audit doctors to improve hand hygiene behavior, but focus may have to shift to senior doctors by combining interventions targeted at behavioral factors such as positive enforcement (Solomon, Hashimoto, Daltroy and Liang,

1998). This is expected to direct them to become future role models for their junior colleagues.

It must be emphasized that while baseline observation was being conducted, patients with multiple-drug resistant organisms were clustered in control ward F (ICU). In light of this, staff members of Ward F were alerted, resulting in hand hygiene compliance rate of 52.1% among doctors. This affected the doctors' pooled baseline compliance (26%) and appeared to be the best compared with other professionals such as nurses (22.5%), HCAs (11.9%), and others (22.4%). However, when no intervention was provided to the control group, compliance rate of doctors of Ward F dropped to 25.5%, which remained better than that of their peers in other wards except Ward E (ICU). This phenomenon continued in the subsequent observation (Table 5.8). As stated by Cantrell et al. (2009), heterogeneity in doctors' hand hygiene compliance among sites in the same hospital was consistent with the local ward culture in terms of perceived vulnerability of patients, role modeling by senior doctors, and their ownership in protecting high-risk patients.

Gould, Wilson-Barnett and Ream (1996) commented that practical barriers rather than poor motivation prevented nurses from optimally performing hand decontamination. In this study, nurses' non-compliance was mostly the lowest. Factors such as knowledge and beliefs, nursing workload, and provision of resources were observed to

influence behavior in complex interacting ways. Healthcare assistants constituted another healthcare team category that plays an important role in providing basic patient care.

6.8.3 Personal Risk

Fear of susceptibility and severity is a powerful motivator that produces a flight response to take an immediate action, explaining why the findings of the questionnaire (Tai et al., 2009) showed a high subjective scores (perceived self performance, attitude, behavioral control, and subjective norms) in “after body fluid exposure risk” than in “before touching a patient”. Similarly better compliance was found in this study in “after body fluid exposure risk” than in “before touching a patient”. Actually, hand hygiene practice among different contacts was consistent with studies conducted in Geneva (Pittet et al., 2000), Germany (Wendt, Knautz & von Baum, 2004), New York (O’Boyle, Henly & Larson, 2001), and Toronto (Raboud et al., 2004). Stein, Makarawo and Ahmad (2003) commented that with the time lag, hand hygiene behavior may not be continued as no immediate consequence is seen as a result of this specific behavior. A simple reason for non-compliance may possibly be the failure to see microorganisms with the naked eye. Only when staff members believe that they are at risk acquiring a disease or causing harm to their patients would they be more likely to practice protective behaviors, if the measure was perceived to be feasible and effective.

6.8.4 Professional Values

In our current study, despite constant reminders to staff about their responsibility in protecting patients from healthcare-associated infections, compliance in “before touching a patient” was persistently lower than other contacts. Goldmann (2006) stressed that neglecting to practice hand hygiene in any case except in emergency is considered a violation if the hospital has perfected its hand hygiene system. Larson (2005) commented that we are in a democratic society that values personal freedom and the ability to make choices. However, when harm results from our actions, the professional mandate is to assure that personal choice does not interfere with best practices.

The public regards healthcare professionals as having the responsibility to protect patients. Thus, professional care is a vital component of the healthcare system. Nursing is a caring profession, and caring is recognized within nursing as the profession’s central value. Value as defined by Taylor, Lilis, and LeMone (1993, 61) is a “personal belief about worth that acts as a standard to guide one’s behavior”. Among personal, professional, and organizational values (Scalzi & Mazarey, 1989), professional values influence the practice environment, activity, and development as these guide the standards for action, provide a framework for evaluating behavior, and influence practice decisions (Kenny, 2002).

Rassin (2008) stated that values can be affected by one's culture, professional education, training, and experience. Therefore, only if one decides to remain in the profession and not treat it as a career (Shaw & Degazon, 2008) can one's professional values be fully implemented, affecting one's attitude, behavior, and professional life experiences. If interventions only target the behavior, success or long-term effect may not be achieved. As stated by Clark, Beck and Alford (1999), when staff members become aware of and acknowledge the need for commitment and adhere, accept, synthesize, and finally internalize it, they will commit to the professional standards. Thus, when nurses demonstrate hand hygiene practice with commitment and responsibility, they will serve as a role model who can encourage others to protect themselves and those around them (Potter, 1997). With the above components interacting with one another, the "Driving Enhancing Practice Model" (Fig. 6.1) was proposed to illustrate the importance of the system, environment, and person in accomplishing professional practice through supporting professionals' ability and control over the delivery of care.

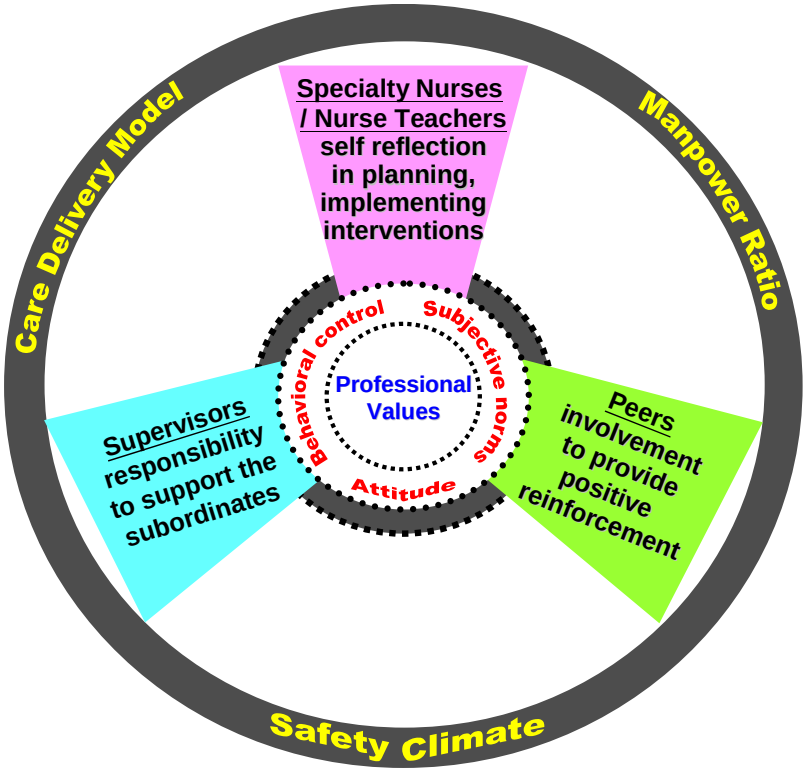

Fig.6.1 Driving Enhancing Practice Model

6.9 Action Research as a Methodology

Through the use of action research methodology, the professional practice of hand hygiene was improved and understood in the present study.

6.9.1 Practice

The staff expressed enthusiasm for the support and development of the hand hygiene program. This active involvement was beneficial for both the researcher and participants, resulting in greater understanding and knowledge of noncompliance to hand hygiene. Practical knowledge on effective methods was useful for facilitating change in practice. In the end, participants were motivated by the researcher to increase interest

in ownership and willingness to change. Simultaneously, key individuals holding formal positions, such as ward and department operational managers, were positively influenced to provide support and to make resources available for the success of the program.

Throughout the action research process, value was added to address both emotional and intellectual needs of staff members through instruction, feedback, advice, support, reinforcement, and engagement. Additionally, the cyclical steps in action research helped the participants and the researcher to reflect on the current practice in a critical manner, to influence change in practice, and to evaluate the resulting changes. It was found that evaluation as a part of the action research; however, the action researcher would not stop there, but continue to consider the valuable suggestions coming from the field of evaluation. All these helped to improve hand hygiene compliance in the acute hospital through the implementation of interventions that addressed the predisposing, enabling, and reinforcing factors.

6.9.2 Theory

Collaboration and participation are two characteristics differentiate action research from other research approaches. Collaboration encourages closer relationships between ward staff and investigator. Meanwhile, participation allows the investigator to address staff concerns, allowing propositional knowledge to be generated apart from practical knowledge. The propositional knowledge of knowing about it,

and not only practical knowledge of knowing how to do it, can develop theory in action through research process and critical reflection.

In this study, the investigator as action researcher developed a responsive and flexible process of research by shifting the focus and changing the approach through the results and lessons learned from one stage to affect and develop the action of the proceeding stage. Without a doubt, multimodal interventions to improve hand hygiene practice are required in addition to the PRECEDE model. However, other factors must be resolved to promote change, including the following: organizational of system change, safety climate, mode of care delivery, manpower ratio, support of supervisors, peers' role of modeling, teacher facilitation, staff engagement and ownership, and staff awareness and commitment to professional values. There is always an emphasis on intervention to facilitate improvement, but the key point is identifying the means to intervene to improve professional hand hygiene practice. With action research, there was a change in understanding the context or phenomenon leading to new knowledge produced.

CHAPTER SEVEN

CONCLUSIONS AND IMPLICATIONS

7.1 Introduction

This action research study examined the planning, process, and outcomes of a multimodal hand hygiene program for healthcare workers at an acute hospital in Hong Kong. The study design evolved during the action research project, with three cycles instead of two as the result of ineffective hand hygiene change practice when the program was extended to the whole hospital. The intervention program included educational talk, provision of alcohol-based handrub, performance feedback, slogan competition, and poster display. More importantly, staff participation in the whole process, role modeling, and commitment of individuals, direct supervisors, peers and infection control nurses were important elements that resulted in behavioral change in hand hygiene practices of healthcare workers.

This action research study provides evidence that when the multimodal program was extended to the whole hospital, implementation must be of the same quality as when the program was implemented in the three experimental wards.

7.2 Implications to Nursing and Health Care

Findings of the study demonstrate that to enhance hand hygiene behavior, strong institutional engagement is required to engender the requisite

organizational climate change. The institution must ensure that adequate staffing is available to deliver effective care. Healthcare workers are adequately educated on hand hygiene with assessed competency. Meanwhile, the staff must have reliable access to alcohol-based handrub at the point of care, with skin lotions made available to prevent skin damage. Moreover, the organization is responsible for establishing a professional environment for its employees, whereas each healthcare worker should be aware of professional values and be accountable to the profession and society. Healthcare workers have the duty to practice good hand hygiene to protect themselves and those around them.

7.2.1 Institutional Safety Climate

It is important to have a leader or executive with a vision to cultivate a safety climate. These leaders should be able to influence managers and supervisors to create a blame-free environment and encourage a culture of safety (Flin & Yule, 2004; Goldmann, 2006). This may be achieved through feedback underscoring that their safety attitudes can have a positive effect on the overall safety performance. In addition, these leaders or managers should possess leadership elements of approachability, availability, role modeling, and inspirational behaviors (Houser, 2003). Supervisors can communicate values and expectations by their own actions and behavior. They support and encourage appropriate hand hygiene practice and point out poor practice in others.

It is not easy to remind colleagues, particularly the senior staff and doctors, to observe proper hand hygiene. In this case, behavior

interventions such as positive reinforcement would be preferable. Ajzen (1985) stated that people generally intend to enact a behavior when they evaluate it positively and when they believe that important individuals such as their supervisors would like them to do so. The same is achieved when peers act as exemplars demonstrate and remind others of the proper way to act. Therefore, infection control link personnel must be invited to link own clinical area to that of the infection control team. For example, infection control link persons may serve as instructors educating and motivating their peers or colleagues to comply.

7.2.2 Care Delivery Model and Manpower Ratio

An appropriate care delivery model with adequate staffing levels is required to support healthcare workers in providing quality care by reducing the number of contacts. This enhances hand hygiene and prevents the spread of infection. The issue of understaffing in the wards has to be addressed.

7.2.3 Education Program

Specialty nurses or nurse teachers have to maintain their own clinical skills. They must continuously learn and become capable of critically analyzing and reflecting on their own practice and outcomes (Hendry & Farley, 1996) before they are qualified to educate, nurture, liaise, provide feedback, and promote awareness on quality and safety. Additionally, these teachers should review course content periodically and deliver essential information in an innovative manner, such as the

use of scenario-based and problem-based activities. To transform participants' points of view, there is a need to assist colleagues in revisiting their existing practice, establish new points of view through exploring issues that question their values and beliefs.

7.2.4 Professional Values

Healthcare workers must uphold professional standards in ensuring patient safety. As values can be transmitted through the teaching curriculum and the educational and work environment (Cameron & Wren, 1999; Hendel & Gefen-Liban, 2003; Reynolds, 1999), it would be important for the institution to develop the staff's professional values through seminars. Administrators must have clearly written guidelines that remain current and are readily shared among employees (Weis & Schank, 2000). Alternatively, educators can assist in shaping the profession (Hendel, Eshel, Traister & Galon, 2006) and facilitating the students' learning process through role modeling behaviors (Eddy, Elfrink, Weis & Schank, 1994). They can encourage students to practice altruism in their own life experiences and reflect on how these may affect their behaviors in future practice (Rassin, 2008).

7.3 Limitations of the Study

There were several limitations to our study. First, although our observations were conducted as unobtrusively as possible, observation bias and the Hawthorne effect must be considered. In fact, no such bias may have affected the secondary outcome variables. Healthcare workers in our institution were

accustomed to infection control nurses (observers) performing daily surveillance in the workplace, thus no awareness of being observed or any social pressure influenced their hand hygiene behavior. Second, repeated observations of the same healthcare worker may have occurred. We could not statistically control for this aspect because our observations were performed anonymously. There may have been certain inter-observer variation. However, with the use of structured observation form for easy decision, we do not consider inter-observer variability as a potential problem. Third, it was difficult to assess which part of the strategy was the most effective as the intervention was multimodal. Pittet et al. (2000) commented that partitioning the intervention effect may be irrelevant since the multimodal approach may be more effective than the sum of its parts. Moreover, our study with control wards as reference may assist in determining that improvement was not merely a result of interventions. Communication, clarification, and interaction in the action research process helped to support understanding, relationship, and development. Fourth, the observations were not evenly distributed and the target population mainly included nurses, doctors, and healthcare assistants. For increased effectiveness, future observations may be performed at any time of the week. In addition, other healthcare members such as physiotherapists and phlebotomists may be invited. More importantly, greater focus must be placed on the medical staff that may require special attention in the promotion of awareness, acceptance, and practice of hand hygiene guidelines. Moreover, one can explore the roles and perception of managers and administrators toward healthcare-associated infections and hand hygiene.

As for the self-reported questionnaire, limitation should be acknowledged. First, the investigator who is an infection control staff placed the questionnaires in the ward might have reinforced social desirability bias. Second, the measure of intention to perform a sensitive behavior such as hand hygiene may reflect social pressure rather than the individual's real intention which is a problem for all self-reported assessments.

7.4 Outcomes of Initiatives

The development and evaluation of the hand hygiene program offers many advantages.

First, with findings in the exploration cycle, current hand hygiene practices and determinants of behaviour to self-reported performance were identified accordingly for understanding and planning of interventions. Second, through the implementation of multimodal interventions in cyclical process of planning, acting, observing, and evaluating, difficulties and problems experienced by healthcare workers were acknowledged with possible solutions sought. Third, by evaluating the impact of the hand hygiene enhancement program, significant improvement was noted with increased compliance in hand hygiene and relative savings in cost. Fourth, in conducting action research on the process of interventions in enhancing compliance, we understood that sustained increase in compliance relied not mainly on the introduction of the alcohol-based handrub, but on behavioral modification through peer pressure and role modeling.

Overall, this study helped to understand that in modifying hand hygiene habits in the healthcare setting, interventions must be specifically and persistently applied at regular intervals. Apart from providing general principles and guidance on hand hygiene, the education program must provide the staff with practical solutions to overcome common daily constraints on observing proper hand hygiene. Mandatory intensive education was essential to increase healthcare workers' awareness during the sequence of care. Moreover, healthcare workers must internalize their responsibility and values to lower healthcare-associated infection rates and protect patients. It is prudent for healthcare providers to ensure no harm will befall the patient while they are being cared for, which in the healthcare setting is the central value. In light of this, the core "professional values" as proposed in the "Driving Enhancing Practice Model" should be grounded on all aspects of the profession through education, motivation, and reinforcement. This promotes the profession of "caring" throughout the healthcare system.

7.5 Issues of Quality in Action Research

Reliability and validity have always been important concepts by which people judge the credibility of research studies. However, both these terms resonate with a positivistic paradigm. Reliability is particularly problematic in action research. Action research is concerned with the collaboration of practitioners in the area of practice situation. Therefore, reliably achieving the same results, as in repeating an experiment, will not occur. Instead, other criteria may be important: To what extent are participative and democratic purposes being built into the work?

In this study, small group conference, performance feedback and individual consultation were facilitated to ensure participation of healthcare workers in the process of program implementation. Are different ways of knowing present in the inquiry practice? Is there an emergent process of engagement in the inquiry? It was found that the staff in the experimental wards actively engaged in the process and provided information to improve the program further. Moreover, concerns of the staff were addressed. Validity in action research revolves around movement between action and reflection. As a consequence, needless vagueness and ambiguity are reduced, while amplification and deepening of the research focus is enhanced.

Action research as the methodology of the study achieved its aims in providing holistic knowledge. It integrates tacit knowledge and the multiple perspectives of disparate stakeholders through an iterative process of research, action and reflection, thus finally articulating a model to inform action.

7.6 Conclusion

Although the hand hygiene procedure is simple, its application by healthcare workers is a universally complex phenomenon. To our knowledge, this study is the first in Hong Kong to achieve the following: evaluate the association of determinants of hand hygiene behavior with self-reported hand hygiene adherence; conduct hand hygiene observations with multimodal interventions provided in cyclical process of planning, acting, observing, and reflecting; and have control wards as reference to identify the potential effectiveness of interventions. Additionally, mandatory intensive education, easy access to

alcohol-based handrub for hand disinfection, and regular observations with performance feedback may have contributed to significant improvement not only in the six pilot wards but in the entire institution with relative cost savings.

Majority of reasons for noncompliance are generic problems or issues that may occur in any group of healthcare workers or hospital. Certainly, good hand hygiene in a hectic work environment may be easily forgotten or neglected if supervisors do not support and inform subordinates of their intent to observe it; the same is true in the absence of peers who serve as exemplars by reinforcing and reminding others of the recommended practice. The fact that microbes on the skin are not visible leads to a high likelihood of overlooking this practice. Therefore for one to develop the intention to enact the behavior, one must believe that it has positive consequences and that supervisors would like one to perform it. Also, the essence lies not only on the interventions but on the people (supervisors, peers or specialty nurses), as they must commit to, engage in it, reflect onto it, as well as receive support from top leaders who are willing to make hand hygiene a priority for patient safety in preventing healthcare-associated infections. Moreover, to allow healthcare workers to recognize the professional obligation to ensure patient safety, adhering to the standards of practice and professional behavior is crucial. It is imperative for healthcare workers to uphold the standards of practice that merit public trust. Our observations provided possible insight into the core factor of “professional values” as proposed in the “Driving Enhancing Practice Model”, which may be extended to other nursing practices as well.

Appendix I

Hand Hygiene Observation Form

Patient Care Ward/ Dept.: _____ **Day of Week:** _____ **Date:** _____
Patient to nurse ratios: _____ **Initials of Monitor:** _____ **Time:** _____ **AM/PM to** _____**AM/PM**

Healthcare Worker (HCW) Type:

1 = Physician / Medical Officer
2A = House Officer
2B = Medical Student
3 = Registered Nurse
4 = Enrolled Nurse
5 = Nurse Officer
6 = Health Care Assistant
7 = Ward Attendant
8 = Pastoral Care
9 = Occupational Therapist
10 = Environmental Services Worker
11 = Patient Transporter
12 = Radiology Technician
13 = Respiratory Therapist
14 = Dietitian
15 = Student nurse
16 = Phlebomist
17 = Others

Key:
A = Airborne
D = Droplet
C = Contact
Y = Yes
N = No
N/A = Not Applicable

TIME INITIATE PATIENT CARE											
BED NO.											
ISOLATION PRECAUTIONS: A, D, C, N/A											
HEALTH CARE WORKER	TYPE										
	SEX	M / F	M / F	M / F	M / F	M / F	M / F	M / F	M / F	M / F	M / F
OPPORTUNITY REQUIRING HAND HYGIENE INTERVENTION (√)											
1. Before Patient Contact											
2. After Contact With Patient's Skin											
3. After Contact With Patient's Gown/Linen											
4. After Contact With Inanimate Objects in Pt Rm											
5. Before IVD Care											
6. After IVD Care											
7. Before IVD Insertion											
8. After IVD Insertion											
9. Before Wound Contact											
10. After Wound Contact											
11. Before Mucous Membrane Contact											
12. After Mucous Membrane Contact											
13. Before Body Fluid Contact											
14. After Body Fluid Contact											
15. Housekeeping / Environmental Activities											
16. Before Putting On Gloves											
17. Gloves Removed & Activity Not Observed											
18. Assist in Aseptic Procedure											
OUTCOME (√)											
Hand Wash (HW)											
Alcohol Hand Antiseptic (HA)											
No Action - Missed Opportunity (N/A)											
Gloves (Y / N)											
Gowns (Y, N, N/A)											

Comments:

_____

_____

Appendix II

Questionnaire on hand hygiene and nosocomial infections for healthcare workers

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

Section A

A1. Gender: O female O male

A2. Age: O ≤ 20 O 21 – 30 O 31 – 40 O 41 – 50 O > 51

A3. Years since completion of basic professional training: _____ years

A4. Years in present institution: _____ years

A5. Profession: O nurse O physician O health care assistant O others: _____

A6. Department: O medicine O surgery O intensive care unit
O other (specify): _____

A7: Have you experienced a hand hygiene promotional campaign in the past? O no O yes: year _____

A8: Did you receive a formal education in hand hygiene after your basic training? O no O yes: year _____

Section B

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

In your opinion:

B1. On average, what percentage (between 0 and 100%) of hospitalized patients will suffer from an HCAI? _____%

B2. On average, what percentage (between 0 and 100%) patients with an HCAI will die due to the infection? _____%

B3. On average, how many additional days will patients with an HCAI have to stay in hospital because of their infection? _____

B4. On average, how much does an HCAI cost in HK dollars? _____

Section C

In this session, we are interested in your perception of the importance of hand hygiene.

In your opinion:

C1. What percentage of HCAIs can be prevented by optimal hand hygiene practices: _____%

C2. On average, how many times per hour do you (ideally) have to cleanse your hands during your patient care activity? _____

C3. What is the average compliance (between 0 and 100%) of healthcare workers with hand hygiene recommendations at your institution (*in general?*)? _____%

C4. How highly ranked is the issue of hand hygiene among all patient safety issues by the top management of **your institution**?
O top priority O among 2-5 top priorities O lower than 5th priority

C5. How highly ranked is the issue of hand hygiene among all patient safety issues by the top management of **your department**?
O top priority O among 2-5 top priorities O lower than 5th priority

C6. How highly ranked is the issue of hand hygiene among all patient safety issues by **yourself**?
O top priority O among 2-5 top priorities O lower than 5th priority

Appendix II (ctd.)

Section D

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

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

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

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

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

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

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

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

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

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

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

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

Section E

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

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

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

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

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

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

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

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

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

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

Appendix II (ctd.)

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

Eb1. Before direct contact with a patient (e.g. helping him/her into bed).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb2. After direct contact with a patient (e.g. after having examined his/her elbow).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb4. After exposure to a patient's body fluids (e.g. respiratory secretions).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb5. After removing gloves used for patient care.
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb7. Between touching two patients sequentially (e.g. measuring the blood pressure of patient A, then of patient B).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

Eb8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).
Extremely difficult O----------O----------O----------O----------O----------O----------O Extremely easy

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

Ec1. Before direct contact with a patient (e.g. helping him/her into bed).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec2. After direct contact with a patient (e.g. after having examined his/her elbow).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec3. Immediately before touching a clean site during patient care (e.g. opening an IV catheter hub).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec4. After exposure to a patient's body fluids (e.g. respiratory secretions).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec5. After removing gloves used for patient care.
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec6. After touching an object in the immediate vicinity of a patient (e.g. touching the bed).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec7. Between touching two patients sequentially (e.g. measuring the blood pressure of patient A, then of patient B).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Ec8. Between touching a patient's groin (femoral pulse) and subsequently examining his/her eye (e.g. to look for anaemia).
Do not care at all O----------O----------O----------O----------O----------O----------O Want me to do it

Appendix II (ctd.)

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

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

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

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

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

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

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

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

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

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

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

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

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

Ed5. After removing gloves used for patient care.

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

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

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

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

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

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

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

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

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

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

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

And some summary questions:

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

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

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

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

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

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

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

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

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

Thank you very much for your time!

Appendix III

THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學
護理學院
School of Nursing
香港 九龍 紅磡
Hung Hom Kowloon Hong Kong

INFORMATION SHEET

Effect of intervention to enhance health care workers' hand hygiene compliance

You are invited to participate in a research study about health care workers' hand hygiene practice. This study is being conducted by Ms. Tai Wai Ming Josepha (Nurse Specialist, Queen Mary Hospital), who is a doctoral student of the School of Nursing in The Hong Kong Polytechnic University.

Background, Risks and Benefits: Hand hygiene is recognized as the leading measure to prevent cross-transmission of microorganisms and to reduce the incidence of health care-associated infections. Nevertheless to sustain compliance to hand hygiene practices in the clinical setting is not easy. Additionally the continuing emergence of multi-drug resistant organisms in healthcare facilities poses a threat to the patients. The purpose of this study is to enhance the hand hygiene practice of health care workers. The results of this study will provide valuable information on promotion of hand hygiene practice. There are no known risks associated with participating in this study.

Procedures: If you agree to participate, you will be required to use about 15 minutes to fill in the questionnaire about your perception of enhancing hand hygiene compliance. Please have the questionnaire completed before 25th August and have it return back together with the signed consent form to the ward manager who will then send back to the investigator. In addition, you may be invited for further participation in the intervention in which detailed information will be provided before implementation.

Voluntary and Confidentiality: Your participation to this study is highly appreciated and is entirely voluntary. You also have every right to refuse the participation without giving any reason. All information related to you will remain confidential and be identifiable by codes known only to the researcher. Additionally all data will be used solely for research purpose and be stored safely with only the researcher and the advisor have the access to the data.

Contact and Questions: If you would like more information about this study, please contact Ms. Tai Wai Ming Josepha at tel. no. 2855 ___ or her supervisors Dr. Mok *(Associate Head, HKPU)* / Dr. Seto *(COS, MIC, OMH)* / Ms. Ching *(SNO, ICN, OMH)* at tel. no. 27666410 / 2855 ___. If you have any complaints about the conduct of this research study, please do not hesitate to contact Secretary of the Human Subjects Ethics Sub-Committee of The Hong Kong Polytechnic University in person or in writing *(c/o Human Resources Office in Room M1303 of the University)*.

Thank you for your interest in participating and making this study a success.

Name of investigator
Tai Wai Ming Josepha

Appendix IV

THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學
護理學院
School of Nursing
香港 九龍 紅磡
Hung Hom Kowloon Hong Kong

Code No.: _____

CONSENT FORM

Effect of intervention
to enhance health care workers' hand hygiene compliance

I _____ hereby consent to participate in the captioned research conducted by Ms. Tai Wai Ming Josepha. Dr. Mok, Dr. Seto and Ms. Ching are her supervisors.

I understand that information obtained from this research may be used in future research and published. However, my right to privacy will be retained, i.e., my personal details will not be revealed.

The procedure as set out in the attached information sheet has been fully explained. I understand the benefits and no risks involved. My participation in the project is voluntary.

I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without giving any reason.

Name of participant _____

Signature of participant _____

Name of researcher Tai Wai Ming Josepha

Signature of researcher _____

Date _____

Appendix V

Feedback on Participation of WHO Hand Hygiene Promotion Program

As participants of the WHO World Alliance for Patient Safety, the Infection Control Team would like to have your opinion on the hand hygiene promotion program for further improvement. This questionnaire would take around 15 minutes to complete. Please answer all questions and return to your ward manager on completion.

Date: _____ Ward: _____ Gender M / F
Age: ☐ <20, ☐ 21–30, ☐ 31–40, ☐ 41–50, ☐ >50 Rank: _____
Years in current position: _____ Years in present institution: _____

1. Do you find the hand hygiene education talk important in helping you understand the risk of transmitting hospital acquired infection?
   Not at all O----------O----------O----------O----------O----------O----------O Very important
2. Which elements of the talk convince you that alcohol-based handrub is better? *(can tick more than one)*
   - ☐ ways of transmission of pathogens via hands
   - ☐ major obstacle for hand hygiene
   - ☐ handrubbing is the solution to time constraint obstacle
   - ☐ effectiveness of alcohol in bacterial reduction
   - ☐ why, what, when and how to perform hand hygiene
   - ☐ others: _____
3. How effective would feedback of hand hygiene compliance increase your hand hygiene practice?
   Not effective O----------O----------O----------O----------O----------O----------O Very effective
4. How useful would posters remind you to perform hand hygiene in your daily work?
   Not at all O----------O----------O----------O----------O----------O----------O Very useful
5. How useful would "scenario description of when to perform hand hygiene" improve your practice?
   Not at all O----------O----------O----------O----------O----------O----------O Very useful
6. How often did your supervisors / ward manager remind you to perform hand hygiene? (between 0 and 100%) ? |__|__|__| %
7. How often did your patients remind you to perform hand hygiene? (between 0 and 100%) ? |__|__|__| %
8. Please specify how much your own hand hygiene performance would affect the hand hygiene compliance of your colleagues? (between 0 and 100%) ? |__|__|__| %
9. With the introduction of handrub, can you specify in your daily work what percentage of handrubbing is used in performing hand hygiene? (between 0 and 100%) ? |__|__|__| %
10. How important would alcohol-based handrub make hand hygiene easier to practice in your daily work?
    Not at all O----------O----------O----------O----------O----------O----------O Very important

Others: *(Answers can be in English or Chinese)*

1. List the biggest barrier that you believe preventing you from performing hand hygiene.
   _____
2. List one incentive that you believe would increase hand hygiene in your ward unit.
   _____
3. Do you consider yourself as a role model (hand hygiene) in your ward unit? Y / N
4. Can you recommend a colleague of the following rank to be the role model in your ward unit?
   Nurse: _____ Doctor: _____ HCA: _____
5. What have you realized, learnt, or changed with the participation of the hand hygiene promotion program?
   _____
   _____
   _____
6. Any other comments or suggestions that you would like to share.
   _____
   _____
   _____

THANK YOU VERY MUCH FOR YOUR TIME!

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