

## Technical Note

# Hand decontamination practices and the appropriate use of gloves in two adult intensive care units in Malaysia

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## Abstract

**Background:** Hand decontamination is a critical infection control practice in the prevention of nosocomial infection. This study was conducted to observe the hand hygiene practices of nurses and doctors in two intensive care units (ICUs) in Malaysia.

**Methodology:** Staff members were observed during patient contacts, and their hand washing techniques and hand hygiene practices were monitored. Five contact periods were observed for staff members while they cared for their assigned patients. Hand hygiene practices before and after patient contacts were categorized as clean uncontaminated, clean recontaminated, new gloves, and unchanged contaminated gloves. Compliance to hand-washing steps and time taken for hand washing were analyzed. Appropriate use of gloves based on CDC criteria also was assessed.

**Results:** Compliance to hand hygiene practices was 70% before each patient contact. Staff members did not completely adhere to the hand-washing steps. The average time taken to wash hands was 20 seconds, and the necessary steps (rubbing palm over dorsum; rubbing fingers interlaced, and rotational rubbing of thumbs) were practiced minimally by all staff. Hand washing protocol was generally followed by all staff (100%). Alcohol hand rubs were available but were used moderately (60%); when used, staff members did not wait for the alcohol to dry. Only 4% of staff changed contaminated gloves between patients.

**Conclusions:** Hand hygiene compliance by ICU staff members needs to be improved. Improving adherence to correct hand hygiene techniques will require effective education programs and behavioral modification techniques. Moreover, hand hygiene guidelines must be incorporated into new staff orientation programs and the continuing education curriculum in the two hospitals studied.

**Key words:** hand hygiene, hand decontamination, gloves, healthcare personal, intensive care unit, education program

*J Infect Dev Ctries* 2010; 4(2):118-123.

(Received 19 October 2009 – Accepted 22 December 2009)

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## Introduction

Nosocomial infection (NI) is a major cause of mortality in intensive care units (ICUs) in both developed and developing countries [1]. The current global effort to reduce NI places strong emphasis on improving compliance to proper hand hygiene techniques, proper usage of gloves, and institutional continuing education programs [2,3,6]. Adherence to hand hygiene recommendations is the most important means of preventing and controlling the spread of NIs in ICUs [2]. However, adherence to proper hand hygiene practices is poor throughout the world, including Malaysia [6-7,8]. ICU patients are at particularly high risk of acquiring NIs because of several risk factors that are known to contribute to the

transfer of pathogenic microorganisms from patient to patient are common in these units. These risk factors include inadequate placement of wash basins and sinks, towels, and hospital supplies; invasive procedures; inappropriate use of antibiotics; lack of knowledge about infection control practices; overcrowding; and high patient to nurse ratios [4].

The transmission of pathogenic microorganisms via hands begins when microorganisms are shed into a patient's immediate bedside unit (e.g., in the bedding). These microorganisms are then transferred to a staff member's hands, where they can survive for at least several minutes before transmission. The omission of hand washing, incorrect technique, or use of inappropriate hand hygiene agents can lead to the

transmission of microorganisms when the staff member has contact with another patient. For transmission to occur, the staff member's contaminated hands or gloves must come into direct contact with another patient or with a formite that is in direct contact with the patient.

Many factors contribute to non-adherence to the recommended hand hygiene guidelines [4,8]. Therefore, it is crucial to understand the current practices and behaviors of healthcare workers in order to develop appropriate and targeted interventions that might improve their hand hygiene practices and the correct use of personal protective equipment. The purpose of this study was to assess the compliance of healthcare professionals (doctors and nurses) to the recommended hand hygiene guidelines and correct usage of gloves in the two ICUs in Malaysia.

## Materials and Methods

### *Setting*

One ICU in a government hospital (A) and a second ICU in a teaching hospital (B) in Malaysia were studied. The total number of staff members in ICU A was 60, and 40 staff members worked in ICU B. On average, for each shift there was one nurse per patient and three doctors were present, except for night duty (2–3 patients per 8 hour shift). These numbers were the same on public holidays.

ICU A had a capacity of 16 beds at the time of the study. Between 2001 and 2006, the average number of beds in the entire hospital was 900. During the study period, the average length of stay varied between 3.94 to 5.37 days, with a bed occupancy rate of 57.24% to 69.4%. Mortality rate varied from 3.6% to 3.99%. A multiracial group of patients were admitted in this unit.

ICU B had 12 beds at the time of this study. The average length of stay varied from 10.9 to 27.6 days, with a bed occupancy rate of 42.4% to 73.7% during the study period. The majority of patients (95%) were Malays.

The ICUs did not have glass walls separating each patient unit; rather, the patient units were separated by curtains. The ICUs were equipped with hand washing sinks designed for closing the taps with the forearm; antiseptic soap and disposable paper towels were provided at each sink. Each patient unit also had 70% alcohol solution for hand rubbing and posted notices reminding everyone to wash hands. Adequate running water with working sinks was present during the study period. The hand hygiene

policy for the unit included hand washing with soap and water before and after patient contact; use of the alcohol hand rub on unsoiled hands during emergencies; use of gloves on clean hands; and disposal of gloves appropriately after each patient contact.

### *Procedure*

A participatory observational study was conducted on 101 staff members. The study took place over a period of 3 months in the two ICUs. The observer worked in the two ICUs collecting continuous surveillance data with permission granted by the staff. For 12 months prior to the three month observation period, the observer familiarized herself with the ICU settings and procedures and she helped the staff with general activities. This was followed by the three month period of observation and documentation during morning and afternoon shifts (7 a.m. to 2 p.m.; 2 p.m. to 9 p.m. daily) when most clinical activities occurred. Staff members were unaware of these observations, even though they had provided their consent one year prior. Three target patients were selected per day and the doctors' and nurses' contacts with those patients were observed five times. Each staff member was observed until the designated endpoint had been reached; the endpoint was when a break in technique was observed more than five times. Each observed contact with the target patient provided two opportunities for the staff member to follow correct hand hygiene procedure (before and after), and these were recorded separately. Additionally, complex or interrupted care procedures, in which the staff member contaminated his/her hands by touching objects outside the patient, sterile field, or patient unit, provided a separate hand hygiene opportunity. Failure to adhere to recommended guidelines in these situations was counted as non-compliance. Staff members who did not practice correct technique more than five times were considered to always use poor technique. Staff members who only broke aseptic technique once but performed the correct technique four other times were considered to rarely use the poor technique. Staff members who demonstrated incorrect practice between two and four times were considered to use poor technique most of the time.

### *Nature of patient contacts for hand hygiene opportunities*

Patient characteristics and the type of devices used for the care of each patient were recorded. The

nature of patient contacts was recorded based on the presumed risk of contamination or transmission of microorganisms. Hand washing compliance was defined as hand washing with antiseptic soap and water before and after each patient contact. Recontamination of washed hands by touching objects before patient contact during a set procedure was counted as non-compliance. Hand decontamination with the alcohol rub before contact was observed and recorded as hand hygiene practices. Hand washing technique was recorded using the essential steps of hand washing as shown in the checklist below. Hand hygiene was required regardless of whether gloves were used. Appropriate glove usage was defined as wearing new gloves on clean hands before patient contact and removal of the gloves without contaminating the environment after patient contact. Contacts with instruments were not recorded separately, but the procedure for which the instrument was contaminated was categorized as a break in asepsis.

The criteria and referenced checklist for hand hygiene (hand washing) developed by the U.S. Center for Disease Control are as follows:

1. Removing all accessories (bracelets, watches, and, if possible, rings) and folding the sleeve above the elbow
2. Turning on water, wetting hands, and applying antimicrobial soap
3. Rubbing palm to palm (approximately 3–6 times; 3–6 seconds)
4. Rubbing palm over dorsum (approximately 3–6 times; 3–6 seconds)
5. Rubbing fingers interlaced (approximately 3–6 times; 3–6 seconds)
6. Rubbing backs of fingers (3–6 times; 3–6 seconds)
7. Rotational rubbing of thumbs (3–6 times; 3–6 seconds)
8. Rubbing wrists (approximately 6 times; 6 seconds)
9. Rubbing forearms (approximately 6 times; 6 seconds)

10. Rinsing under running water
11. Keeping hands higher than elbows while rinsing
12. Wiping hands dry with paper towel without touching right and left hands
13. Wiping hands in fingertip-to-wrist direction without touching right and left hands
14. Turning off water without contamination

### Statistical analysis

The Statistical Package for Social Sciences (SPSS) (version 12.0.1) software was used to analyze the data. Descriptive analysis was used to analyze hand hygiene compliance before and after patient contacts among nurses and doctors as a cohort group.

### Results

The patient to nurse ratio during the study period varied from 1:1 to 1:3. In total, 505 patient contacts by 101 staff members were analyzed (i.e., five contacts per staff member). The majority (85%) of patient contacts were by nurses. The characteristics of the staff members and their hand hygiene practices are as follows.

The mean (SD) age of staff members was 30 (6.47) years, and the mean post-graduation experience was 5 years. Most staff members were female (79.2%,  $n = 80$ ). The staff consisted of 61 (60.4%) nurses and 40 (39.6%) doctors. A continuous education program about infection control was attended by 18 staff members, whereas the other 83 did not attend any formal workshops or lectures during the study period.

The hand washing protocol was generally followed. Hand washing was inadequately practiced, and the correct hand washing procedure was not followed by 70% of the staff. The average time taken to wash hands varied between 15 and 20 seconds, and rubbing the palm over the dorsum, rubbing fingers interlaced, and rotational rubbing of thumbs were not practiced. Alcohol hand rubs were available but were used only moderately; when used, staff members did not wait for the alcohol to dry. Some staff members contaminated their hands after hand washing but before patient contact by touching case notes and observation charts, answering phones, touching their head dress, adjusting their mask, or touching their body.

**Table 1.** Pattern of hand washing and usage of gloves for hand hygiene

<b>Staff (n = 101)</b>	<b>Yes (%) (n)</b>	<b>No (%) (n)</b>
<b>Adherence to indications of hand washing</b>	30	70 (71)
<b>Hands washed only before contact</b>	70 (71)	30
<b>Hands washed before and after contact</b>	32.7 (33)	67.3 (68)
<b>Hands washed before wearing gloves</b>	28.7 (28)	71.3 (72)
<b>Hands washed immediately after removal of gloves</b>	28.7 (29)	71.3 (72)
<b>Hands washed immediately after removal of mask</b>	1.0(1)	99.0 (100)
<b>Misuse of gloves (no indications)</b> <i>(Wears gloves when not performing contaminated procedures. Always wears gloves with no indicated purpose)</i>	74.3 (75)	25.7 (26)
<b>Wears gloves to answer phone (do not know whether clean or contaminated)</b>	93.1 (94)	6.9 (7)
<b>Wears gloves to write notes (do not know whether clean or contaminated)</b>	94.1 (95)	5.9 (6)
<b>Uses contaminated gloved hands to pull patient screens before glove removal</b>	100.0 (101)	0.0
<b>Removes contaminated gloves immediately after procedure before doing other chores on other patients</b>	29.7 (30)	70.3 (71)
<b>Removes contaminated gloves without soiling hands</b>	99.0 (100)	1.0 (1)
<b>Disposes of gloves correctly into the right bin without contamination</b>	100 (101)	-
<b>Appropriate glove use</b>	26.7 (27)	73.3 (74)
<b>Substitute gloves for hand washing</b> <i>(Replaces hand washing by using gloves)</i>	70.3 (71)	29.7 (30)
<b>Gloves worn on hands when contaminated are changed after contact</b>	27.7 (28)	72.3 (73)
<b>Contaminated gloves not changed before doing other patient care activities on same patient</b>	78.2 (79)	21.8 (22)

Key: Yes = always done in all five contacts with patients; No = sometimes or infrequently done, meaning performed in fewer than five contacts with patients.

For glove use, 71.3% of the staff did not wash their hands before putting on gloves, whereas 29.7% removed their gloves immediately after procedures before doing other chores and 28.7% washed their hands after removing gloves. In addition, 93.1% did not remove their gloves when answering phones and wrote notes with their contaminated gloves still on their hands. 71.3 % did not wash their hands after removal of gloves. General misuse of gloves was noted in 74.3% of the staff; misuse refers to unnecessary wearing of gloves when there was no indication for glove usage. Contaminated gloves were not removed by 70.3% of the staff after they completed procedures and moved on to other chores

such as charting observations. Moreover, gloves were substituted for hand washing by 71 of the 101 staff members studied.

## Discussion

During this study there was a patient-to-staff ratio of 1:1 (morning shift), 2:1 (evening shift), and 3:1 (night shift and public holidays) for intensive care services. About 30% of patient contacts were made with clean uncontaminated hands. Gloves were used appropriately in 18.8% of patient contacts, but gloves were not changed between patients in many high- and low-risk contacts. Low-risk contacts included nasogastric tube feeding, placement of electrodes or an

oximeter on the skin, holding hands, bathing, taking vital signs, and making beds. High-risk contacts included invasive procedures such as insertion of tracheotomy tubes, insertion of central venous lines, administration of intravenous drugs, suctioning of endotracheal tubes, and changing dirty diapers of bedridden patients.

Proper hand hygiene practices in many ICUs have been shown to be suboptimal [5], ranging from 30% to 48%. However, the compliance rate in this study was within the range of values reported in published works on hand hygiene compliance in developed countries. The low compliance to hand hygiene practices found in the current study could be attributed to the emergency situations in an ICU, the heavy workload required to treat seriously ill patients, the distance required to reach washing basins, the high patient-to-staff ratio, staff members' unawareness of their habits, and new staff members' lack of knowledge about good hand hygiene practices. Following appropriate hand hygiene practices and creating awareness of such practice represent a great challenge to staff members. Pittet *et al.* [3] reported that high workload and high demand for strict adherence to hand hygiene were the most significant risk factors for noncompliance. In the current study, hand washing duration was within the recommended time limit and compliance to hand washing techniques was fairly good and comparable to that of other studies [4].

Other studies have shown high rates of inappropriate glove use in ICUs [7]. In the current study, the high rate of inappropriate use of gloves and the lack of use of the available alcohol solutions might be attributable to ritual habits and to resistance to following protocols. Accessibility to clean gloves could be another factor that contributed to the high frequency of unchanged gloves in this study as the ward manager provided a limited number of gloves at any given time. As such, it is possible that staff members were conserving gloves. Lack of knowledge about infection control also may have contributed to the high rate [7] of unchanged gloves for low-risk contacts by staff members. Although the 70% alcohol solution that was available contained emollient, staff members complained that the use of this solution made their hands dry, red, and rough. Thus, the unpleasant effects of the alcohol solution and lack of knowledge about its benefits in infection control could have contributed to noncompliance in its use.

The strength of this study was that direct observations were made unobtrusively under the

guise of collecting and documenting surveillance data for NI, and none of the staff members were aware that hand hygiene practices were being observed. Thus, the findings of this study could represent the accurate status of hand hygiene practices in the two ICUs because the method we used was the gold standard for measuring adherence rate [9,10]. The study's limitations were the small number of observations, the short duration of the study, and the lack of repeated measures. The data collection was limited to the peak time (morning and afternoon shifts) of clinical work in the ICUs, and only 101 available staff members were observed. Hand hygiene practices varied between the two institutions, and different strategies are needed to improve the practices among healthcare workers in the different ICUs [8].

Education targeted at the following issues will improve the hand hygiene practices in the ICUs: (a) improve attitude about hand washing before and after patient contact; (b) increase awareness of the implications of hand recontamination and the benefits of clustering patient care; (c) improve knowledge and attitude about appropriate use of gloves; and (d) improve knowledge about alcohol rub use in emergencies and its benefits in settings with high workloads. Improving the provisions of basic hospital supplies, especially gloves and alcohol rub with emollient, is also recommended [4]. In the long term, we recommend a revision of current medical, health sciences, dental, and nursing training curricula to include preventive practices, such as hand hygiene, that reduce the risk of healthcare associated infections in Malaysia.

## Conclusion

Non-adherence to infection control practices such as hand hygiene is the single most potentially modifiable cause of NI and sepsis in adult ICUs. Factors contributing to the burden of NI could be overcrowding, lack of infrastructure, high patient-to-staff ratio, and inappropriate use of antimicrobial drugs. Focused and feasible educational programs that improve hand hygiene practices and appropriate use of gloves are crucial for improving the outcome of hospitalized ICU patients in the two ICUs studied. The "Predisposing, Reinforcing, Enabling Constructs in Educational Diagnosis and Evaluation Health Education Theory" should be used as the theoretical framework for continuous in-service education programs.

## Acknowledgements

We thank the staff members of the ICUs of the two centers for their professional help and support, as well as the directors of the two hospitals and their ethical committees for granting us permission to conduct this study. We would also like to extend our thanks and appreciation to INFORMM, Health Campus, Universiti Sains Malaysia for its encouragement and financial support of this study.

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**Conflict of Interest:** No conflict of interest is declared.