

Efficiency of Hand Hygiene among Undergraduate and Postgraduate Dental Students

ประสิทธิภาพการล้างมือในนิสิตทันตแพทย์ระดับปริญญาบัณฑิตและหลังปริญญา

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ABSTRACT

Hand hygiene is known for reducing risk of transmission the pathogen between patient and healthcare workers. In oral surgical procedures, the pathogens on surgical team members' hands can gain access to surgical wound through unnoticeable small defect in gloves. Therefore, the efficiency of hand hygiene before surgical operation should be concerned. This study aimed to study the efficiency of surgical hand washing in dental students. The sample of bacteria on dental students' hands was collected by swab technique before and after surgical hand washing. The colony forming units (CFUs) were counted. The result demonstrated that the CFUs counts on hand after hand washing were substantial reduction. Interestingly, undergraduate students (UG) had less CFU counts than postgraduate students (PG). In conclusion, UG had the superior efficiency of hand hygiene compared with PG.

บทคัดย่อ

การล้างมือช่วยลดความเสี่ยงในการแพร่กระจายเชื้อระหว่างผู้ป่วยและบุคลากรทางสาธารณสุข ในการทำงานทางศัลยกรรมช่องปาก เชื้อโรคบนมือของทีมผู้ทำการผ่าตัดสามารถเคลื่อนสู่แผลผ่าตัดผ่านรอยร้าวของถุงมือที่อาจจะมองไม่เห็น ดังนั้นบุคลากรทางสาธารณสุขจึงควรตระหนักถึงประสิทธิภาพการล้างมือก่อนทำศัลยกรรม การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาประสิทธิภาพการล้างมือสำหรับการทำงานศัลยกรรมของนิสิตทันตแพทย์ โดยการเก็บตัวอย่างเชื้อแบคทีเรียบนมือของนิสิตทันตแพทย์ก่อนและหลังล้างมือเพื่อทำการทางศัลยกรรม นับจำนวนเชื้อแบคทีเรียบนมือ ผลการศึกษาพบว่าจำนวนเชื้อแบคทีเรียบนมือลดลงเป็นจำนวนมากหลังล้างมือ และพบว่าหลังล้างมือจำนวนเชื้อแบคทีเรียบนมือของนิสิตทันตแพทย์ระดับปริญญาบัณฑิตลดลงน้อยกว่านิสิตทันตแพทย์หลังปริญญา โดยสรุปคือ การล้างมือของนิสิตทันตแพทย์ระดับปริญญาบัณฑิตมีประสิทธิภาพมากกว่านิสิตทันตแพทย์หลังปริญญา

Key Words: Hand hygiene, Oral surgery clinic, Dental students

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Introduction

Hand hygiene is recognized as the most crucial procedure to prevent healthcare-associated infections (HAIs), because hands are one of the most common sources of microorganism transmission in patient care especially during surgical procedures. The infectious microorganisms can be transferred from patients to surgical team members, surgical team members to patients or even patients to patients. Health care workers' hands become progressively colonized with commensal flora as well as potential pathogens during operation or patient care (WHO, 2009). Total bacterial counts on the of health care workers range from 3.9×10^4 to 4.6×10^6 CFU/cm² and may increase as great as 4000-fold per hour when the skin is occluded with gloves (WHO, 2009) (Miller & Palenik, 2010).

The organisms on surgical team members' hands may be transferred to the patient's mucous membranes or into the patient's blood stream via injection sites or open wound created during surgical procedures and lead to surgical site infections (SSIs). These result in poor quality of life as delayed wound healing, requiring longer hospitalization, re-admission to hospital or intensive care unit (ICU) treatment, increased use of antibiotic and additional cost. Moreover, SSIs also increased morbidity and mortality rates (Kirkland et al, 1999) (Owens, 2008). Therefore, good knowledge and attitude related to hand hygiene, especially effective hand washing are critical factors to prevent cross infection in every aspect.

Hand hygiene could reduce the transmission of health-care associated pathogens and the incidence of infection (Hand Washing Liaison Group, 1999) (Herud et al, 2009). Although the availability and routine use of gloves for surgical procedure raise

question about the relative importance of hand hygiene, hand washing and gloving technique are still a serious concern. The surgical team members should be reminded that pathogens can gain access to surgical wound via an unnoticeable small defect in gloves. Among all surgical procedures, oral and maxillofacial surgery including orthognathic surgery had the second highest prevalence of gloves perforations after gynecological surgery. This may due to the involvement of sharp instrument usage e.g. wire and orthodontic tooth brackets (Kuroyanagi et al, 2012). The most common site of glove perforation was the index finger of glove worn non-dominant hand (Kuroyanagi et al, 2012) (Laine & Aarnio, 2001) (Green & Gompertz, 1992).

Although hand hygiene is recognized as the key measure to prevent cross-transmission of pathogens and reduce the incidence of SSI, the overall average health care workers' compliance is less than 40% (WHO, 2009). The reasons of non-compliance included timing pressure, lack of sinks and antiseptic agents, poor knowledge regarding clinical efficiency of hand hygiene, bad attitude and negative influence of senior staffs considered the role models (Pittet et al, 2004) (Kanitha et al, 2005). Basurrah and Madani reported an adherence to hand hygiene before patient contact was highest among medical students (43.3%) and lowest among residents (0%) (Basurrah & Madani, 2006). Disciplinary differences in hand hygiene education and assessment during undergraduate training may impact on graduates' behavior upon entering the workforce (Mortel et al, 2010).

Multiple studies have been conducted to study the practice related to hand hygiene among nursing and medical students (Mortel et al, 2010) (Mortel et al, 2011) (Kadi and Salati, 2012). A study in

Greek nursing and medical students demonstrated that nursing students had greater hand hygiene practices, and considered hand hygiene was more important in their curriculum than medical students (Mortel et al, 2010). Moreover, the student's hand hygiene knowledge and belief may increase over time, particularly after start taking care of real patients (Mortel et al, 2011). Graf et al analyzed beliefs about hand hygiene in medical students in their first clinical year from survey sheets, only 21% of these students knew the indications for hand hygiene and most of them expected that the compliance about hand hygiene would be decreased in more experienced physicians (Graf et al, 2011). Considering only the compliance of hand hygiene is not enough, the efficiency of hand hygiene should be concerned. Particularly, dental treatment is a procedure definitely contact patient's secretion, some procedures can introduce bacteria to the blood stream and cause systemic complication. Hand hygiene should be considered as a strict protocol to prevent transmission of infection. Unfortunately, no study has reported a hand hygiene practice among dental students. Therefore, we are interested in studying the efficiency of hand hygiene among undergraduate and postgraduate dental students.

Objectives of the study

To observe amount of viable microorganisms on hand of undergraduate and postgraduate dental students before and after hand hygiene.

Methodology

Study design

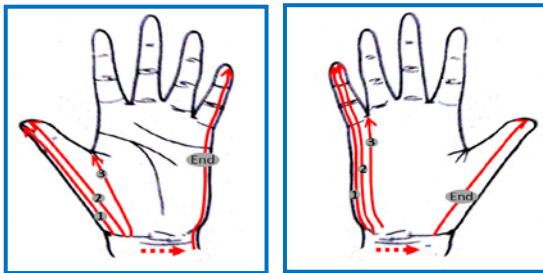
A cross-sectional study was undertaken from September to December 2013 in Oral and Maxillofacial Surgery Department, Faculty of

Dentistry, Chulalongkorn University (Bangkok, Thailand), after being approved by the ethic committee. On the basis of WHO's concept of "Five moments for hand hygiene", the 4th-year, 5th-year, 6th-year undergraduate (UG) and postgraduate (PG) dental students attending oral surgery clinic were conveniently selected. The sample of bacteria on participant's dominant hand was collected before hand washing. Then the participants were asked to perform surgical hand wash with 5 milliliters of chlorhexidine gluconate in their usual technique. Immediately after drying the hands with sterile towel, before donning fitted gloves, sample of bacterial culture from participant's non-dominant hand was collected again with the same technique.

Specimen collection

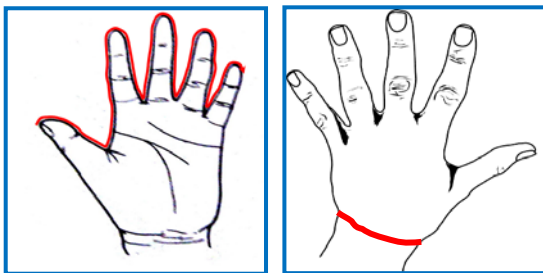
Four sterile cotton swabs were used to collect bacteria from four areas of operator's hand by reproducible technique as follow: 1) Ran the first sterile cotton swab across the palm, starting from the wrist to the fingertip two times and one time from the wrist to inter-finger's area, repeated in the same action from thumb to little finger. 2) Ran the second sterile cotton swab across the back of the hand in the same action mentioned previously. 3) Ran the third sterile cotton swab across the border of each finger, starting from the tip of the thumb to little finger's tip. 4) Ran the fourth sterile cotton swab around the wrist 2 times. The steps of specimen collection are showed in figure 1.

The tip of cotton swab was cut by sterile scissors and the put into test tube containing 1 milliliter of sterile phosphate buffer saline (PBS). All test tubes were delivered to the Microbiology Department for culturing.



Step 1: ran the first sterile cotton swab across the palm

Step 2: ran the second sterile cotton swab across the back of the hand



Step 3: ran the third sterile cotton swab across the border of each finger

Step 4: ran the fourth sterile cotton swab around the wrist

Bacterial culturing technique

To recover bacteria from cotton swab, the test tubes containing cotton swab's tip were placed on shaker at 100 rpm for 10 minutes, then vortexed vigorously for 1 minute. One hundred microliters of sample was pipette and spread on Tryptic soy agar (TSA) plate. The sterile glass balls were used to spread the sample over the surface of an agar plate. After 48 hours of incubation at 37 °C in aerobic condition, colony counts were obtained to calculate colony forming unit (CFU).

Statistical analysis

One-way ANOVA was conducted to ascertain the difference of CFU counts on hand before hand hygiene. Kruskal-Wallis Test was conducted to analyze the difference of CFU counts on hand after perform surgical hand wash and percent reduction of

bacteria. All data was analyzed with SPSS software for Windows version 17.0. A p-value of < 0.05 is considered to be statistically significant.

Results

Total number of bacteria on hand before and after hand hygiene among dental students

One hundred and twenty dental students including thirty two of 4th-year, thirty four of 5th-year, thirty of 6th-year UG and twenty four PG participated in this study. Bacterial load on hand prior to hand hygiene was calculated from the sum of all bacteria from four regions of hand. The mean±SD of CFU counts on hands before hand hygiene were 1974.06±10081.5, 15034.71±9473.18, 12709±9516.53 and 15369.17±9752.28 in 4th-year, 5th-year, 6th-year UG and PG, respectively (Fig. 2). However, no significant difference in total number of bacteria on hand were observed among all groups.

Overall, surgical hand wash performed by UG and PG dental students resulted in a substantial reduction of total number of bacteria on hand. The mean±SD of CFU counts on hands after hand hygiene were 5.31±8.03, 17.94±16.10, 30±19.48 and 77.50±34.04 in 4th-year, 5th-year, 6th-year UG and PG, respectively. PG had significantly higher number of bacteria left on hand after performed surgical hand wash compared to all groups of UG (P < 0.001). Moreover, the significant different were also found among UG (P < 0.001) (Table 1).

Number of bacteria in each region of hand before and after hand hygiene among dental study

From our data, the dirtiest parts of hand determined by highest number of bacterial accumulation were at the back of operator's hand,

followed by palm, border of each fingers and wrist, respectively. However the palm of 6th-year UG was the site where bacteria least accumulated (Fig 2). After

hand hygiene, highest numbers of bacteria were found at the wrist and at the border of each finger, respectively (Fig 3).

condition	parameter	4 th -year UG	5 th -year UG	6 th -year UG	PG
Before hand hygiene	mean±SD	1974.06±10081.50	15034.71±9473.18	12709.00±9516.53	15369.17±9752.28
	median	17050	14945	10745	13700
After hand hygiene	mean±SD	5.31±8.03 *	17.94±16.10 *	30±19.48 *	77.50±34.04 *
	median	0	20	20	70

* P < 0.001 analyzed by Kruskal-Wallis Test among four groups

Table 1: Comparison the CFU counts on hands of UG and PG dental students before and after hand hygiene.

The CFU counts on hand after hand hygiene were substantial reduction. The difference was statistically significant among all groups.

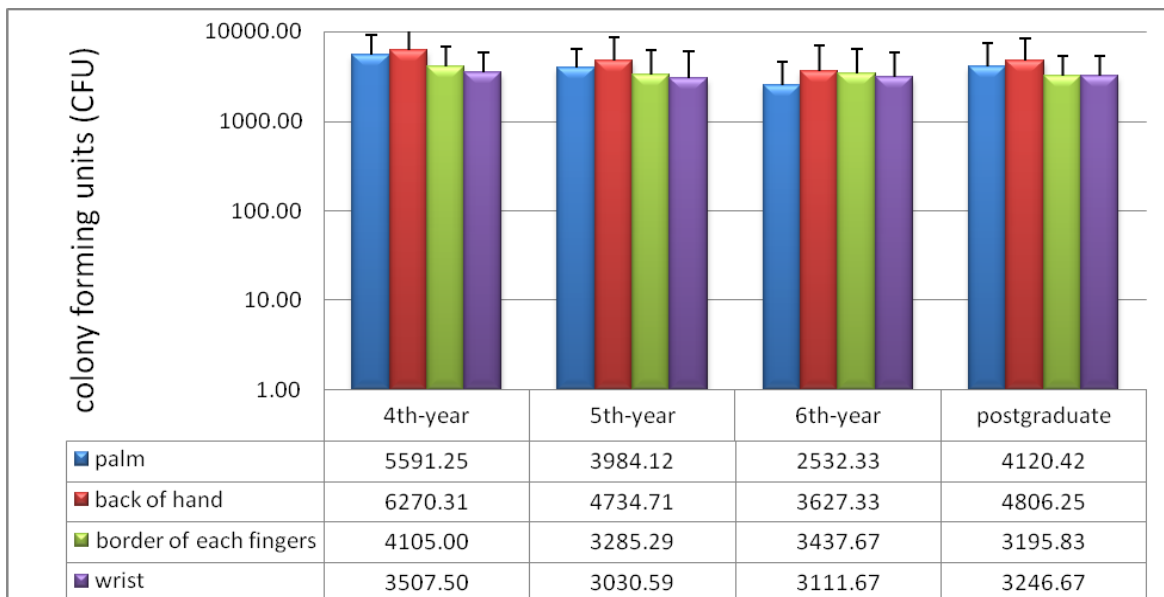


Figure 2: Comparison of bacterial counts on hands by region before hand hygiene. The back of the hand was the site where bacteria most accumulated.

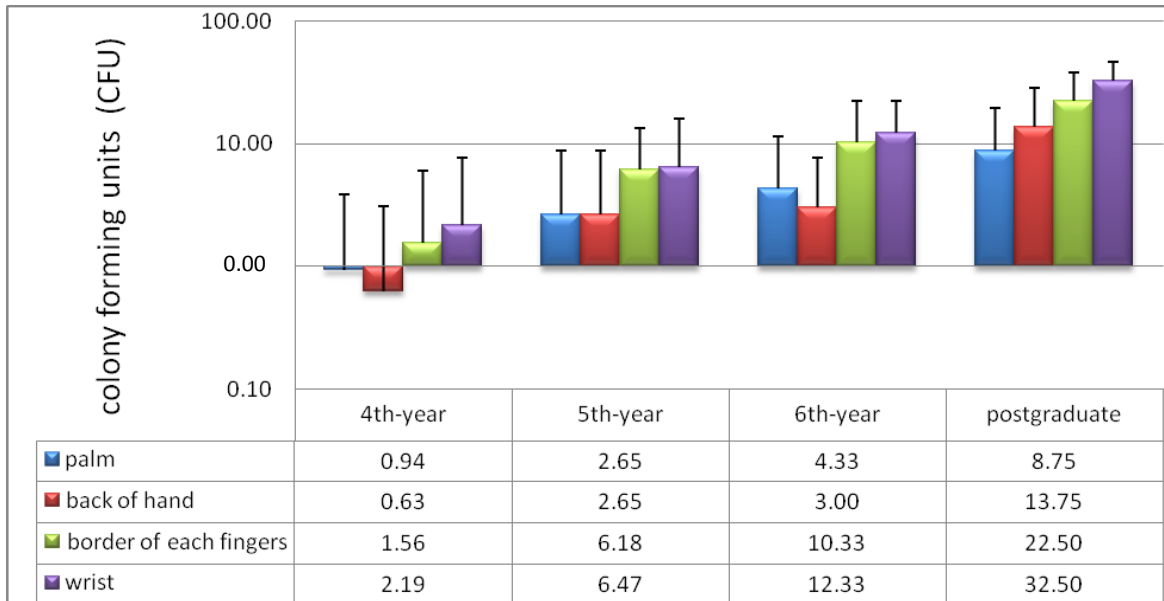


Figure 3: Comparison of bacterial counts on hands by region after hand hygiene. The wrist was the site where bacteria most remaining.

Efficiency of hand hygiene determine by percent reduction of total recoverable bacteria on hand after surgical hand wash among dental students

After surgical hand wash, the percentage of bacteria on hand was considerably reduced, as high as 99 percent of bacteria on hand were eliminated. The average percent reduction were 99.97 ± 0.06 , 99.82 ± 0.24 , 99.65 ± 0.32 and $99.23 \pm 0.64\%$ in 4th-year, 5th-year, 6th-year UG and PG, respectively. Despite the minimal difference of percent reduction, statistically significant different were found among all groups (Fig 4). This result was consistent with CFU counts on hand after hand hygiene.

Efficiency of hand hygiene determine by percent reduction of total recoverable bacteria on each region of hand after surgical hand wash among dental students

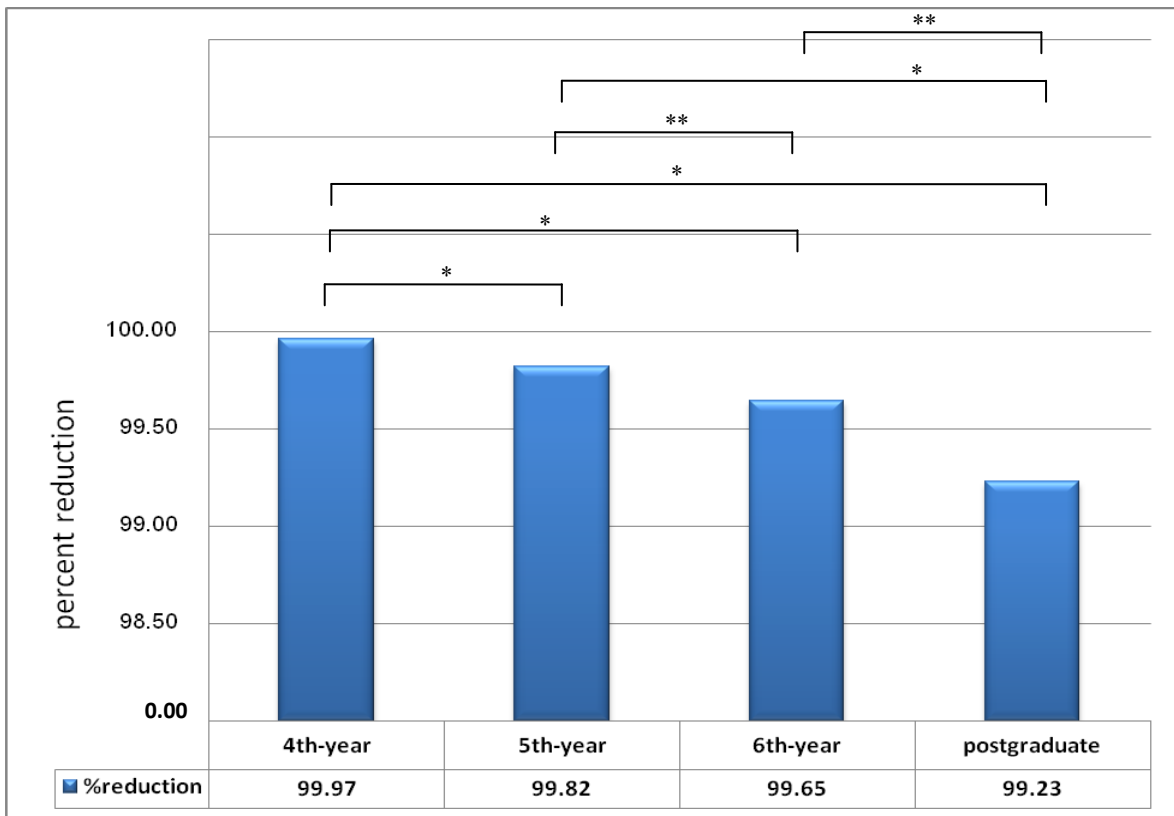
The percent reduction of bacteria in each region of hand of 4th-year UG was comparable.

by lower percent reduction of bacteria were obtained in those areas (Fig 5).

Discussion

The WHO Guidelines on Hand Hygiene in Health Care was developed since 2002 to improve practices and reduce risk of transmission of pathogen between patient and healthcare workers (HCWs). In surgery, hand washing and gloving technique are still a serious concern. Among all surgical procedures, the pathogens on surgical team members' hands can gain access to surgical wound through unnoticeable small defect in gloves. Thereby, regarding the compliance of hand hygiene before surgical operation is not enough, the efficiency of hand hygiene should be concerned.

The number of UG dental students participated in this study was not different between groups. Even though the number of PG dental students was quite lower because of a limitation of number of students enrolled in this program.



* P < 0.001, P = 0.002 analyzed by Kruskal-Wallis Test

Figure 4: Comparison percent reduction of bacteria after hand hygiene among undergraduate and postgraduate dental students. The difference was statistically significant among all groups.

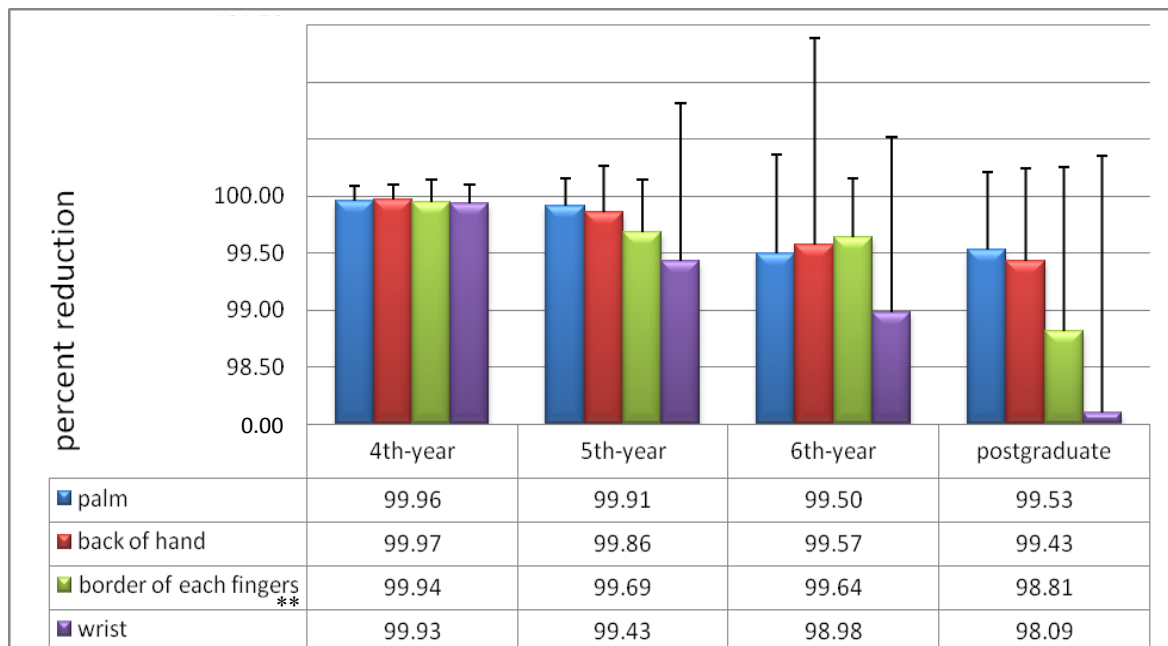


Figure 5: Comparison of percent reduction of bacteria by region after hand hygiene. The percent reduction was lowest at the wrist followed by border of each fingers in all groups.

The efficiency of hand hygiene among UG and PG dental students in this study was represented by the number of bacteria remaining after surgical hand washing. For the quantification of CFU counts, swab technique and culturing on agar plate was chosen over the method of using hand imprint technique for more efficacious in recovering the microorganism burden from the whole hand. Furthermore, this technique was more effective than “glove juice” technique in collecting the bacterial flora colonized on groove of hand skin and provided a more precise measurement of bacterial contamination in each region. Species identification was not performed because this primary focus is to obtain a quantitative rather than a qualitative analysis.

In swab technique, participant’s dominant hand was chosen for collecting the sample of bacteria because people usually use dominant hand doing activity in daily life, therefore collecting the sample bacteria contaminated on dominant hand would be more precise than the sample bacteria on non-dominant hand. After hand hygiene, participant’s dominant hand was not chosen to collect the sample of bacteria again because most of bacteria cultured on hand had been previously removed by swab technique. Thus, the sample of bacteria remaining after hand hygiene was collected from participant’s non-dominant hand.

This study demonstrated that the percent reduction of bacteria was lower when the dental students were in higher year, as the 4th-year UG had the highest percent reduction and PG had the lowest percent reduction of bacteria on hand. In 6-year undergraduate dental curriculum of Chulalongkorn University, the infection control theory is in the 2nd year course and the practice of hand hygiene is in

the 4th-year course just before attending clinical course. Therefore an adherence to hand hygiene of 4th-year UG may higher comparing with seniors. Since the hand hygiene is the basic knowledge, there was no repeat in PG education course. This result was consistent with other studies demonstrating that the adherence and compliance to hand hygiene decreased according to duration of education. Basurrah and Madani reported an adherence to hand hygiene before patient contact was highest among medical students (43.3%) and lowest among residents (0%) (Basurrah and Madani, 2006). Graf et al found that the first clinical year medical students expected the compliance about hand hygiene decreased in more experienced physicians (Graft et al, 2011). Contrarily, Kanitha et al reported that residents or fellows had a higher adherence to hand hygiene (16.9%) compared with medical students (3.8%) (Kanitha, 2005). Mortel et al reported the nursing and medical student’s hand hygiene compliance improved over time, particularly increasing the experience of real patient care (Mortel et al, 2011).

To our knowledge, this study is the first report of the efficiency of hand hygiene among dental students. It has provided the important information on the efficiency of hand hygiene related to the duration of education, which may benefit in improving dental curriculum. Our result implied that the more estranging from emphasis on infection control, the more neglecting to practice hand hygiene. Thus, the infection control program and hand hygiene practice should be revised every year and should be performed in postgraduate dental course.

This study was conducted in a minor oral surgery clinic where the convenient and accessible hand hygiene facilities such as antiseptic hand washing

solution, tap water with sink, sterile towel were provided. In this study chlorhexidine gluconate hand washing solution produced from the same manufacturer was dispensed to each participant in the same amount. The participants were not observed during practice hand hygiene, to let them performed their regular technique, which may vary in technique and length of time depending on each individual. The sample of bacteria on participant's hand was collected by the only one examiner, therefore technical bias was very unlikely. In conclusion, hand hygiene in dental students seems to be effective as more over 99% reduction of bacteria. However, UG had the superior efficiency of hand hygiene compared with PG.

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