



An evaluation of the effectiveness of nursing students' hand hygiene compliance: A cross-sectional study

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ABSTRACT

Background: Hand hygiene is crucial for safe healthcare. Although the use of alcohol hand rubs is encouraged in clinics, there are few studies that focus on the proper use of alcohol hand rubs among nursing students.

Objectives: The aim of this study is to evaluate the effectiveness of alcohol-based hand rub application and proper hand washing techniques which influence nursing students' hand hygiene compliance to make recommendations for future practice of hand hygiene training.

Design: This cross-sectional study was carried out from May 3/June 3 2016 with the participation of 257 nursing students. Their hand hygiene techniques were analyzed using a UV lamp and an alcohol-based mix marked with fluorescence.

Results: Of the participants, 77.0% were first-year students and 55.3% were males. The percentage of skin surface covered by alcohol-based hand rub was 82.0% on both hands. The lowest percentages of skin area covered by fluorescent-labelled hand rub were identified in the metacarpal area near the wrist and thumbs. While there was a difference between points for using proper hand-rub technique on the dorsal and palmar surfaces of the hands ($p < 0.01$), no difference was determined between the right and left hands ($p > 0.05$). It was found that the largest fluorescent remains were on fingers after hand-washing, and there was a difference in terms of hand-washing points between right-left hands and dorsal-palmar surfaces ($p < 0.01$).

Conclusions: There is a need to improve nursing students' compliance with hand hygiene. It is suggested that the use of hand-rub among students should be popularized, and new techniques that prevent the frequently omitted areas of the hands should be integrated into the curriculum.

1. Introduction

Over the last decade, there has been a remarkable increase in epidemics around the world. Healthcare workers form the leading group that is affected by these epidemics. As a large portion of healthcare personnel, nurses have proximity with infected individuals, and this puts them at higher risk of being exposed to contagious diseases (Bernard et al., 2009; Branch-Elliman et al., 2015; International Council of Nurses [ICN], 2016). During the worldwide epidemic of early 2003, healthcare workers accounted for a large proportion of persons with severe acute respiratory syndrome (Park et al., 2004). In recent years, during the Ebola disease outbreak in West Africa, 815 of healthcare workers infected with Ebola and two thirds of them died, > 50% were nurses (ICN, 2016). Also out of the epidemics, healthcare workers were affected by occupational exposures. Kuncio et al. stated that pediatric health workers were often exposed to pertussis due to inadequate infection control measures (Kuncio et al., 2014). From the perspective of

patients, infections stemming from healthcare not only increase their health expenses, but also constitute a significant risk factor for morbidity and mortality (Luangasanatip et al., 2015; World Health Organization [WHO], 2016). More than 2.5 million cases of healthcare-associated infections (HAIs) occur in the Europe, total burden of HAIs in the EU of 501 DALYs per 100,000 people (Cassini et al., 2016), 4.0% of inpatients in U.S. acute care hospitals had at least one HAI (Ray et al., 2015).

On the other hand, it is for sure that hand hygiene (HH) is the most important of all control measures against all infections for both healthcare personnel and patient safety (WHO, 2009; Sax et al., 2007; Allegranzi and Pittet, 2009). World Health Organization suggests that alcohol based handrub (AHR) should be used as the first choice for hand hygiene of nonsoiled hands to safer care. If hands are visibly dirty or when exposure to potential spore-forming organisms, they need to be washed with soap and water (Boyce and Pittet, 2002; WHO, 2009). Despite its ease and extensive regulations on HH, studies show that

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compliance with HH is below the desired level among nurses (Allegranzi and Pittet, 2009; Ward et al., 2014; Azim et al., 2016). The reasons that prevent compliance with HH are: increased care-giving and limited time for hand-washing, hand irritation, allergy to chemicals, insufficient supplies and resources and lack of knowledge, experience and education (Çelik and Koçaşlı, 2008; Hynes, 2015). Compliance with HH practices among nursing students is at lower levels than expectations similar to nurses (Van De Mortel et al., 2012; Nair et al., 2014; Avşar et al., 2015). During clinical applications, due to direct patient contact or contaminant surfaces and devices, both nursing students and their patients are facing increasing the risk of healthcare-associated infections because of lack of knowledge, skills and experience (Çelik and Koçaşlı, 2008; Avşar et al., 2015). Improving the education of nursing students is an effective and sustainable strategy for increasing nurses' compliance with HH. Furthermore, it is important to prevent health care-associated infections.

While AHR are widely used in hospitals, studies that focus on the proper use of AHR are very limited. The aim of this study is to evaluate the factors that influence nursing students' hand hygiene compliance, the use of effective hand-washing techniques, and proper hand-rub application in line with standards.

2. Methods

2.1. Setting

This cross-sectional study was carried out from May 3 to June 3, 2016 with the voluntary participation of 257 first-year and fourth-year students in the department of nursing at Mersin University. The reason choosing this institution was that it was the only public university that provided nursing education in the city as well as it contains many students. Mersin University (MeU) is a state university in Mersin province, Turkey. MeU Nursing Faculty providing undergraduate education took a step to academic life in 1996–1997. The students are admitted to the faculty with the exam conducted by the Higher Education Institution. The students take theoretical lectures and clinical practice (per a week) for seven semesters. They work as intern nurses at the hospital for a final term.

Of a total of 305 first and fourth year students, 28 students did not want to participate to the study, 20 students were not taken to study because of some dermatologic problems on the hands, nail polish and using henna.

2.2. Instrument and Data Collection

The instrument of this study contained three sections. At the first section, the research data were collected using a questionnaire form that included personal data such as age, gender and class, as well as questions about frequently used HH methods, favorite gels or soaps, frequency and duration of washing hands, frequency of contact with patients, frequency of hand-washing in the clinic, washing hands when using gloves and dermatological problems on the hands. This form was prepared by the researchers according to literature (Avşar et al., 2015; Cole, 2009; WHO, 2009; Barrett and Randle, 2008) and filled out by students in the classroom in 10 min.

The second and third sections of this research were carried out in the skills laboratory of the university. Soap and paper towels were provided in the laboratories prior to the experiment. The students were taken to the laboratories in groups of five. One drop of phosphorus (disodium distylylbiphenyl disulfonated, anions) was added to 75 ml hydroalcoholic solution (HAS) (80% ethyl alcohol, 10% prppan-2 ol and glicerol, deionize water) to prepare the AHR solution. Each student was asked to cover her hand with HAS as done in clinics. The students were not informed about the amount of solution to be used or the duration of its application. Each student was given a code number. Using this code, dorsal and palmar images of their right and left hands

were photographed twice with a digital camera. An 50 × 40 cm light-proof black box with room for hands and taking photographs was used to diminish exposure to UV and to ensure better imaging of the fluorescent material. In addition, the room was made dim with curtains.

At the third section of the study, the students were asked to wash their hands according to the antiseptic technique used in the clinic. Then their photographs were taken once again. After the photo-shoot, the students were informed what should be careful about within the stages of the technique of hand-washing by showing them the fluorescent remains on their hands. The participants were asked not to talk to other students who had not yet participated in the research in order to avoid any effect on them. All the stages of this study were carried out by the researchers.

Alcohol-based hand-rub use and the practice of hand-washing were evaluated with the surface area covered by fluorescent material. The UV photographs of students' hands were converted JPEG format for analysis. Measurements taken for each image were made according to blue areas and densities. The study followed these stages to calculate the entire hand surface: distal phalanges (1a, 2a, 3a, 4a, 5a), intermediate-proximal phalanges (1b, 2b, 3b, 4b, 5b) and the areas where the metacarpal (metacarpal I area - close to fingers)- carpal bones, (metacarpal II area - far from the fingers) are located were measured by a tape measure to identify the palmar and dorsal surface of the right and left hands (Fig. 1). The surface of each hand was calculated in terms of cm², and these measurements were later turned into percentages. The dorsal/palmar surface and their percentages were: thumb, 22 cm² 14.5%; 2nd, 3rd, 4th fingers, 40.5 cm², 27%; little finger, 11 cm², 7.5%, metacarpal area near fingers, 36 cm², 24%; metacarpal and carpal area away from the fingers, 40.5 cm², 27%; and the total area, 150 cm², 100%. The projection of 100 was transformed into 1.000 for the convenience of researchers analyzing photographs on the computer. The entire dorsal and palmar surfaces of right and left hands were evaluated out of 4.000 points (Fig. 1). Considering that the percentage distribution of individuals with different hand sizes may vary, measurements were carried out for two men and two women with different hand sizes. Since the difference was only 1%, the same percentage was used for all participants. If the total percentage of all hand surfaces covered with fluorescence was below 75%, disinfectant use was deemed insufficient. For this reason, hand-washing was not calculated for these individuals.

2.3. Statistical Analysis

The data were analyzed using SPSS statistical package program (version 21, New York, USA). Descriptive statistical analyzes (Mean standard deviation, frequency, percentage) were used in the evaluation of the data; Shapiro–Wilk test was used while evaluating normal distribution; independent-samples *t*-test, ANOVA, Mann-Whitney *U* and Kruskal Wallis *H* test were used for normally and non-normally distributed variables, respectively, *p* < 0.05 was accepted as statistically significant.

2.4. Ethical Considerations

Approval was obtained from the Mersin University Clinical Research Ethical Committee (08.04.2016 and 2016/134) and the institution. At the beginning of the study, intervention procedure and details were explained to the students and a written consent was obtained from all of them.

3. Results

The average age of the 257 students participated in the research was 20.54 ± 1.87 years, 44.7% of them were females and 77.1% of them were first-year students. Of the students, 23.3% said that they made direct contact with patients 1 to 5 times a day while this number was 6 to 10 times for 38.9%, 11 to 15 times for 14.8%, and > 15 times for

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