Does Adherence to World Health Organization Hand Hygiene Protocols in the Operating Room Have the Potential to Produce Irritant Contact Dermatitis in Anesthesia Providers?

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Anesthesia providers have the burden of constant hand hygiene during task dense periods. The requirement for hand hygiene often demands frequent application of alcohol-based hand rub. To assess whether frequent alcohol-based hand rub use leads to skin changes or irritant contact dermatitis, volunteers cleaned their hands with alcohol-based hand rub every 15 minutes for 8 hours for 5 sequential days. They were examined by a dermatologist before and after and asked about subjective skin changes. Results suggest an increase in irritant contact dermatitis scores and subjective complaints. (Anesth Analg 2019;129:e182–e184)

The nature of surgery puts patients at risk for health care–associated infection.1 This is not a trivial matter because more than a third of all health care–associated infections are surgical site infections. Inadequate hand hygiene among anesthesia providers has been shown to play a role in intraoperative transmission of infections, which may lead to surgical site infections.2,3 At present, there are no definitive hand hygiene guidelines for anesthesia personnel, and requirements for nonoperating room environments are assumed to pertain to the operating room as well as medical and surgical wards. In the operating room, however, there are certain task dense periods where hand hygiene would need to be completed on an almost continuous basis by anesthesia providers.

All health care professionals have a risk of developing hand eczema, also known as irritant contact dermatitis.4 The impact of irritant contact dermatitis on anesthesia providers remains unexplored, with few studies being conducted on operating room personnel. Adherence to World Health Organization requirements would require almost constant hand hygiene for anesthesia providers, particularly during intense periods such as induction and emergence.

Concern of developing irritant contact dermatitis has been shown to have an impact on hand hygiene compliance,5 and a primary reason cited for noncompliance is the repeated and deleterious effects of hand hygiene products.6,7 The initiatives to reduce methicillin-resistant Staphylococcus aureus have dramatically increased hand hygiene compliance. At the same time, however, irritant contact dermatitis has become more prevalent.8 Further, maintenance of epidermal integrity among health care workers is key for reducing health care–associated infection because chronic skin compromise has important implications for infection control.7

It has been shown that many health care workers do have varying degrees of irritant contact dermatitis, and alcohol-based hand rub is often perceived by them as the cause. The adverse neurosensory response on preirritated skin may further reduce hand hygiene compliance even though alcohol-based hand rub is less irritating than handwashing with soap and water.2,7 Irritant contact dermatitis is not an insignificant issue. It may lead to absence from work, impaired quality of life, and even unemployment, highlighting the need for education and research.5,9

Given recent suggestions that anesthesia providers’ hand hygiene needs to be improved,10 coupled with the complexities of hand hygiene compliance in the operating room, the primary aim of this study was to establish whether frequent use of alcohol-based hand rub results in changes of skin health. The secondary aim was to evaluate whether the use of alcohol-based hand rub with moisturizer would result in less irritation.

METHODS

Seventeen students volunteered and were enrolled in the study. All reported that they did not use alcohol-based hand rub regularly before the study. Nine volunteers used alcohol-based hand rub without a moisturizer (Purell; Gojo Industries Inc, Akron, OH), and 8 volunteers used alcohol-based hand rub with moisturizer (Purell Advanced, Gojo Industries Inc, Akron OH [Purell+] every 15 minutes over an 8-hour period for 5 consecutive days. Participants were assigned to 1 of 2 groups using a randomization table. This study was exempted by the University of Miami Miller School of Medicine Institutional Review Board.

Volunteers were provided identical dispensers and instructed to use 2 pumps of alcohol-based hand rub or alcohol-based hand rub+ (approximately 1.5 mL) and cover the entire surface of their hands until dry. All 17 volunteers
were asked to clean their hands with alcohol-based hand rub every 15 minutes using an alarm smartphone application as a reminder. Also, upon each application of alcohol-based hand rub, the volunteer photographed themselves recorded with a time-stamped image. A dermatologist inspected the participants’ hands before the study began and again at the end of the 5-day period using the Hand Eczema Severity Index dermatitis scale. This tool measures the severity of hand eczema using scores from 0 to 360 based on the following indicators: erythema, infiltration or papulation, vesicles, fissures, scaling, and edema in 5 parts of the hand: fingertip, finger, palm, back of hand, and wrist. A total score was constructed by summing the scores of the 5 parts of the hand. To assure blinding of the dermatologist, he was not informed of participant assignment. In addition to the objective component of the study using the Hand Eczema Severity Index scale, the participants were asked to subjectively evaluate their hand health. There were 3 yes/no questions about perceived discomfort, unpleasant odor, and interference with performing tasks.

**Statistical Analysis**

To address the 2 objectives of this study, we used a linear mixed model. The model included fixed effects for group (Purell versus Purell+), time (baseline versus day 5), and the interaction of group and time. Subjects are considered to be a random effect to adjust for the within-subjects correlation between baseline and day 5. The comparison of Hand Eczema Severity Index baseline scores with day 5 scores for each group determined whether there was a significant change in each group. The interaction term provided an answer to the second objective to determine if the changes from baseline to day 5 were significantly different between the 2 groups. Three planned comparisons were made at the 2-tailed .05 α level to address the study objectives: significance of change between baseline and day 5 for the Purell and Purell+ groups (time effect in each group) and significance of the difference in change between the 2 groups (interaction effect). Model means, SEs, and significance test P values are presented in the Table. In addition, we present the 95% CI for the difference between groups of the change scores.

The responses to 3 subjective questions were also analyzed with Fisher exact test. Respondents were asked to respond either yes or no to perceived discomfort, objectionable smell, and interference with task performance.

Because we used a convenience sample, the sample size was fixed; therefore, no a priori sample calculations were made. The statistical power to detect a moderate effect size of .5 for a 2-sample t test was estimated to be 16%, using sample sizes of 8 and 9 and comparisons evaluated at a 2-sided .05 α level. SAS 9.4 (SAS Institute, Inc, Cary, NC) was used for all analyses.

**RESULTS**

Results are shown in the Table. There was no significant difference between Purell and Purell+ groups at baseline: 1.78 ± 0.39 versus 1.25 ± 0.42, respectively (P = .374). Regarding the first study objective, there was a significant increase in the Hand Eczema Severity Index total score from baseline to day 5 for the Purell group (1.78 ± 0.39 versus 6.22 ± 1.68; P = .015). Similarly, there was a significant increase in the Hand Eczema Severity Index total score from baseline to day 5 for the Purell+ group (1.25 ± 0.42 versus 5.50 ± 1.78; P = .026). For the second study objective, there was no significant difference in the change in Hand Eczema Severity Index total scores when comparing Purell with Purell+ groups (4.44 ± 1.62 versus 4.25 ± 1.72; P = .935). The difference was 0.19 ± 2.36 with 95% CI −4.84 to 5.22.

There were no significant differences between the groups in the responses to the 3 subjective questions. The P values for the tests between groups were all 1.000. Therefore, we dropped the group comparisons. Of the 16 respondents who answered the subjective questions, 11 (69%) reported they experienced discomfort from using either Purell or Purell+, 8 (50%) reported that they thought the smell was objectionable, and 13 (81%) reported that using the alcohol-based hand rub interfered with the performance of their tasks.

**DISCUSSION**

With the increased attention to health care–associated infection and recent studies suggesting that the anesthesia work environment is a potential source of contamination, anesthesia providers are increasingly expected to follow World Health Organization guidelines for hand hygiene, including the “Five Moments for Hand Hygiene.” This is not a trivial matter. Loftus et al reported that bacterial transmission in the anesthesia work area of the operating room is a root cause of 30-day postoperative infection, affecting as many as 16% of surgical patients. The number of required hand hygiene events for anesthesia providers is astounding. We chose to evaluate a much lower number of hand hygiene events and hypothesized that if our volunteers who used alcohol-based hand rub every 15 minutes for 5 days had either subjective complaints or objective findings of irritant contact dermatitis, then the actual incidence in a clinician would be far greater. This study had several limitations. First, we did not ask volunteers to use alcohol-based hand rub with the frequency that might be required in an actual operating room, as it was considered to be impractical, potentially harmful, and would severely limit enrollment of volunteers. Second, participants may have known that they were using Purell+ because the bottle is tinted, potentially affecting their self-reporting of irritant contact dermatitis. This, however, is unlikely, because there

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline Mean ± SE</th>
<th>Day 5 Mean ± SE</th>
<th>Baseline Versus Day 5 Mean ± SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purell</td>
<td>1.78 ± 0.39</td>
<td>6.22 ± 1.68</td>
<td>4.44 ± 1.62</td>
<td>.015</td>
</tr>
<tr>
<td>Purell+</td>
<td>1.25 ± 0.42</td>
<td>5.50 ± 1.78</td>
<td>4.25 ± 1.72</td>
<td>.026</td>
</tr>
<tr>
<td>Purell versus Purell+</td>
<td>0.52 ± 0.58</td>
<td>0.72 ± 2.44</td>
<td>0.19 ± 2.36*</td>
<td>.935</td>
</tr>
</tbody>
</table>

*The 95% CI for the difference between Purell and Purell+ in the change from baseline to day 5 is −4.84 to 5.22.*
was no statistically significant difference between groups. In addition, because we used a convenience sample, our sample sizes were limited to 9 subjects using Purell and 8 subjects using Purell+. This study was underpowered; thus, the ability to detect a difference between the Purell groups in the change from baseline to day 5 was very low (16%). However, we were able to detect a significant change in each Purell group. Third, Purell and Purell+ were used in this study as they are commonly used in hospitals and clinics. Other brands may have different results. Fourth, there was no control group (volunteers who did not use alcohol-based hand rub or alcohol-based hand rub+ but were evaluated by the dermatologist) in this study. Last, none of the participants had clinically significant dermatitis, but some did show signs of worsening scores and increased inflammation, which over time and repeated exposure may have continued to worsen. Findings of subjective complaints (skin feeling uncomfortable or dry) and objective signs (irritant contact dermatitis seen by a dermatologist blinded to group) verified that the extensive use of alcohol-based hand rub may have unintended cutaneous consequences. Any skin irritation may in fact produce the very unwanted result of dissuading appropriate hand hygiene compliance. Alternative solutions, such as frequent glove changes during a case, applying alcohol-based hand rub to gloves between changes, and wearing double gloves, should be studied further. In conclusion, results of this preliminary study demonstrate that repetitive use of alcohol-based hand rub may be associated with a change in skin health as determined by a dermatologist using an objective measure of irritation. As health care–associated infections related to anesthesia practice are under heightened scrutiny, future research evaluating clinicians in a real operating room environment performing hand hygiene with great frequency should be undertaken.

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REFERENCES