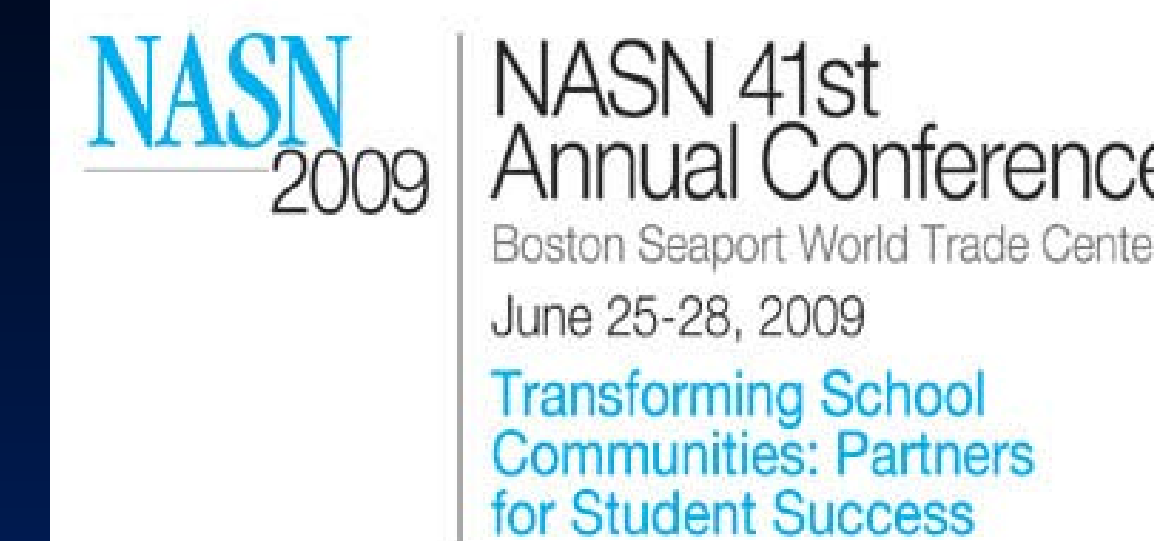




# A Comparative Dermal Irritancy Evaluation of Hand Sanitizers: Are Non-Alcohol Products Actually the Real Skin Irritants?

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## Abstract

Hand sanitizers are frequently used in educational settings. Due to concern about potential irritating effects of alcohol based hand sanitizers (ABHS), some school districts are considering non-alcohol sanitizers. These contain quaternary ammonium compounds, typically benzethonium chloride (BEC) or benzalkonium chloride (BAK). This study compares the irritation potential of hand sanitizers.

The skin care industry standard to evaluate products for dermal irritancy potential is the 21-day cumulative irritation assay. Total cumulative irritation scores were determined for a positive control, 0.2% SLS; a negative control, baby oil; and 10 sanitizers, with various active ingredients (62% ethanol, 0.13-0.24% BEC, 0.1-0.2% BAK, and 0.05% thymol).

The ABHS were as mild as baby oil. All non-alcohol hand sanitizers tested were significantly more irritating than both baby oil and the ABHS. In addition, 3 of the 4 BAK products were significantly more irritating than the positive control, a known cumulative irritant.

These data show that alcohol-based hand sanitizers can be mild and not pose irritation risk, however the non-alcohol sanitizers tested are likely to be irritating to the skin.

## Introduction

Hand hygiene is one of the most important steps for preventing the transmission of disease causing microorganisms<sup>1</sup>. The CDC and the U.S. Department of Health and Human Services advise schools to provide easy access to hand hygiene products like soap & water and alcohol-based hand sanitizers. There are numerous hand hygiene products available including instant hand sanitizers (IHS). The typical active ingredients of IHS used in educational settings are either alcohol (ethanol or isopropyl alcohol) or quaternary ammonium compounds (QAC) (BAK or BEC), other active ingredients are not often used in IHS.

School nurses support the health and wellness of students, which includes ensuring that safe and effective hand hygiene products are used for preventing the spread of germs. Currently the only active that is recognized as safe and effective by the FDA for IHS is ethanol<sup>2</sup>; however other active ingredients, including QACs are currently used despite limited data on the safety and efficacy of these compounds.

There are anecdotal reports of ABHS causing skin dryness and irritation, and multiple non-alcohol hand sanitizers make claims that they are less drying and/or less irritating than ABHS. While it is known that both alcohol and QACs have the potential to cause skin dryness, hand sanitizers are typically formulated to be skin friendly and contain moisturizers that offset the potentially irritating effects of the active ingredients.

To date, limited data exist comparing the irritancy potential of ABHS to non-alcohol hand sanitizers. Therefore a direct comparison of the irritation potential of ABHS and non-alcohol based hand sanitizers was conducted utilizing a 21-day cumulative irritancy test. This test is the industry standard for assessing the potential of a topical product to cause irritancy, and is an excellent tool for evaluating the comparative irritancy potential of test products; the same methodology is recommended by the FDA for dermal patches used for topical drug delivery.<sup>3</sup>

## Materials and Methods

**Test Method:** According to the method of Phillips<sup>4</sup> occlusive patches containing 0.2 g of test articles were placed left of the spinal midline on 34 subjects (Figure 1). Patches were worn for 24 hours, removed, and 10 minutes after patch removal skin was evaluated for erythema and edema using the 0-4 scale (0=no reaction up to 4=severe reaction). Subjects were then re-patched with the test article at the same site on the back. This process continued for 22 consecutive days excluding Sundays (scores from Monday were carried back for Sunday). Total cumulative irritation scores were calculated for each test article by adding the sum of scores for each day for each participant. The cumulative irritancy potential of the test articles was classified according to the Berger and Bowman Scale<sup>5</sup>.

**Statistical Analysis:** Test articles and controls were compared using ANOVA followed by post hoc analysis, all statistical tests were calculated using the 0.05 level of significance for Type I (a) error.

**Study Design:** The study was executed by two independent clinical test laboratories. Test articles included a negative control (baby oil), a positive control (0.2% sodium lauryl sulfate (SLS), a known cumulative irritant), and ten commercially available products, including: graph name (product name on label), 62% ethanol gel (PURELL® Instant Hand Sanitizer), 62% ethanol foam (PURELL Instant Hand Sanitizer Foam), 0.2% BEC foam (Betco Winning Hands Alcohol Free Foaming Hand Sanitizer), 0.1% BEC foam (TC Enriched Foam Alcohol Free Sanitizer), 0.2% BEC foam (Clean Shape Foaming Instant Hand Sanitizer), 0.13% BAK foam (Soapopular Hand Sanitizer), 0.05% thymol spray (CleanWell All Natural Hand Sanitizer), 0.13% BAK foam (X3 Clean Foaming Hand Sanitizer), 0.24% BAK foam (Aero Instant Foaming Hand Sanitizer), and 0.13% BAK foam (Woodward's HandClens Foaming Sanitizer and Lotion).

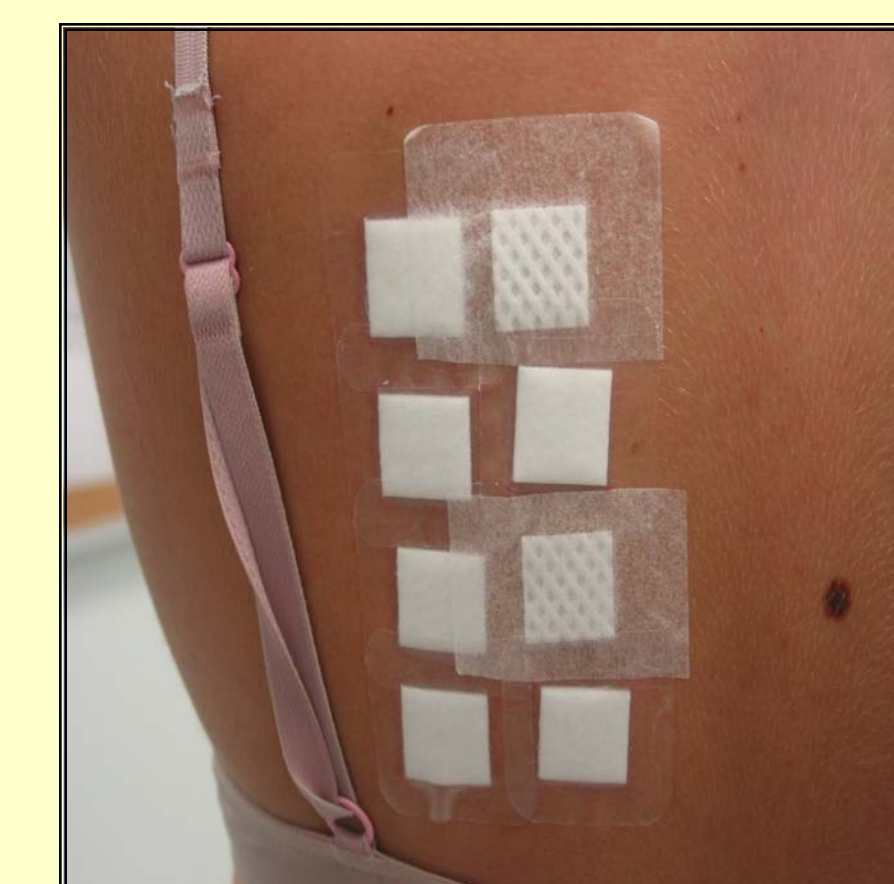
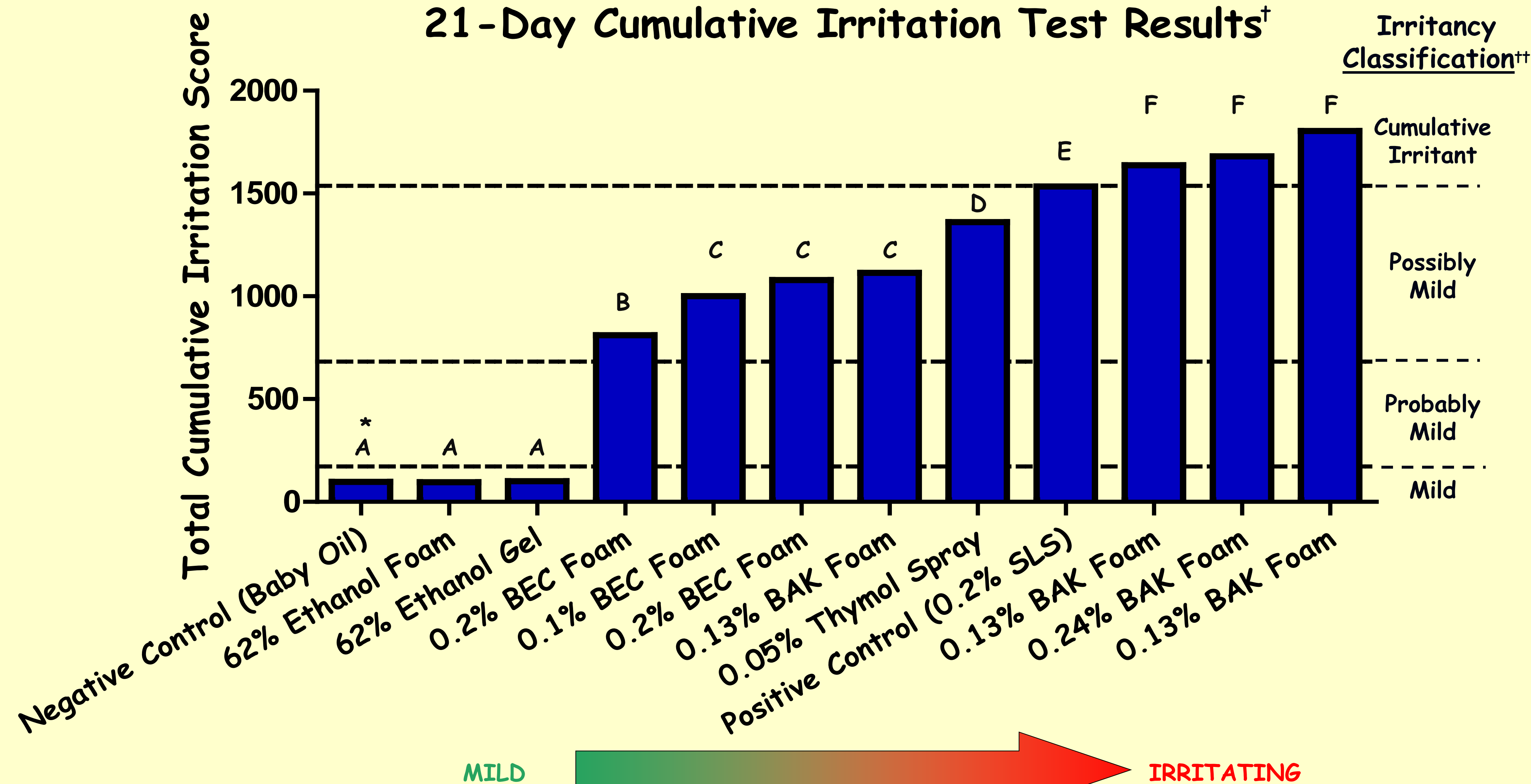


Figure 1. Example of occlusive patches containing test articles on the back of a study participant.

## Results

### 21-Day Cumulative Irritation Test Results<sup>†</sup>



\*Letters above bars indicate the results of the statistical analysis. Bars with the same letter are statistically equivalent, bars with different letters are statistically different. A to F indicates mild to irritating.

<sup>†</sup>Data shown from RCTS Study #2500, a confirmatory study with similar results (data not shown) was conducted by BioScreen Clinical Services, Study #09-004.

<sup>††</sup>Classification based on Berger and Bowman scale<sup>5</sup>: score of 0-171 indicates the product is a mild material with no evidence of irritation; score of 172-682 indicates the product is probably mild in use, with evidence of slight potential for very mild cumulative irritation; a score of 683-1536 indicates the product is possibly mild in use with evidence of a moderate potential for mild cumulative irritation; and a score of 1537-1982 indicates the product is an experimental cumulative irritant with evidence of a strong potential for mild-moderate cumulative irritation, all scores are reflective of test conditions and may not represent product performance during "real-world" usage.

## Summary

- All non-alcohol IHS products tested were significantly more irritating than the ABHS gel and foam.
- The only products to achieve a mild rating were the ABHS gel and foam. In addition the ABHS were the only products tested that were as mild as baby oil.
- BAK products appear to be more irritating than BEC products, which is consistent with previous findings<sup>6</sup>.
- 3 of 4 BAK products tested were rated as cumulative irritants and were significantly more irritating than the positive control (0.2% SLS).
- Natural products (thymol) have the potential to be irritating, and it should not be assumed that "natural" means "non-irritating".
- The irritancy potential of non-alcohol products is formulation dependent, not dependent on the active ingredient alone, as products with identical active ingredients were statistically different in this test.

## Conclusions

- Claims that non-alcohol IHS are less irritating than alcohol-based IHS should be interpreted with caution.
- School nurses should advise their school district to carefully evaluate hand hygiene products for objective skin performance data to ensure that the IHS is mild enough for frequent use.
- Ethanol is considered safe and effective by the FDA for use in hand antiseptics<sup>2</sup>, and the proven safety of ethanol for use in hand hygiene products was further supported by this data.

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