# Meeting Global Standards for Hand Sanitizer Efficacy: Formulation Matters

Poster # P26

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## Introduction

Alcohol-based hand rubs (ABHR) are recommended for use in healthcare settings by the WHO and U.S .CDC, and are recognized as one of the most important interventions for the prevention of hospital associated infections[1-2]. Additionally, numerous studies have demonstrated the clinical effectiveness of these products[3-4]. These types of products are typically evaluated using standard methods, either European Norms or ASTM standards[5-6]. In Europe the EN 1500, Hygienic Hand Rub Method, is used, whereas the U.S. FDA requires ASTM E 1174, the Health Care Personnel Handwash Method. Countries in other regions recognize one or both of these methods.

Recently, a number of publications have questioned whether products that are typical in the United States (gels and foams containing 60-70% ethanol) are as efficacious as products that are more common in Europe (liquid rubs containing >80% ethanol)[7-9]. These publications specifically state that gels and foams are less efficacious than liquid rubs, and that concentrations of at least 75% alcohol are necessary to meet global efficacy requirements. In addition the WHO guidelines contain recipes for ABHR for local production based on 75% to 80% alcohol[2].

Studies were conducted to determine the influence of alcohol concentration, product format and product formulation on the ability to meet global *in vivo* efficacy standards.

## Materials and Methods

**EN 1500:** Products A, B, C, and D were tested according to EN 1500[5] in a randomized, crossover design, where hands were contaminated with *Escherichia coli* K12 NCTC 10538. For test product applications, 3 ml of test product was applied to the hands for a 30 seconds contact time, followed by 5 second water rinse. $Log_{10}$ reductions were calculated for the test product and comparisons were made to the reference product, two applications of 3 ml of 60% isopropanol for a 60 second contact time, followed by 5 second water rinse. $Log_{10}$ reductions were calculated and statistical analysis performed. A total of 12-20 subjects were evaluated for each test product. To meet the requirements of the norm the test product must demonstrate statistical non-inferiority to the reference product.

**Health Care Personnel Hand Wash (HCPHW) Study:** Products A, B, E, F, G, H, I, J, K, WHO-EtOH, and WHO-IPA were evaluated according to the ASTM E1174 "Standard Test Method for Evaluation of the Effectiveness of Health Care Personnel Handwash Formulations", as described by the U.S. FDA (C and D were not tested)[6]. A neutralization study per ASTM E1054-08 was successfully performed to ensure the neutralizer employed in this study was effective. Subjects hands were contaminated with *S. marcescens* (ATCC #14756). The test product was applied to the hands with a volume of 2 ml, and rubbed in until dry. A total of 12 subjects were evaluated for each test product for a series of 10 applications, with samples completed after applications 1, 3, 7, and 10. $Log_{10}$ reductions from baseline were calculated and statistical analysis was conducted utilizing an ANOVA test and correlation analysis was done using a Pearson's Correlation Coefficient(α=0.05). For demonstration of *in vivo* bactericidal efficacy, U.S. FDA requires a minimum 2 $log_{10}$ reduction after the first application and a minimum 3 $log_{10}$ reduction the tenth application.

**Products A and B are patent pending formulations that optimize the antimicrobial performance of alcohol without the need for additional antimicrobial ingredients.*
*Studies were conducted by 3rd party laboratories.*

## Summary

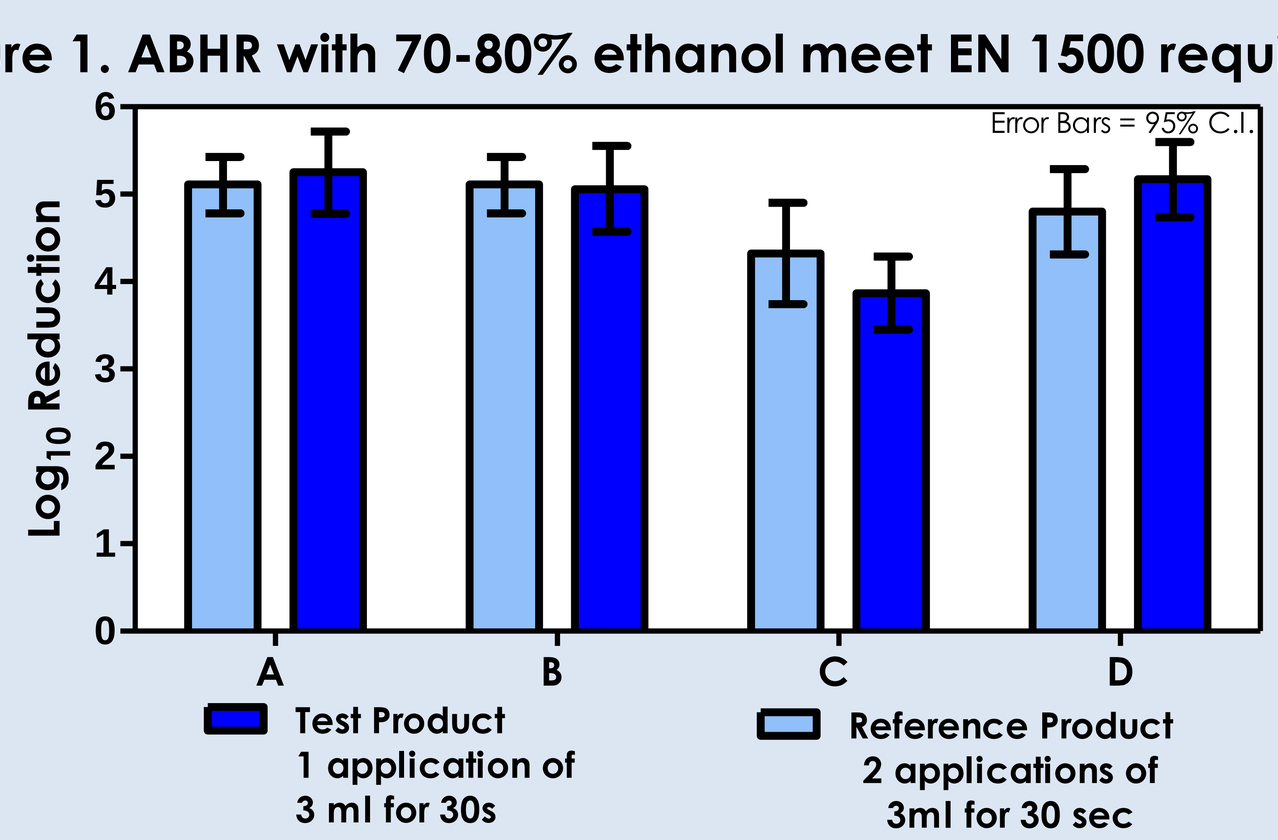

- **Alcohol concentration in excess of 70% is not required for efficacy:**
  - Well-formulated 70% ethanol gel and foam ABHR met both EN1500 and U.S. FDA Healthcare Personnel Handwash (ASTM E1174) requirements, and had superior performance to multiple products containing 60-90% alcohol.
- **Product formulation is a critical determinant of ABHR efficacy:**
  - Products A and B were superior to all other products tested after 10 uses at volumes more representative of in use conditions (2 ml).
  - Products A and B maintained efficacy with repeated use, whereas other alcohol products declined in efficacy with repeated use, highlighting the importance of evaluating products after multiple applications.
- **Product format does not influence efficacy:**
  - The novel 70% ethanol formulations were efficacious in both gel and foam formats, meeting EN 1500 and U.S. FDA requirements.


## Conclusions

- **Formulation matters. Increasing alcohol concentration in ABHRs alone is not sufficient to guarantee efficacy on hands.**

## Results

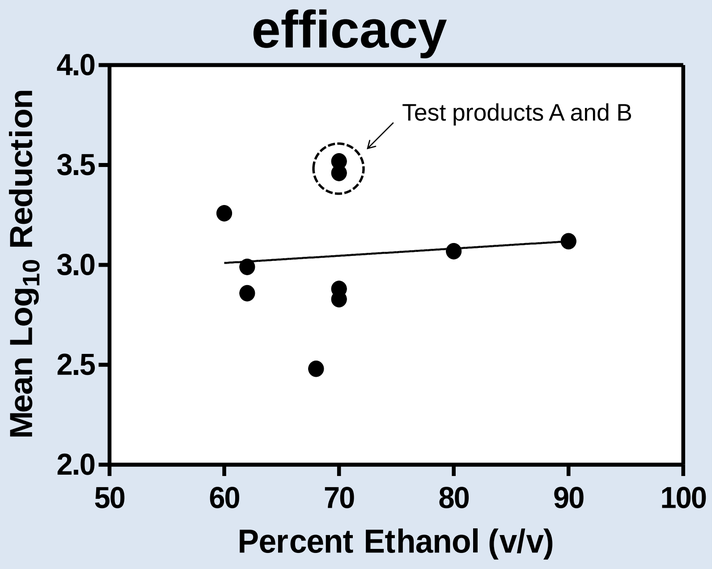
**Figure 1. ABHR with 70-80% ethanol meet EN 1500 requirements**




**All test products were statistically equivalent to the internal reference standard, meeting EN 1500 requirements.**

## Results

**Figure 3. Ethanol level is not correlated with antimicrobial efficacy**




**The log reductions shown in Figure 2 for application 1 were plotted and show no correlation between efficacy and ethanol concentration ($P$ = 0.77).**

**Figure 2. Well-formulated 70% ethanol products meet U.S. FDA Healthcare Personnel Handwash (ASTM E1174) requirements**




**When tested at a 2 ml volume, only the 70% ethanol formulations, products A and B, met U.S. FDA efficacy requirements for a ≥3 log reduction at application 10. Products A and B were statistically superior to the majority of other products tested, including those with higher alcohol, after a single application, and were statistically superior to all other products tested after ten applications.**

**Test Products:**

| Code | Product | Active Ingredient | Manufacturer |
|---|---|---|---|
| A* | PURELL® Advanced Instant Hand Sanitizer | 70% ethanol (v/v) | GOJO Industries |
| B* | PURELL Advanced Instant Hand Sanitizer Foam | 70% ethanol (v/v) | GOJO Industries |
| C | PURELL MHS Hygenic & Surgical Hand Rub | 80% ethanol (v/v) | GOJO Industries |
| D | PURELL Green Certified Instant Hand Sanitizer | 70% ethanol (v/v) | GOJO Industries |
| E | Endure 320 Advanced Care Waterless Antimicrobial Hand Rinse with Moisturizer | 62% ethanol (v/v) | Ecolab |
| F | Avagard™ Foam Instant Hand Antiseptic with Moisturizers | 62% ethanol (w/w)<br>70% ethanol (v/v) | 3M™ |
| G | Avagard D | 61% ethanol (w/w)<br>68% ethanol (v/v) | 3M |
| H | Alcare OR Foamed Antiseptic Hand Rub | 62% ethanol (v/v) | Steris |
| I | Rio Gel Antiseptico | 70% ethanol (v/v) | Rioquímica |
| J | Cutan Alcohol Foam Antiseptic Handrub | 60% ethanol (v/v) | DEB |
| K | Sterillium Comfort Gel | 85% ethanol (w/w);<br>(90% ethanol (v/v)) | Bode Chemie Hamburg |
| WHO-EtOH | WHO-recommended handrub formulation with ethanol | 80% ethanol (v/v) | n/a |
| WHO-IPA | WHO-recommended handrub formulation with isopropanol | 75% isopropanol (v/v) | n/a |

## References


1. Boyce J, Pittet D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. 51 ed. 2002.
2. WHO Guidelines on Hand Hygiene in Health Care. World Health Organization. 2009.
3. Hilburn J, Hammond BS, Fenderl EJ, Groziak PA. Use of alcohol hand sanitizer as an infection control strategy in an acute care facility. Am J Infect Control 2003;31(2):109-16.
4. Larson EL, Eke PI, Laughon BE. Efficacy of alcohol-based hand rinses under frequent-use conditions. Antimicrobial Agents and Chemotherapy 1986;30(4):542-4.
5. EN 1500. 1997. Chemical disinfectants and antiseptics-Hygienic handrub—test method and requirements (phase 2).
6. Food and Drug Administration. 2004. Tentative final monograph for healthcare antiseptic drug products: proposed rule. Fed. Regist. 59:31441–31450
7. Kampf G. (2008) How effective are hand antiseptics for the postcontamination treatment of hands when used as recommended?. AJIC, 36: 356-360.
8. Kramer, A., Rudolph, P., Kampf, G, Pittet, D. (2002) Limited efficacy of alcohol-based hand gels. Lancet. 359:1489-1490.
9. Kampf, G., Marschall, S., Eggerstedt, S., Ostermeyer, C. (2010) Efficacy of ethanol-based hand foams using clinically relevant amounts: a cross-over controlled study among healthy volunteers. BMC ID. 10:78.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