

Meeting Health Canada Standards for Alcohol Based Hand Rub Efficacy: Formulation Matters

Sarah L. Edmonds, M.Sc.

David R. Macinga, Ph.D.

Poster presented at:
CHICA-Canada 2011 National Conference
May 28 - June 2, 2011 • Toronto, ON

ABSTRACT

Background / Objectives

Alcohol-based hand rubs (ABHR) are an important intervention for preventing illness. The objective of this study was to determine the relative influence of alcohol concentration and product formulation on the efficacy of ABHR using Health Canada recommended methods.

Methods

Test products included 4 ABHR: A (novel 70% ethanol gel), B (novel 70% ethanol foam), C (80% ethanol gel), and D (85% ethanol gel). WHO-recommended hand rub formulations were included as benchmarks: WHO-EtOH (80% ethanol) and WHO-IPA (75% isopropanol). Test products A, B, and C were evaluated by EN 1500 at a volume of 3 ml rubbed for 30 seconds. Additionally, products A, B, D, and WHO benchmarks were evaluated at a volume of 2 ml using ASTM E1174.

Results

Products A, B, and C each met EN 1500 requirements, demonstrating non-inferiority to the 60% isopropanol reference product. When evaluated by E1174, log reductions for Products A, B, D, WHO-EtOH, and WHO-IPA were 3.58, 3.55, 3.12, 3.07, and 3.12, respectively after one application; and 3.50, 4.00, 1.80, 2.39, and 2.04, respectively after the tenth application. Only A and B met Health Canada requirements for ≥ 3 log reduction using EN and ASTM methods.

Conclusions

Product formulation was found to have a greater influence over efficacy than alcohol concentration as well formulated products containing 70% ethanol were more efficacious than products with higher alcohol levels. These results demonstrate that alcohol concentrations in excess of 70% are neither necessary nor sufficient for efficacy.

INTRODUCTION

Alcohol based hand rubs (ABHR) are recommended for use in healthcare settings by the U.S. CDC and WHO, and are recognized as one of the most important interventions for the prevention of illness¹⁻². Additionally, numerous studies have demonstrated the clinical effectiveness of these products³⁻⁴. ABHR are typically evaluated using standard methods, either European Norms or ASTM standards⁵⁻⁶. For the evaluation of professional healthcare use hand rubs, Health Canada specifies using ASTM E1174, the Health Care Personnel Handwash Method, or the EN 1500, Hygienic Hand Rub Method to evaluate the *in vivo* bactericidal efficacy of these products, and states that a minimum of a 3 log reduction is required for efficacy⁷.

The WHO, U.S. CDC, and U.S. FDA have concluded that 60% to 95% ethanol is safe and effective for disinfecting hands^{1,2,6}. However, publications have raised concerns regarding both the level of alcohol required for ABHR efficacy as well as the appropriateness of certain product formats⁸⁻¹⁰. These publications speculate that concentrations of at least 75% to 80% ethanol are necessary to meet global efficacy requirements and that gel and foam products are less efficacious than rubs. In addition the WHO guidelines contain recipes for ABHR for local production based on 75% to 80% alcohol².

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

MATERIALS AND METHODS

EN 1500

Products A, B, and C were tested according to EN 1500⁵ 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. Log₁₀ 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. Log₁₀ 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. For demonstration of *in vivo* bactericidal efficacy, Health Canada requires a minimum 3 log₁₀ reduction for the test product.

Health Care Personnel Hand Wash (HCPHW) Study

Products A, B, D, 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. FDA⁶. A neutralization study per ASTM E1054-02 was successfully performed to ensure the neutralizer employed in this study was effective. Subjects hands were contaminated with *S. marcescens* (ATCC #14476). 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. Log₁₀ reductions from baseline were calculated and statistical analysis was conducted utilizing an ANOVA test ($\alpha=0.05$). For demonstration of *in vivo* bactericidal efficacy, Health Canada requires a minimum 3 log₁₀ reduction after the first application and the tenth application.

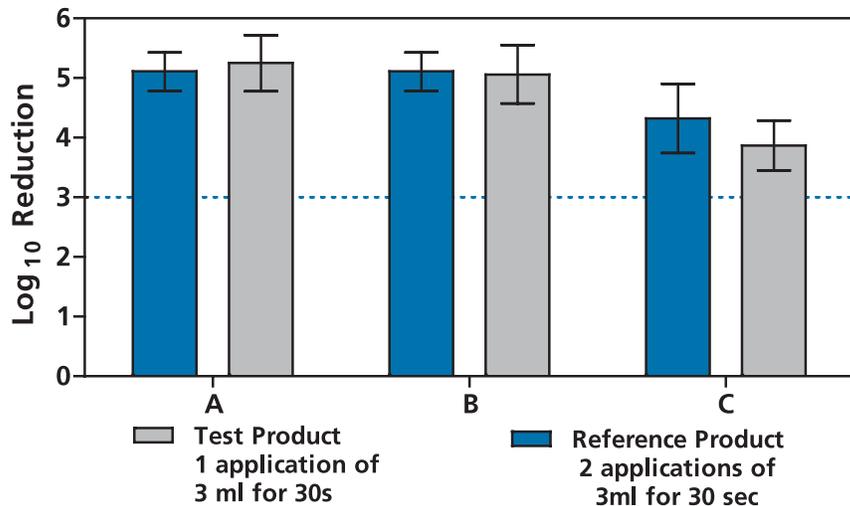
Test Products:

Code	Product	Manufacturer
A*	PURELL® branded alcohol gel – 70% ethanol (v/v)	GOJO Industries
B*	PURELL branded alcohol foam – 70% ethanol (v/v)	GOJO Industries
C	PURELL branded alcohol gel – 80% ethanol (v/v)	GOJO Industries
D	Sterillium branded alcohol gel – 85% ethanol (w/w); (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

* Products A and B are patent pending formulations that optimize the antimicrobial performance of alcohol without the need for additional antimicrobial ingredients.

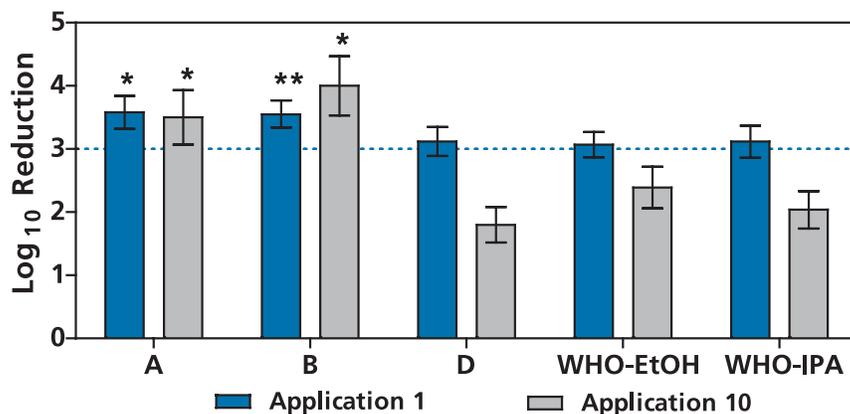
RESULTS

EN 1500: ABHR with 70-80% ethanol meet Health Canada bactericidal efficacy requirements



All test products were statistically equivalent to the internal reference standard, meeting EN 1500 requirements. In addition, all products obtained a >3 log reduction, thus meeting Health Canada bactericidal efficacy requirements.

ASTM E1174: Well-formulated 70% ethanol products can meet Health Canada bactericidal efficacy requirements



When tested with a 2 ml volume, only the 70% ethanol products (A and B) met Health Canada bactericidal efficacy requirements for a ≥ 3 log reduction.

*Indicates statistical superiority to product D, WHO-EtOH, and WHO-IPA | **Indicates statistical superiority to WHO-EtOH

Error bars = 95% C.I.

SUMMARY

Alcohol concentration in excess of 70% is not required for efficacy

- Well-formulated 70% ethanol gel and foam ABHR met Health Canada requirements for both ASTM E1174 and EN1500, and had superior performance to products containing 75-90% alcohol.

Product formulation is a critical determinant of ABHR efficacy

- Products A and B were superior to Product D, WHO-EtOH, and WHO-IPA, and maintained efficacy with repeated use, whereas higher alcohol products declined in efficacy with repeated use.
- Products A and B met the 3 log reduction requirement for ASTM E1174 with volumes representative of in use conditions (2 ml) when higher alcohol products did not.

Product format does not influence efficacy

- Products in both gel and foam formats met Health Canada bactericidal efficacy requirements.

CONCLUSIONS

Formulation matters

- Increasing alcohol concentration alone is not sufficient to guarantee efficacy.

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. Guidance Document Human-Use Antiseptic Drugs, Health Canada, 2009.
8. Kampf G. (2008) How effective are hand antiseptics for the postcontamination treatment of hands when used as recommended?. *AJIC*, 36: 356-360.
9. Kramer, A., Rudolph, P., Kampf, G, Pittet, D. (2002) Limited efficacy of alcohol-based hand gels. *Lancet*. 359:1489-1490.
10. 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.

**For more information, contact Sarah Edmonds, GOJO Industries, Inc.
330-255-6745
edmondss@GOJO.com**