Comparative Efficacy of Hand Wash Lather Times of 5 to 20 Seconds by an In Vivo Cross-Contamination Test Method

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Abstract

Background: Hand hygiene is fundamental in managing food safety risk. Understanding the efficacy of hand hygiene protocols is crucial for risk assessments, choosing interventions and establishing effective guidance. There is little published data measuring microbial reduction on hands after different hand wash durations.

Purpose: This study evaluated the in vivo effectiveness of a typical foaming hand wash at three different wash durations in reducing bacterial load and transfer to food items.

Methods: A leading commercially available non-antibacterial foam handwash was tested with one dose as delivered from an automatic wall mounted dispenser using ASTM E2784 ("Standard Test Method for Evaluation of the Effectiveness of Handwash Formulations Using the Paper Towel (Palmar) Method of Hand Contamination"). All twelve subjects performed the "Core Handwash" technique for 5-, 15- and 20-seconds with no other variables in a cross over design. Mean log10 reductions of Escherichia coli (ATCC #10536) on hands as well as bacterial counts transferred to melon balls were measured. Analysis of variance was used to compare treatments.

Results: No significant difference (p>0.05) in efficacy between lathering scrub times of 5-, 15- and 20-seconds was observed. The mean log reduction was 2.95 after 5-seconds, 2.86 after 15-seconds and 3.00 after 20-seconds. The mean log transfer to melon was also not different (p>0.05): 4.85 after 5-seconds, 4.76 after 15-seconds and 4.64 after 20-seconds.

Significance: This study demonstrates that requiring hand wash times of at least 20-seconds as currently prescribed in most food safety guidance (including the FDA Food Code) may be unnecessarily long. A well-formulated hand wash product can provide substantial bacterial reduction in the common observed wash time of 5-seconds. Allowance of shorter wash times by foodservice employees could increase the number of hand washes per shift, thereby reducing overall foodborne illness risk.

Introduction

The literature on hand washing is dated (not much recently), often contains conflicting data, and key variables are only superficially studied or not studied at all. This leads to hand hygiene recommendations / decisions often being made on assumptions without scientific support.

Jensen et. al. studied many handwash variables and found for two marketed soaps no significant effects on bacterial reduction for soap volume (0.5, 1.0, 2.0ml tested) and water temperature (60, 80, 100°F tested). Lather times of 5, 10, 20, and 40 s were evaluated with no specific technique (subjects washed as they normally do). For one soap the 30-s wash (20 s of lathering and 10 s of rinsing) produced a significantly different mean log reduction in bacterial counts compared with the baseline 15-s wash and no significant difference for the second soap.[1]

There are multiple test methods to consider for in vivo antimicrobial efficacy testing. This method (ASTM E2784) was chosen because it measures both log reduction of e. coli on hands and transfer to food.

Fischler et. al. established this method, finding that a well formulated antibacterial hand wash formulation was consistently greater than 1.0 logs better for reduction of bacteria (Escherichia coli and Shigella flexneri) on hands and in transfer to food (melon balls) vs. a typical bland soap.[2]

FDA Food Code dictates desired practices of foodservice employees in the US. With respect to hand hygiene the current model food code drives for hand washing (20-seconds lather minimum) and does not currently allow ABHR (unless done immediately after hand washing).[3]

The Arbogast et. al. study of alcohol-based hand rubs (ABHR, aka hand sanitizers) vs. a 20-second lather hand wash using ASTM E2784 found both were effective, but ABHR yielded significantly better log reduction than hand washing.[4]

Fraser et. al. suggests rethinking hand hygiene in foodservice to be more practical and to apply healthcare guidance and best practices.[5]

The Boyce et. al. literature review for food handlers hand hygiene suggests ABHR would be beneficial at reducing pathogens on hands when hands are not heavily soiled.[6]

Materials

Faucet = *A market leading touchless electronic faucet with proven, reliable process control settings and Bluetooth® enabled mobile app reporting capabilities: HyTronic® faucet and CF Connect app by Chicago Faucets.*

Hand Wash = *A foodservice market leading hand wash + wall mounted dispenser: Kay "Foaming Lotion Hand Soap" (Lot #4303GR4200) dispensed from an Ecolab "NEXA" touchless automatic dispenser.*

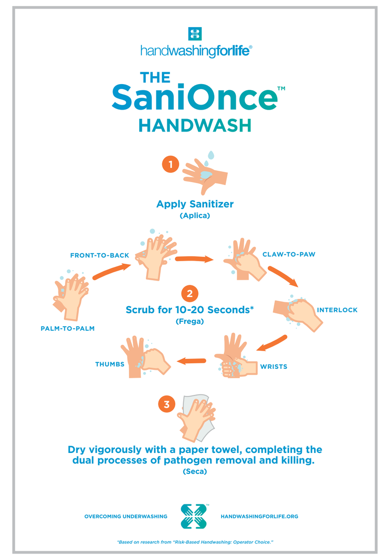
ABHR = *A foodservice market leading hand sanitizer + wall mounted dispenser: PURELL "VF Plus" gel (Lot #485792) dispensed from an "ES8" touchless automatic dispenser.*

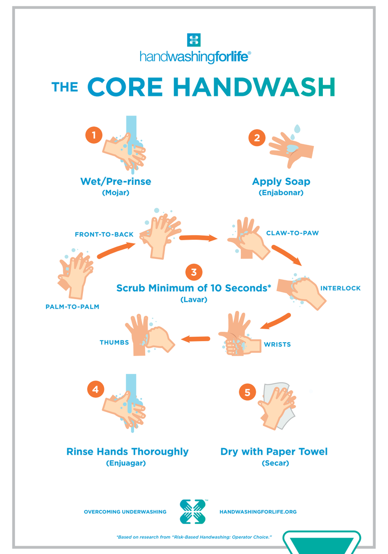
Paper Towel = *A foodservice market leading paper towel + wall mounted electronic dispenser: A 100% recycled paper towel with good absorption and wet strength (Lot # 26495), dispensed from a touchless Pacific Blue Ultra™ unit, in single 8" x ~13" towels, both manufactured by Georgia-Pacific Pro.*

Methods

ASTM E2784 was followed with a detailed protocol and thoughtfully defined key controls:

- Hand wash water temperature was monitored and maintained at 40°C (= 104°F) ± 2°C.
- Hand wash water flow rate was monitored and maintained at 4 L per minute.
- 6 Test Subjects completed each test product on the same day. Executed 2 days (February 14th & 15th, 2024), resulting in 12 total subjects completing all hand hygiene configurations.
- Hand Wash & ABHR dosing data was measured on both days. The average hand wash dose = 0.93ml and the average ABHR dose = 1.28ml.
- A clinician monitored every panelist product application / usage, and prompted consistently good technique (per the figures in this section).





Simplified for Study Execution

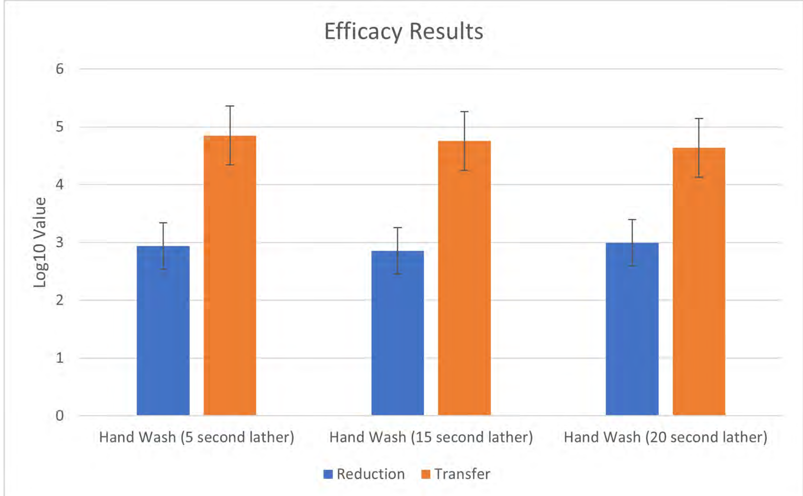
Results

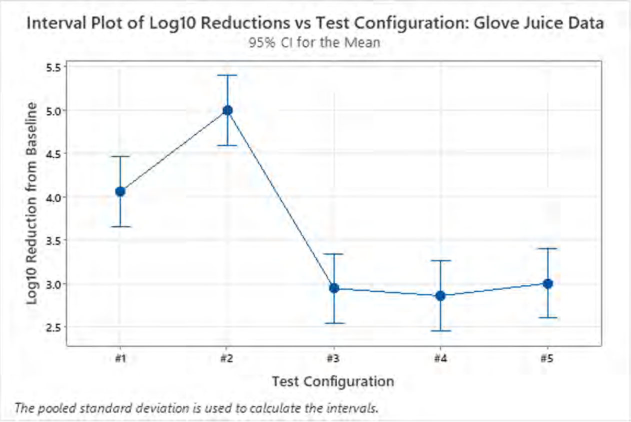
Table 1. Antibacterial Efficacy Results Summary

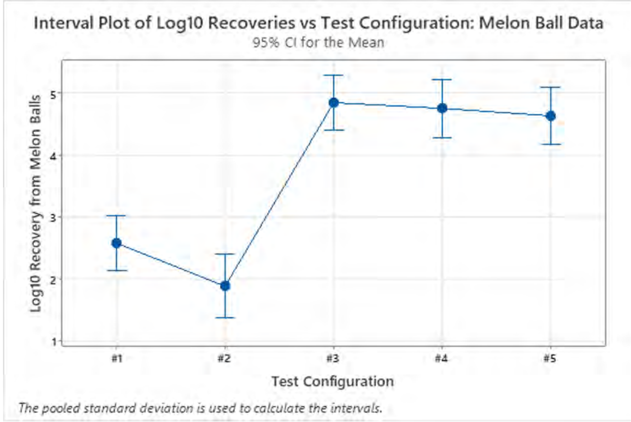
Intervention (Test Article)	Mean Log Reduction (higher is better)[a]	Mean Log Transfer to Melon (lower is better)[a]
Hand Wash (5-second lather)	2.95 A	4.85 A
Hand Wash (15-second lather)	2.86 A	4.76 A
Hand Wash (20-second lather)	3.00 A	4.64 A

a) *The data are expressed as mean + standard deviations. Means with different letters in the same column are significantly different (p≤0.05).*

Figures:







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Conclusions & Recommendations

- A well-formulated hand wash product can provide substantial bacterial reduction in a lather time of 5-seconds with good technique.
- This study demonstrates that as currently prescribed in most food safety guidance (including the FDA Food Code) may be unnecessarily long.
- Based on this research the US FDA Food Code sections requiring hand wash times of at least 20-seconds should change to allow a shorter wash time with emphasis on hand wash quality plus washing technique to fully cover both hands.
- This study highlights the importance of choosing appropriate hand hygiene products based on realistic in vivo test methods.

Future Research Needs

- Study whether allowance of shorter wash times by foodservice employees increases the number of hand washes per shift, thereby reducing overall foodborne illness risk.
- Execute the same method with other interventions for comparison:
  - Other HW marketed products at more typically practiced faster lather wash times (i.e., 5 seconds)
  - Key Comparisons / Controls: Water only, Same HW + ABHR used back-to-back, gloved hands
- Disrupting pathogen transmission from hands to food is particularly relevant in both food preparation and service to patients/residents in a healthcare setting. More studies are needed to sample the hands of food handlers / servers in restaurants and healthcare settings (i.e., hospitals and nursing homes) and the microbial burden on frequently touched surfaces.
- Research Gap: Testing in real foodservice settings to measure hand hygiene compliance baselines and the impact of targeted interventions (e.g., apply automated hand hygiene monitoring tools and behavioral science techniques such as competition and gamification). A 2024 CDC published study in 4 restaurants[7] found that workers did about nine activities an hour where they should have washed their hands, but they only washed their hands about 2-3 times an hour. Key barriers include time pressure, sink accessibility and limited consequences / management emphasis on hand washing.
- Utilization of this data in quantitative microbial risk assessments (QMRA) and risk models. Apply the risk model findings to define future development and research priorities.

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