TAB 7 FDA Reviewer's Literature Survey to Determine the Clinical Benefit of Consumer Antiseptics

Medical Officer's Review

Product Name: Healthcare Consumer Antiseptics
Use: Antisepsis
Sponsor: N/A
Type of Document: Literature Review
Date Submitted: June 9, 2005
Date Reviewed: September 22, 2005
Reviewer: Steven Osborne, M.D.

Table of Contents:

Purpose

The purpose of this review is to determine if there is a correlation between use of healthcare consumer antiseptics and a reduction in illness rates in homes, schools, or day care centers.

Background

Household antiseptic personal cleansing products, including bar soaps, gels, liquid soaps, and even tissues containing antibacterial ingredients, such as triclosan, alcohol, chlorhexidine gluconate, benzalkonium chloride, or PCMX (parachlorometaxylenol), are marketed to the consumer with claims of health benefits. These products, which are readily available and popular, are termed consumer antiseptics. Some investigators have demonstrated in vitro tests showing cross-resistance from triclosan to antibiotics occurs in specific organisms (Aiello AE, Larson E. Antibacterial cleaning and hygiene products as an emerging risk factor for antibiotic resistance in the community. Lancet Infect Dis. 2003; 3:50l-6). Thus, any potential benefit of using antibacterial products for home hygiene must be weighed against the theoretical risk of antiseptic or antibiotic resistance. This review examines available data to determine if there is a correlation between a reduction in bacteria from use of a consumer antiseptic and a reduction in disease incidence or disease transmission.

Review

A PubMed search was done with search terms:

- Wash AND antibacterial
- Wash AND antimicrobial
- Acne and antibacterial
- Acne and triclosan
- Hand AND (wash OR hygiene) AND (home OR domestic OR consumer)
- (Disease OR illness) AND transmission AND (home OR consumer OR house) NOT (virus or viral)
- Hand sanitizer
- Sanitizer AND school
- (Antibacterial OR antimicrobial OR antiseptic) AND school
- Benefit AND consumer AND antimicrobial
- Consumer AND antiseptic
- Consumer AND antimicrobial
- Antibacterial AND atopic dermatitis
- Biocide AND (home OR consumer OR dome)
- Hygiene AND (community OR domestic OR home)
- Consumer AND antiseptic NOT (mouthrinse OR mouth)
- Atopic dermatitis AND triclosan
- Dermatitis AND triclosan
- Eczema AND triclosan
- Impetigo AND triclosan
- Staphylococcus AND triclosan

The resulting references were scanned for relevance and, of those, 13 were selected for this review. The other references from this search were reviewed for the March 2005 Advisory Committee on Healthcare Antiseptics or will be reviewed by a microbiology interdisciplinary scientist.

Larson conducted a large double-blinded clinical trial (termed the *Larson trial* for this review) in which households were randomly assigned to use personal and household cleaning products with or without antimicrobial ingredients. This clinical trial is apparently not published in the literature as a single study, but rather several articles are written describing various aspects of the trial. The following 5 references in this review are published from the *Larson trial.* The specific objective, results, and conclusions in each reference will be mentioned with the review of the reference.

- Reference 3 (Aiello AE et al. 2004)
- Reference 7 (Larson E et al. 2003)
- Reference 9 (Larson EL et al. 2003)
- Reference 10 (Larson E and Gomez-Duarte C 2001)
- Reference 11 Larson EL, Lin SX, and Gomez-Pichardo C 2004)

General overview of the Larson trial:

Design and Methods:
The study was a randomized, double-blind, placebo-controlled, prospective trial conducted in an inner city Hispanic community in northern Manhattan. Households were eligible for inclusion if there were three or more individuals living in the households with at least one preschool child, the occupants had access to a telephone, English or Spanish were spoken, there were no plans to move within the next year, and the research team was allowed to make home visits. Potential households were recruited through posters and flyers. The study enrolled 238 households. Based on a pilot study that showed an incidence of infectious disease symptoms of 35% per month, the investigators estimated they could have detected a difference in infection rates between households of 20% or more (e.g. 35% to 15%) with a power of 80% and an alpha of less than 0.05.

The households were randomly assigned to one of two intervention groups: those who used handwashing and household cleaning products with antibacterial ingredients and those who used products without antibacterial ingredients. All products were provided without cost, were packaged identically with a generic label indicating their use, and were delivered to the household monthly. The products were readily available over the counter. "Antibacterial" was defined as the presence of triclosan, quaternary ammonium compounds, or hypochlorite. The product label had to include the term antibacterial or disinfectant. Households assigned to the antibacterial group were provided a liquid kitchen spray, an all-purpose hard-surface cleaner containing a quaternary ammonium compound, liquid handwashing soap containing triclosan, and a laundry detergent containing oxygenated bleach. The placebo group was provided with analogous products without antibacterial ingredients. Both groups were given the same dishwashing liquid detergent and bar soap, neither of which contained antibacterial ingredients.

On the initial home visit and at quarterly visits thereafter for 48 weeks, data were collected regarding home hygiene practices and the presence of new infectious disease symptoms during the previous month for each household member using the validated Home Hygiene Assessment Form (HHAF). The HHAF was a 31-page interview booklet designed for this study and used to collect information about demographics, illnesses, food handling, laundry, general cleaning, sharing of hygiene items such as towels and toothbrushes, a visual examination of the laundry area and bathroom, handwashing techniques of the primary care provider in the home, and participants' beliefs about how germs are spread and what is done to prevent infections in the home. The primary care provider was defined as the family member that spent the most time in the household and provided the majority of the caregiving for the family within the home.

Comment:

1. The HHAF was tested for validity in pilot work by Larson et al. 2001(reference 8).

In addition to quarterly home visits and interviews, the participants were contacted weekly by telephone, visited monthly, and were asked to notify the study team if any member of the household had a new infectious disease symptom. For the first 100 reports of current illness, an on-call physician attempted to confirm the symptoms by direct observation in a home visit.

Results: The 238 enrolled households included 1,178 members, the majority of whom were 19 years of age or younger. There were 14 dropouts (5.4%) over the 48 weeks of the study, leaving 224 households as completers. In the first 100 symptom reports, 93 were confirmed by the physician. Because of this high correlation the verification of symptoms was discontinued after the first 100 reports. All data collection on hygiene practices, patient symptoms, bacteria found on the hands of the primary caregiver, and resistance to triclosan was completed within one year of the initial home visit. Additional results and conclusions are specific to each of the 5 references that follow, and will be noted in the review of each reference.

Reference 3 (Aiello AE et al. 2004, Relationship between triclosan and susceptibilities of bacteria isolated from hands in the community)

Objective: The purpose of this report was to provide community-based data on triclosan minimum inhibitory concentrations (MICs) among of bacterial flora isolated from hands and to determine whether there was an association between triclosan MICs and antibiotic susceptibility.

Design and Methods:
The subjects were from the *Larson trial*. A hand culture from the primary caregiver within the home was obtained at baseline and 1 year later. Samples were taken after participants washed, rinsed, and dried both hands in their usual manner with the assigned liquid hand-washing product. A trained data collector randomly chose the hand to be cultured by using a coin flip. After insertion of the hand into a sterile polyethylene bag containing 50 ml of culture medium (0.075 M phosphate buffer, pH 7.9, containing polysorbate 80), the collector massaged the hand through the wall of the bag for 1 min. The authors stated that post-handwash cultures were utilized since these cultures reflect any immediate influence attributed to use of either antibacterial or nonantibacterial handwashing products on changes in bacterial species and better represent resident flora found on the hands. The interviewers timed the subjects in seconds for the duration of their handwash with the assigned product. In addition, the reported number of handwashes per day for each primary caregiver was recorded. A panel of antibiotics was chosen based upon prior research regarding a link between triclosan and antibiotic resistance and the clinical applicability of the antibiotics. Examples of the antibiotics were gentamicin, imipenem, ciprofloxacin, trimethoprim-sulfamethoxazole, oxacillin, and ceftriaxone. Resistance was interpreted per the standards of the National Committee for Clinical Laboratory Standards.

Results:
Isolates comprising 10 different bacterial species were examined for their triclosan MICs and susceptibilities to selected antibiotics. The organisms with the highest median triclosan MICs were K. pneumoniae at baseline and P. jtuorescens-P. putida at the end of the year. The triclosan median MICs for the gram negative species varied widely, as did MICs for S. aureus.

After 1 year of product use there was no significant association between triclosan MICs and antibiotic susceptibility among all species combined (OR = 1.08, 95% CI = 0.62 to 1.97), or for any individual species. Upon reexamination of a subset of isolates with high triclosan MICs at baseline or after one year (>32.0 µg/ml, three K pneumoniae, one E. cloacae, one A. baumannii, and two P. fluorescens), it was found that none of the isolates were inhibited on agar plates containing concentrations of 1,024 µg/ml. This result suggests that these isolates can survive the triclosan concentrations used in some consumer products.

Comments:

1. This report does not clearly demonstrate an association between triclosan MICs and antibiotic susceptibility. The data showing development of increased triclosan MICs varied across organisms.

2. This report did not look at infection rates in the participants, thus precluding an assessment of clinical benefit from handwashing with or without antimicrobial soap.

Reference 7 (Larson EL et al 2003, Short-and long-term effects of handwashing with antimicrobial or plain soap in the community)

The purpose of this report was to measure the effects of handwashing with a plain or antimicrobial soap on bacterial counts of the hands before and after a single wash and before and after handwashing following a year of product use.

Design and Methods:
Subjects were 238 primary caretaker volunteers in the *Larson trial.* Cultures were obtained immediately before and after handwashing with the assigned soap. Two sets of paired pre- and post-handwash samples were obtained --one at the beginning of the study (between 9/00-1/01) and the second after participants had used the same handwashing product for 12 months (between 9/01-2/02).

Results:
At baseline, 28.1% of households had an antimicrobial soap present for handwashing, while 71.9% had only a plain, non-antimicrobial soap. There were no significant differences in colony forming units of bacteria (CFU) either before or after handwashing based on whether there was antimicrobial soap present in the home or not (p = 0.66 and 0.19 respectively). Compliance with use of the assigned study product was essentially 100%.

A total of 220 paired pre and post wash samples were available at baseline and 224 at the end of one year (see comments). Bacterial counts ranged from 3.1 to >7.2 logs. In paired samples, there was no significant reduction in counts after handwashing at baseline for persons using the assigned antimicrobial soap (p = 0.52), but those using the assigned plain soap had lower counts after washing (p = 0.04, *see Comment #3 below*). By the end of one year, post-wash counts were significantly lower than pre-wash (p < 0.001) for those using either antimicrobial or plain soap, Table 1.

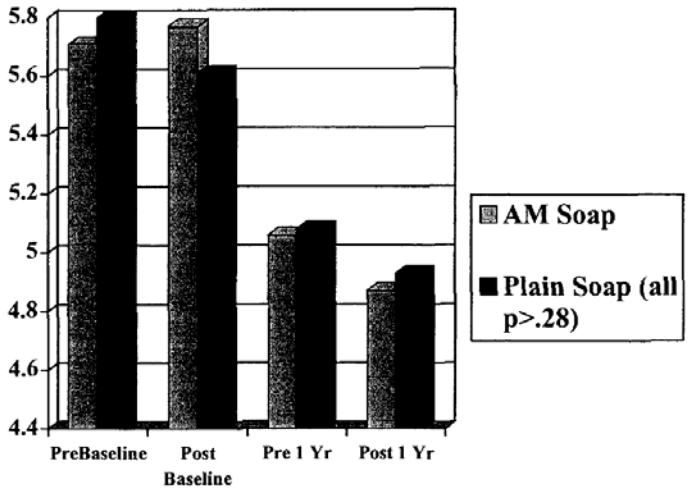
Table 1. Mean Log Pre and Post-Handwashing Microbial Counts (+ standard deviation) at Baseline and One Year

	Baseline (n = 220)			*One Year (n = 224)*		
	Prewash (±SD)	*Postwash (±SD)*	*p value* [95% CL]+*	*Prewash (±SD)*	*Postwash (±SD)*	*p value* [95% CL]+*
Antimicrobial soap	5.71 (1.04)	5.77 (1.03)	0.52 [−.23, .11]	5.06 (0.59)	4.87 (0.62)	0.000 [.09, .29]
Non-antimicrobial soap	5.80 (0.95)	5.62 (1.05)	0.04 [.009, .36]	5.08 (0.68)	4.93 (0.65)	0.003 [.05, .25]
Total group	5.76 (1.00)	5.71 (1.05)	0.41 [.07, .17]	5.07 (0.64)	4.90 (0.64)	0.000 [.10, .24]

*Difference between pre and post-wash CFU counts, paired t-test.
+95% Confidence Limits.

However, Figure 1 shows that there were no significant differences in mean log counts either before or after handwashing between those using the antimicrobial soap and those using non-antimicrobial soap at baseline or after a year of use (all p values >0.28).

Figure 1. Comparison of mean pre and post-handwash CFU counts between groups using antimicrobial (AM) or plain soap.



Comments:

1. The authors do not explain why there are 224 paired samples at the end of one year but only 220 paired samples at baseline.

2. This report did not describe infection rates in the participants, thus precluding an assessment of clinical benefit from handwashing with or without antimicrobial soap.

3. The mean differences in bacterial counts after one handwash with, and also after one year of use of, the plain or antimicrobial soap are less than a 1-log reduction. A less than 1-log reduction in bacteria might not be clinically significant. It is possible that even if infection data had been collected by the investigators, a reduction in bacterial infection rates would not have been detectable.

Reference 9 (Larson EL et al. 2003, Microbial flora of hands of homemakers)

This study described the types and numbers of microbial flora on the hands and assessed the effect of a single handwash on flora from the hands of 224 Larson trial participants. The investigators then compared the antimicrobial susceptibility patterns of bacterial isolates with isolates from hospitalized patients. There were no significant differences in microbial density after washing with either plain or antimicrobial soap. Mean log counts on the entire hand before and after handwashing were 5.72 and 5.69, respectively. A total of 1325 isolates were identified, including 520 staphylococci, 622 gram-negative bacteria, and 183 yeasts. More than two thirds of participants carried at least 1 enteric, gram-negative organism before handwashing (76.8%) and after handwashing (75.1%). The majority of gram-negative isolates tested in the community sample were more sensitive to antibiotics than inpatient isolates.

Comment:

1. This report did not look at infection rates in the participants, thus precluding an assessment of clinical benefit from handwashing with or without antimicrobial soap.

Reference 10 (Larson EL, Lin SX, and Gomez-Pichardo C 2004, Predictors of infectious disease symptoms in inner city households)

Objective: This report aimed to determine the incidence and predictors of infectious disease symptoms over a 48-week period in inner city households.

Design and Methods:
The 224 households for this study were from the *Larson trial*. On the initial home visit and at the quarterly visits thereafter for 48 weeks, data were collected by self-report regarding home hygiene practices and the presence of new infectious disease symptoms during the previous month for each household member using the Home Hygiene Assessment Form. The presence of infectious disease symptoms was confirmed by direct observation by a physician in 93% of the first 100 self-reports.

Results:
The incidence of new symptoms in the month before quarterly home visits ranged from 8.9% to12.4% for individuals and from 32% to 39.7% for households. After combining results from all four quarterly visits, the correlation of the data collected with any infectious disease symptom is shown in Table 2 below.

Table 2. Logistic regression model: predictors of any infectious disease symptom in the household combining all four quarters.

Predictors	Estimate (Beta Coefficient)	Relative Risk	95% Confidence Limits	*p* value
Hygiene practice				
Use of antimicrobial cleaning and hygiene products	0.18	1.2	0.9; 1.6	.28
Only one person prepares food	−0.15	0.9	0.6; 1.2	.36
Household members drink only bottled water	0.72	2.1	1.2; 3.6	.01
Usually use hot temperature for white laundry	−0.39	0.7	0.5; 0.9	.02
Believe that most likely to get germs in kitchen	−0.66	0.5	0.3; 0.8	.008
Frequency of handwashing (self-report)	0.03			.07
Duration of handwashing (observed in seconds)	0.01			.2
Characteristics of households				
Any child attending day care	−0.04	0.9	0.7; 1.4	.8
Any household member worked in child care or healthcare settings	−0.04	0.9	0.7; 1.4	.8
Number of people in the household	0.07			.13
Percent of children younger than 5	1.22			.06
Percent of household members who rated health fair/poor or with chronic condition	0.71			.01
Percent of household members who spent ≥40 hours/week or more outside the house	0.49			.1

Four factors were significantly associated with infection. Drinking only bottled water increased risk (relative risk [RR], 2.1; 95% confidence interval (C.I, 1.2-3.7). Using hot water (RR, 0.7; 95% C.I, 0.5-0.9) and bleach (RR, 0.29; 95% C.I. 0.23-0.66) for laundry and reporting that germs were most likely to be picked up in the kitchen (RR, 0.5; 95% C.I., 0.3-.8) were protective. No other hygiene practices, including handwashing, were associated with infection risk. The authors noted that studies of a potential role for bottled water in infections are warranted, as is a renewed appreciation for the potential protective role of laundry practices such as using bleach and hot water.

Comments:

1. An unavoidable limitation of the study was that both the hygiene practices and infectious disease symptoms were ascertained by self-report.

2. Frequency and duration of handwashing were not predictors of infection risk, so this study does not support the use of an antibacterial soap. However, because infectious disease transmission may be impacted by multiple hygiene practices the data does not indicate that handwashing should be regarded as ineffective.

Reference 11 (Larson EL et al. 2004, Effect of antibacterial home cleaning and handwashing products on infectious disease symptoms: a randomized, double-blind trial)

Objective: To evaluate the effect of antibacterial cleaning and handwashing products for consumers on the occurrence of infectious disease symptoms in households.
Design and Methods: This article was derived from the *Larson trial* data.

Results:
Figure 2 shows the flow of households through the study and Table 3 shows the subject characteristics. Initially, 272 households were assessed, with 238 randomly assigned and included in the analysis. Most were Hispanic, with slightly more women than men. Over 80% were self-described in good health.

The participants experienced primarily respiratory symptoms (runny nose, sore throat, or cough). Fever was present during 11% (301 of 2737) of household-months, vomiting was present in 2.2% (61 of 2737), diarrhea was present in 2.5% (69 of 2737), and boils or conjunctivitis were present in 0.77% (21 of 2737). Differences between intervention and control groups were not significant for any symptoms (all unadjusted and adjusted relative risks included 1.0) or for numbers of symptoms (overall incidence density ratio, 0.96, 95% CI, 0.82 to 1.12).

Figure 2. Profile of randomized clinical trial.

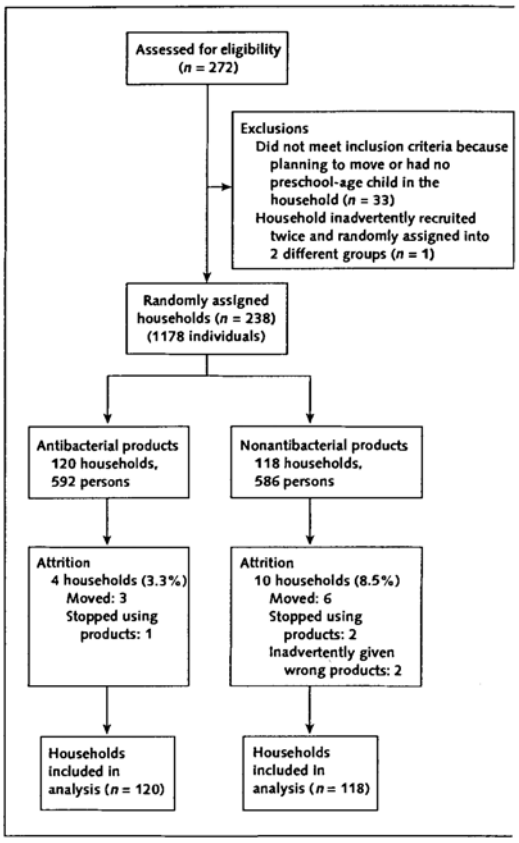


Table 3. Characteristics of household members

Characteristic	Antibacterial Group	Nonantibacterial Group	Total	*P* Value*
Age, *n (%)*				
0–5 y	180 (30.4)	176 (30.0)	356 (30.2)	>0.2
6–10 y	72 (12.2)	62 (10.6)	134 (11.4)	
11–19 y	60 (10.1)	61 (10.4)	121 (10.3)	
20–35 y	163 (27.5)	174 (29.7)	337 (28.6)	
36–45 y	73 (12.3)	66 (11.3)	139 (11.8)	
46–60 y	32 (5.4)	39 (6.7)	71 (6.0)	
>60 y	12 (2.0)	8 (1.4)	20 (1.7)	
Sex, *n (%)*				
Male	276 (46.6)	266 (45.5)	542 (46.0)	>0.2
Female	316 (53.4)	320 (54.6)	636 (54.0)	
Ethnicity, *n (%)*				
Hispanic	585 (98.8)	573 (97.8)	1158 (98.3)	0.16
African American	5 (0.8)	6 (1.0)	11 (0.9)	
White, non-Hispanic	0	5 (0.9)	5 (0.4)	
Other	2 (0.3)	2 (0.3)	4 (0.3)	
Location of birth, *n (%)*				
United States	267 (45.5)	281 (48.0)	548 (46.8)	>0.2
Outside United States	320 (54.5)	304 (52.0)	624 (53.2)	
State of health, *n (%)*				
Excellent or good	490 (84.1)	478 (82.0)	968 (83.0)	>0.2
Fair or poor	93 (15.9)	105 (18.0)	198 (17.0)	
Chronic condition, *n (%)*				
Yes	69 (12.1)	69 (12.1)	138 (12.1)	>0.2
No	499 (87.9)	501 (87.9)	1000 (87.9)	
Occupations of adults†, *n (%)*				
Child care	62 (20.5)	60 (21.0)	122 (20.7)	>0.2
Homemaker	54 (17.9)	62 (21.7)	116 (19.7)	
Food services	29 (9.6)	24 (8.4)	53 (9.0)	
Health care	20 (6.6)	9 (3.1)	29 (4.9)	
Other	137 (45.4)	131 (45.8)	268 (45.6)	

* Chi-square test comparing antibacterial and nonantibacterial groups.
† Only occupations likely to increase the risk for exposure to infections were specifically reported; "other" category includes, for example, construction or office work.

Table 4 below shows that over 48 weeks, both unadjusted and adjusted relative risks for each symptom showed no significant effect of antibacterial product use on infectious disease symptoms.

Table 4. Rates of at least one infectious disease symptom for each household-month by group.

Symptom	Rate		Unadjusted Relative Risk (95% CI)	*P* Value	Adjusted Relative Risk (95% CI)*	*P* Value
	Antibacterial Group	Nonantibacterial Group				
	% (n/n)					
Vomiting	2.2 (31/1396)	3.0 (30/1341)	0.75 (0.47–1.19)	>0.2	0.77 (0.47–1.27)	>0.2
Diarrhea	2.4 (33/1396)	2.9 (36/1341)	0.88 (0.55–1.41)	>0.2	0.90 (0.54–1.50)	>0.2
Fever	10.2 (142/1396)	11.9 (159/1341)	0.87 (0.70–1.08)	>0.2	0.84 (0.63–1.12)	>0.2
Sore throat	10.0 (140/1396)	10.3 (138/1341)	0.98 (0.78–1.22)	>0.2	0.95 (0.71–1.26)	>0.2
Runny nose	26.8 (374/1395)	25.6 (343/1341)	1.04 (0.91–1.18)	>0.2	1.03 (0.81–1.32)	>0.2
Cough	23.2 (324/1396)	23.6 (316/1341)	0.99 (0.86–1.14)	>0.2	0.97 (0.79–1.18)	>0.2
Skin/conjunctivitis	0.01 (7/1396)	0.01 (14/1341)	0.48 (0.20–1.19)	0.11	0.46 (0.18–1.21)	0.11

* Generalized estimating equations for logistic regression analysis, adjusted for number of children younger than 6 years of age, number of people who rated health as poor or fair or who had chronic conditions, size of the household, and number of people spending 40 or more hours outside of the household per week.

Comments:

1. This study does not show a clinical benefit for the tested antibacterial products. In addition, the study is confounded by use of more than one antiseptic, since the all-purpose hard-surface cleaner contained a quaternary ammonium compound, the liquid

handwashing soap contained triclosan, and the laundry detergent contained oxygenated bleach. However, we can say that the group using the multiple antiseptics did not benefit over the nonantimicrobial group.

2. The majority of illnesses, characterized by symptoms of cough, runny nose, sore throat, fever, diarrhea, or vomiting, were probably related to upper respiratory infections or gastrointestinal infections typically caused by a virus. In addition to direct or indirect contact transmission, respiratory infections, in particular, can be spread by an airborne mechanism. Whether the antiseptics used would reduce transmission of bacterial infections cannot be assessed.

Other References:

Reference 1 (Aiello AE et al. 2003, A comparison of the bacteria found on the hands of 'homemakers' and neonatal intensive care unit nurses)

This study compared the counts, types and antimicrobial resistance profiles of bacterial flora on the hands of 204 individuals in the community to that of 119 nurses at a nearby university teaching hospital. This study showed significant differences in bacterial flora and antimicrobial susceptibility of the hand flora of hospital personnel compared with homemakers, but there was no study of the incidence or transmission of infections.

Comments:

1. This study did not look at infection rates in the participants, thus precluding an assessment of the relationship between the resident bacteria on the hands and infections.

Reference 2 (Aiello AE and Larson EL, What is the evidence for a causal link between hygiene and infections?)

Objective: To examine and assess the epidemiological evidence for a causal relation between hygiene practices and infections.

Design and Methods:
The investigators conducted a Medline database search for articles published during the period January 1980 to June 2001 with keywords including “hygiene”, “health”, “sanitation”, “soap", “washing", “handwashing”, “community”, “infection", “infectious illnesses”, “diarrhea”, and “day care”. Articles were included in the review if the outcome(s) was infection or symptoms of infection and if the independent variable(s) was one or more hygiene measures. Hygiene measures were defined as any method of hygiene that was not based solely on infrastructure or implementation of facilities, such as municipal water supply and waste disposal. Articles were restricted to those written in the English language and employing either interventional or observational designs. The study design was categorized as an interventional study if the design was either experimental (formally randomized) or quasi-experimental (non-randomized intervention assignment). All studies that lacked implementation of an intervention were considered

observational. Articles were excluded if the hygiene measures were solely public health infrastructure and/or systems such as municipal water supply and waste disposal, or if the setting was a healthcare facility, such as a hospital or residential nursing home.

Results:
The investigators found 30 interventional and 24 observational studies during the 21.5 year period (Tables 5 and 6).

Interventional studies: (Table 5)
Hygiene education was the most common intervention (23/30, 77%) followed by various handwashing practices. Most of the studies examined diarrhea or gastrointestinal illness as at least one of the main outcomes (24/30, 80%). Other outcomes included respiratory infections, skin infections, trachoma, flu-like symptoms, otitis, sinusitis, and absences from school due to symptoms of infection (13/30, 43%). In general, the reduction in all infectious disease symptoms and infections was appreciable, greater than 20% for most hygiene interventions. Two studies (2/30, 7%) found no reduction in diarrhea illnesses after the implementation of hygiene educational interventions.

Observational studies: (Table 6)
One observational study was conducted in the USA (4%), and 23 in developing countries (96%). The US study focused on home-based day care providers. The majority of the studies conducted in developing countries examined practices within the family, household, and community. Two studies were done in day care centers and one involved Australian military personnel treating Kurdish refugees in Iraq. Most of the studies looked at variables involving hygiene-related behavior (i.e. hand- washing and diapering practices), knowledge (i.e. risk behaviors), and/or personal and environmental cleanliness. Diarrheal illness was the most common health outcome studied (19/24, 79%). Other illnesses examined included trachoma (3/24, 12%), respiratory illness (2/24, 8%), and helminth infection (1/24, 4%). All but two of the studies found a correlation between hygiene variables and a reduction in infection.

Fifty-three studies published from January 1980 – June 2001 examined a hypothesis regarding hygiene and health and indicated a trend toward reductions of infection after changes in hygiene measures or behaviors were implemented (one study was not relevant). The reduction in risk of infections was greater than 20% for most of the interventions, and most of the observational studies reported an association between risk factors associated with inadequate hygiene and infection.

Among the interventional studies summarized in Table 6, those that used randomization were more likely to produce study groups with similar baseline characteristics. Those included five studies conducted in child-care centers and three conducted at the community level. The authors state that for most of the studies summarized in Table 6, randomization was problematic. Some studies were under-powered, and the long-term health effects of interventions were not ascertained.

Comments:

1. The data presented does not demonstrate a clinical benefit for any specific antiseptic.

Table 5. Interventional studies assessing effects of hygiene on infections, 1980-June 2001

Author, year	Type of intervention/setting/country	Results
Black et al, 1981[6]	Handwashing with soap/child care centres/USA	48% reduction in incidence of diarrhoea
Khan, 1982[7]	Handwashing with soap, water container and water supplied/families/Bangladesh	67% reduction in risk of *Shigella* sp secondary infection, p<0·01
Torun, 1982[8]	Water supplied and hygiene education/ villages/Guatemala	Study 1: no differences between villages in diarrhoeal, respiratory, skin infections, and other infectious diseases. Study 2: diarrhoeal disease appreciably lower among intervention children ages 0–24 months
Stanton and Clemens, 1987[9]	Hygiene education /communities/Bangladesh	26% reduction in risk of diarrhoea in children age <6 years in intervention area *vs* control area
Hill et al, 1988[10]	Hygiene education/community/Philippines	70% decrease in diarrhoea and fever per 2-week period among children age <6 years
Bartlett, 1988[11]	Hygiene education/day care centres/USA	30% decrease in incidence of diarrhoea among children in intervention homes
Han and Hlaing, 1989[12]	Handwashing with soap supplied/ community/Rangoon, Burma	No significant appreciable differences in rates of diarrhoea for pre-intervention *vs* post-intervention
Alam et al, 1989[13]	Water supplied and hygiene education/ community/Bangladesh	Odds of having none or one episode of diarrhoea was significantly lower for children living in households using three or four hygiene practices compared with none or only one practice
Aziz et al, 1990[14]	Water supplied, hygiene education, and latrine built/community/Bangladesh	25% fewer episodes of diarrhoea and 30% reduction in dysentery among children in intervention area
Butz et al, 1990[15]	Alcohol hand rinse, hygiene education, gloves, diaper changing pads/day care vinyl centres/USA	28% lower risk of diarrhoea days in intervention homes *vs* controls, 95% CI (0·54–0·72) 66% lower risk of vomiting days in intervention day care homes *vs* controls, 95% CI (0·20–0·56). No appreciable significant reduction in runny nose
Wilson et al, 1991[16]	Handwashing with soap supplied and hygiene education/community/Indonesia	89% and 45% reduction in episodes of diarrhoea and skin/eye diseases, respectively, among children in intervention community
Monsma et al, 1992[17]	Handwashing with soap and hygiene education/school/Canada	22% less absenteeism, 25% less visits to the physician, and 86% less medications used compared with previous year
Ahmed et al, 1993[18]	Hygiene education/community/Bangladesh	Reduction in diarrhoea morbidity at intervention site
Araya et al, 1994[19]	Hygiene education/family/Chile	Approximately 10 mean days of diarrhoea among children in the intervention group *vs* 14 in the control group, p<0·01. No appreciable significant decrease in persistent diarrhoea in intervention *vs* control group
Haggerty et al, 1994[20]	Hygiene education/community/Zaire	11% reduction in risk of reporting diarrhoea during the peak diarrhoeal season in intervention areas *vs* controls, 95% CI (0·85–0·98). Mean number of diarrhoea episodes among children (3–35 months of age) 1 year after baseline in intervention area was 0·85 *vs* 0·90 in control; difference was not statistically significant
Kotch et al, 1994[21]	Hygiene education/day care centres/USA	After adjustment, 46% reduction in episodes of severe diarrhoea in intervention classrooms *vs* controls, 95% CI (0·03–1·04). No statistically significant differences in any other illnesses
West et al, 1995[22]	Hygiene education/community/Tanzania	After adjustment, 38% lower risk of severe trachoma in intervention village *vs* control
Mohle-Boetani et al, 1995[23]	Handwashing with soap supplied and hygiene education/community outbreak/USA	42 shigella cases in June *vs* 10 after intervention implementation in July
Shahid et al, 1996[24]	Handwashing with soap supplied and water container/community/Bangladesh	62% reduction in primary and secondary cases of diarrhoea combined and all pathogens analysed in intervention *vs* control area, 95% CI (0·33–0·43)
Pinfold and Horan, 1996[25]	Handwashing with soap supplied and hygiene education/community/Thailand	39% overall reduction in risk of diarrhoea in children <5 years in intervention *vs* control area, p<0·05
Krilov et al, 1996[26]	Hygiene education/school/USA	Compared with baseline, there was a decrease in median number of total illnesses per month from 0·70 to 0·53 in children 6 weeks to age 5, p<0·05
Kimel, 1996[27]	Handwashing with soap and hygiene education/school /USA	1·8% of students ill per day in intervention classes *vs* 3·8% in control classes, p=0·001
Niffenegger, 1997[28]	Handwashing with soap and hygiene education/schools/USA	Weeks 1 through 11: 9·4% of students age 3–5 in intervention school had colds *vs* 12·7 % in control, p<0·05. Weeks 12 through 21: 18·9% of students in intervention school had colds *vs* 27·8% in control, p<0·05
Master et al, 1997[29]	Handwashing with soap/school/USA	25% reduction in days of absences due to all communicable illnesses, p=002. 21% reduction in days of absences due to respiratory illness in handwashing group *vs* control, p=0·02. 57% reduction in days of absences due to gastrointestinal illness in handwashing group *vs* control, p=0·07
Peterson et al, 1998[30]	Handwashing with soap supplied/ refugee camp/Malawi	27% reduction in risk of diarrhoea in households with soap *vs* no soap, 95% CI (0·54–0·98)
Carabin et al, 1999[31]	Hygiene education/child care centres/Canada	No appreciable reduction in incidence rate of diarrhoea or upper respiratory infections from pre to post-intervention
Falsey et al, 1999[32]	Hand sanitising with alcohol foam supplied and hygiene education/adult day care centres/USA	50% reduction in respiratory infection rate in adult day care attendees associated with education programme for staff members
Roberts et al, 2000[33]	Hygiene education/child care centres/Australia	After adjustment, 15% reduction in rate of absence from respiratory infection in intervention centres *vs* controls, 95% CI (0·55–1·11)
Roberts et al, 2000[34]	Same as above	After adjustment, 50% reduction in rate of absence from diarrhoea in intervention centres *vs* controls, 95% CI (0·36–0·68)
Dyer et al, 2000[35]	Hand sanitising product supplied/ school/USA	28·9% and 49·7% reduction in risk of gastrointestinal and respiratory-related illnesses, respectively, in children in intervention group *vs* control

Table 6. Observational studies assessing effects of hygiene on infections, 1980-June 2001.

Author, year	Risk factors examined/study design/country	Results
Bertrand and Walmus, 1983[36]	Maternal knowledge and attitudes/cross-sectional/Colombia	Raised prevalence of diarrhoea significantly associated with child malnutrition, age of mother, house appearance, maternal birthplace, mother's general knowledge of diarrhoea
Stanton and Clemens, 1985[37]	Handwashing and home hygiene practices/ case-control/Bangladesh	Significantly less maternal handwashing and more disposal of excreta on floor in controls versus cases
Araya et al, 1994[39]	Hygienic practices in family/cross-sectional/Chile	Adequate hygienic habits associated with increased of diarrhoea
Baltazar and Solon, 1989[38]	Disposal of faeces/case-control/Philippines	Clinically diagnosed diarrhoea was significantly associated with a 34% increase with unsanitary disposal of children's stools
Taylor et al, 1989[39]	Facial cleanliness and other hygiene-related risk factors/cross-sectional/Tanzania	Poor facial cleanliness and household fly density was significantly associated with an increased risk for trachoma
Henry and Rahim, 1990[40]	Contamination of children's hands and drinking water/cross-sectional/Bangladesh	Diarrhoea rates significantly lower with more sanitation and water contamination and correlated with degree of contamination of hands
Yeager et al, 1991[41]	Personal and environmental hygiene/cross-sectional/Peru	Water storage, location of child defecation, child eating soil or faeces, young age were significant predictors of diarrhoea
West et al, 1991[42]	Facial cleanliness and other hygiene related risk factors/cross-sectional/Tanzania	70% higher rate of trachoma in children with flies and nasal discharge on their faces
Ekanem et al, 1991[43]	Home hygiene and environmental factors/ case-control/Nigeria	Faeces around toilet area, use of chamber pots, indiscriminate waste disposal, source of domestic water were significantly associated with diarrhoea
Moy et al, 1991[44]	Hygiene level and socioeconomic status/ cross-sectional/Zimbabwe	Higher mean attack rates of diarrhoea were associated with hygiene level, use of protected water source, toilet facilities, and socioeconomic status. None of the associations were statistically significant
Wijewardene et al, 1992[45]	Home hygiene and education level/ case-control/Sri Lanka	Lack of piped water and latrine, low level of maternal education and awareness of disease spread, no disposal of child faeces in latrine, improper garbage disposal were significantly associated with an increased risk of diarrhoea in cases versus controls
Bartlett et al, 1992[46]	Home hygiene and environmental factors/ longitudinal/Guatemala	Presence of toy, faecally soiled diaper or baby bottle on ground, dirty maternal hands, faeces in yard, child wearing faecally soiled diaper were significantly associated with persistent diarrhoea
Baltazar et al, 1993[47]	Personal and domestic hygiene/case-control/ Philippines	The odds of diarrhoea increased significantly with declining standards of overall cleanliness and kitchen hygiene but not for living conditions
Punyaratabandhu, et al,1993[48]	Hygiene factors in government housing project/ prospective follow-up study/Thailand	Non-working mothers, unhygienic behaviour of child caretaker such as no handwashing and method of cleaning milk bottles were significantly associated with an increased risk in childhood diarrhoea
Dikassa et al, 1993[49]	Household cleanliness and caretakers hygiene knowledge/case-control/Zaire	70% higher risk of severe childhood diarrhoea if mothers scored poorly on disposal of child faeces and household garbage and knowledge that poor caretaker cleanliness was a cause of diarrhoea
Sempertegui et al, 1995[50]	Hygiene factors in child care centres and homes/ cross-sectional/Ecuador	Reuse of water for child handwashing and washing raw vegetables was significantly associated with diarrhoea episodes
Rudland et al, 1996[51]	Chemoprophylactics, plate, and handwashing in British and Australian troops/cross-sectional/Iraq	Not taking doxycycline and having no enforced plate and hand washing regimen significantly associated with higher diarrhoea rates
Ghosh et al, 1997[52]	Maternal behaviours/case-control/India	Bottle feeding, non-use of soap to clean feeding container, open water storage, drinking pond water, indiscriminate disposal of child faeces were associated with significantly higher incidence of diarrhoea in case versus control families
Oyemade et al, 1998[53]	Environmental and personal hygiene practices/ cross-sectional/Nigeria	Water and food bought from vendors, child defecation practices, mothers' cleaning up after child defecation, refuse disposal were significantly associated with diarrhoea in children
St Sauver et al, 1998[54]	Hygienic practices in families and group day care homes/cross-sectional/USA	Infrequent handwashing significantly associated with higher rates of respiratory illness
Gorter et al, 1998[55]	Hygiene practices/prospective follow-up study/ Nicaragua	Washing of hands, domestic cleanliness, and use of diapers by children was protective for diarrhoea
Barros et al, 1999[56]	Hygiene practices in child care centres/ prospective follow-up/cross-sectional/Brazil	33% less diarrhoea in classes where soap was frequently used during diapering. None of the risk factors examined were associated with respiratory infections
Scolari, 2000[57]	Home hygiene practices/cross-sectional/Brazil	Statistically significant correlation between helminth infections and most housing/hygienic variables
Pruss and Mariotti, 2000[58]	Hygiene factors related to trachoma/review of 19 studies/39 parts of the world	Clear evidence to support facial cleanliness and environmental improvements to prevent trachoma

Reference 4 (Curtis V, Cairncross S, and Yonli R. 2000, Domestic hygiene and diarrhoea - pinpointing the problem)

The authors reviewed the literature regarding the biological, ecological, and epidemiological evidence concerning the role of specific hygiene behaviors in the transmission of diarrheal disease. They do not clarify search terms or a timeframe for the review. They state they looked for basic principles to guide practitioners in the targeting of hygiene promotion programs. They distinguish between handwashing as a primary barrier (to remove fecal matter after contact with stools) and handwashing as a secondary barrier (before preparing food, handling fluids, feeding, eating). They conclude that safe stool disposal, a primary barrier to transmission of diarrheal disease, may be more important than handwashing before eating, which constitutes a secondary barrier.

Comments:

1. This literature review does not correlate the use of specific consumer antiseptics with a reduction in disease incidence or transmission.

Reference 5 (Gibson LL et al. 2002, Quantitative assessment of risk reduction from handwashing with antibacterial soaps)

The authors sought to examine the reduction in infection risk with different soap formulations after diaper changing using a microbial quantitative risk assessment approach**.** They developed a mathematical model to assess the number of bacteria on the hands immediately after handling diapers then washing with antibacterial soap versus control. They applied the model to estimate the risk of infection from exposure to Shigella bacteria in day care centers. Using literature data and lab experiments, the authors calculated a 1.63 fold reduction in the probability of disease via contaminated hands during diaper changing, given the presence of an infant shedding Shigella, with the use of soap with a sanitizing agent (1.5% triclosan) compared with a control of soap alone.

Comment:

1. This is not a clinical trial and thus an assessment cannot be made of the clinical benefit of a given consumer antiseptic.

Reference 6 (Kagan LJ, Aiello AE, and Larson E. 2002, The role of the home environment in the transmission of infectious diseases)

The author's purpose was to summarize current health care literature (l980 – 2000) regarding evidence of disease transmission within the home, and to assess effectiveness of cleaning practices and products.

The investigators performed a Medline search with key words: home hygiene, domestic hygiene, food hygiene, and cross- contamination. They reviewed the microbiology of the home, kitchen, bathroom, and laundry area, examined the routes of transmission of infections in the home, and discussed cleaning and disinfection techniques. The authors comment that, in general, non-antimicrobial soaps are adequate to reduce transient bacterial flora, but alcohol-based products may be beneficial in circumstances where immediate antimicrobial activity is needed after encounters that result in a high probability of contamination (diaper changing) and where soap, running water, and/or clean towels are not readily available. They conclude that a single recommendation for hand hygiene practices in the home is probably inappropriate.

Comment:

1. The cited literature was primarily observational or involved microbiological data. This article does not provide data to demonstrate that the use of specific consumer antiseptics will decrease infections.

Reference 8 (Larson E, and Gomez Duarte C. 2001, Home hygiene practices and infectious disease symptoms among household members)

Objective: To describe the relationship between home hygiene practices and prevalence of infectious disease symptoms among household members.

Design and Methods:
Subjects were recruited from the waiting room of a pediatric urgent care clinic located in the study neighborhood, local churches, local elementary schools, and by word-of-mouth from neighborhood referrals.

The Home Hygiene Assessment Form (HHAF) was used to collect data. The dependent (outcome) variable, infectious disease transmission in the household, was operationally defined in two ways:

- two or more individuals in the same household had the same symptom(s), and,
- at least one of them sought medical attention for the symptom(s) and received specific treatment or antibiotics.

Results:
A total of 430 households were initially recruited, but 32 (7.4%) were not interviewed: four refused, four were out of the country for a prolonged period of time, and 24 were not reached by phone after three attempts. The final sample consisted of 398 households including 1,662 individual members. Table 7 shows the characteristics of the household members.

At least one individual in 78.6% of households reported symptoms of infection in the previous 30 days, and 37.9% of households met the definition of disease transmission (Table 8).

Table 7. Characteristics of Household Members.

Characteristic	Number	Percent
Sex (n = 1,649)		
Male	695	42.1
Female	954	57.8
Age (n = 1,650)		
Up to 5 years	423	25.5
5–12 years	284	17.1
13–20 years	199	12.0
21–50 years	660	39.9
> 50 years	90	5.4
Ethnicity (n = 1,644)		
Hispanic/Latino	1,585	96.4
African American	44	2.7
White, non-Hispanic	11	0.7
Other	4	0.2
Country of Birth (n = 1,644)		
Dominican Republic	791	48.1
United States	710	43.2
Other Central/South America	93	5.7
Europe/other	50	3.0
Health Status (n = 1,639)		
Excellent/good	1,307	79.7
Fair/poor	331	20.2
Chronic Illness (n = 1,637)		
Yes	255	15.6
No	1,382	84.4
Time Spent Outside Home (n = 1,641)		
40+ hr/week	485	29.6
20–39 hr/week	516	31.4
< 20 hr/week	640	39.0

Table 8. Reported symptoms of infection in previous 30 days among 1,662 household members

Overall Prevalence (n = 390)		Number	(Percent)
Nobody ill;		84	(21.5)
One person ill;		111	(28.5)
Two or more persons ill, but no medical attention or treatment;		39	(10.0)
Two or more persons ill and at least one sought medical attention but did not receive specific treatment or antibiotics for symptoms;		8	(2.1)
Two or more persons ill and at least one sought medical attention and received specific treatment or antibiotics for the symptoms.		148	(37.9)
Prevalence of Specific Symptoms in Individuals	**Mean Duration (min/max, ± stand deviation)**	**Number**	**(Percent)**
Vomiting (n = 1,625)	2.68 days (1–30, ± 3.40)	142	(8.7)
Diarrhea (n = 1,620)	4.64 days (1–180, ± 16.27)	106	(6.5)
Fever (n = 1,621)	2.48 days (1–13, ± 1.81)	209	(12.9)
Runny nose (n = 1,622)	8.81 days (1–160, ± 15.44)	383	(23.6)
Cough (n = 1,622)	7.63 days (1–240, ± 14.37)	378	(23.3)
Sore throat (n = 1,621)	5.29 days (1–240, ± 14.11)	312	(19.2)
Skin infection (n = 1,620)	18.8 days (1–180, ± 38.16)	56	(3.5)

Five variables were significantly correlated with household transmission: location of washing machine (home or communal, defined as any shared laundry facility outside the home), location of clothes dryer (home or communal dryer), use of bleach in laundry, equipment used to clean bathtubs (cloth, sponge, brush, or several), and type of product used to clean the shower (antimicrobial or nonantimicrobial). None of the food preparation or personal hygiene practices was associated with transmission in these data. Only two variables were independently predictive of increased risk of transmission among house- hold members – use of a communal washing machine (P=0.009) and lack of bleach use in the laundry (P=0.04) (Table 9). The investigators did not solicit information on specific handwashing behavior such as frequency and duration.

Table 9. Significant predictors of prevalence of infectious disease symptoms among household members

Variable	Odds Ratio, p Value
Using communal laundry	4.02 $p = 0.009$
Using bleach in laundry	0.17 $p = 0.04$

*Logistic regression.

Comments:

1. This study reviewed home hygiene practices of the participants, but did not specifically evaluate the use of antimicrobial soap in handwashing.

2. No determination can be made regarding the clinical benefit of a particular antiseptic from these data.

Reference 12 (Lee GM et al 2005, Illness transmission in the home: a possible role for alcohol-based hand gels)

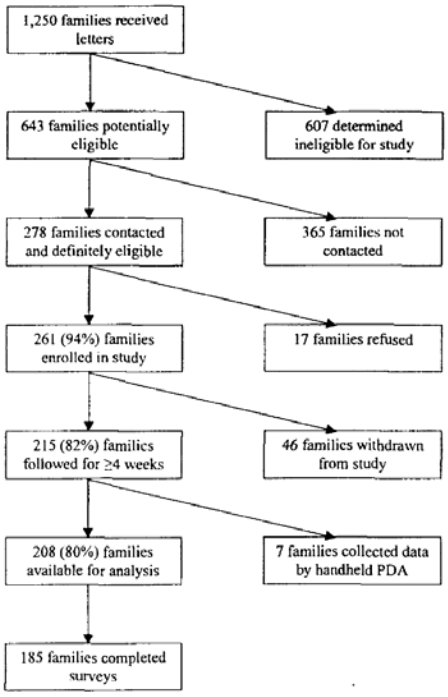
Objective: To determine transmission rates for respiratory and gastrointestinal (GI) illnesses within families with children enrolled in child care.

Design and Methods:
This is an observational, uncontrolled, prospective cohort study. Families were recruited from 5 pediatric practices, 3 urban practices and 2 suburban practices, in the metropolitan Boston area. A random-number generator was used to identify 250 families from each practice for a total of 1250 families. Subjects were sent recruitment letters and subsequently screened for eligibility. Inclusion criteria for the families were:

- at least 1 child 6 months to 5 years of age
- at least 1 child in child care with at least 5 other children for 10 hours per week anticipated for the duration of the study
- family planned to reside in the metropolitan Boston area for the duration of study
- family had access to a telephone
- primary caregiver could speak English or Spanish.

Families were excluded when their homes also functioned as family child care centers for 5 or more children or when a household member's occupation included working with children 6 months to 5 years of age for >10 hours per week. The study flow is shown in Figure 3.

Figure 3. Study enrollment and flow



Results:
The investigators observed 1545 respiratory and 360 Gl illnesses in 208 families from November 2000 to May 2001. Of these, 1099 respiratory and 297 GI illnesses were considered primary illnesses introduced into the home. The secondary transmission rates for respiratory and GI illnesses were 0.63 and 0.35 illnesses per susceptible person-month, respectively. Only two thirds of respondents correctly believed that contact transmission was important in the spread of colds, and fewer than half believed that it was important in the spread of stomach flu. Twenty-two percent of respondents reported use of alcohol-based hand gels all, most, or some of the time; 33% reported always washing their hands after blowing or wiping a nose. The authors concluded that use of alcohol-based hand gels had a protective effect against respiratory illness transmission in the home (RR 0.6, 95% CI 0.4-0.9, shown in Table 10).

Table 10. Predictors of Secondary Transmission of Respiratory and GI Illnesses in the Home on Multivariate Analysis

Variable	Respiratory Illnesses, IRR Adjusted for Site (95% CI)	GI Illnesses, IRR Adjusted for Site (95% CI)	*P* Value
Using alcohol-based hand gels	0.6 (0.4–0.9)		.010
Educational level of respondent			
Some high school or high school graduate		0.1 (0.0–1.0)	.054
Some college or college graduate		0.6 (0.3–1.2)	.138
Some graduate/professional school		1.0	—
Insurance			
Individual or employee-sponsored		1.0	—
Medicaid		4.3 (1.2–15.2)	.023
Insurance (Medicaid) × education (some high school or high school graduate)		3.1 (0.2–43.8)	.397

Comment:

1. This study, as designed, cannot prove that use of an alcohol-based gel, or any other consumer antiseptic, protects against respiratory infections, since the study was observational, not controlled, and not designed to assess alcohol gel, or other antiseptic, efficacy as a primary endpoint. It is not clear that the collection of families selected is a representative sample of the population. For example, the 22% who use an alcohol based gel seems high.

Reference 13 (Toshima Y et al. 2001, Observation of everyday hand-washing behavior of Japanese, and effects of antibacterial soap)

Objective: To assess everyday handwashing behavior as well as actual contamination of hands with foodborne pathogens. To assess the efficacy of a commercial antibacterial soap containing benzalkonium cetylphosphate, used in typical hand-washing practice.

Design and Methods:
Hand-washing was observed for 157 adults in restrooms in four shopping centers and for 68 pupils at lunchtime in an elementary school in Tokyo. Time was separately recorded for lathering and rinsing. For those who did not use soap, their handwashing under tap water was timed. Observations were made out of view of the subjects.

The effect of washing with an antibacterial soap on bacteria indigenous to the skin was assessed after a long washing scheme, which involved lathering for 30 seconds and rinsing for another 30 seconds.

Next, 12 housewives were asked to prepare dishes using raw meat or seafood in their own kitchens. Times spent in washing hands immediately after handling the food was observed. Subjects were not informed that an observation of hand-washing time would be performed. Liquid or solid hand soap was found in each kitchen.

The investigators studied the effect of hand-washing with a commercial antibacterial soap containing 1.0 % benzalkonium cetylphosphate and 0.2 % triclocarban on the total coliforms transferred from ground meat compared to placebo soap control. The following procedure was used:
The participant washed their hands with a non-antibacterial soap, and worked 200 g of ground meat, 50% beef and 50% pork, with each palm two times, for 30 seconds each time. After removing bits of meat, the participant wet the palms with tap water, and rubbed them together back and forth 10 times for 3 seconds with 1 ml of either the antibacterial soap or the placebo, rinsed the hands under tap water (water flow: 5 l/min, water temp.: 22ºC) for 8 seconds, ran 100 ml of sterilized water over the hands without rubbing them together, and absorbed remaining water by lightly pressing a sterilized towel against the hands. This washing was followed by the quantification of colony-forming units for both hands, using the glove juice method.

Results:

Tables 11 and 12 show that subjects generally spent less than 10 seconds washing and less than 10 seconds rinsing their hands regardless of whether they were in a public restroom, a school, or when preparing dishes from raw meat or seafood at home.

Table 11. Time spent for washing hands in public restrooms and at a sink of an elementary school

Site	Subjects	Month (number of subjects)	Rate of soap users (%)	Non-soap users	Soap users	
				Time spent for washing hands under tap water (average in seconds)[a]	Time spent for lathering hands (average in seconds)[b]	Time spent for rinsing hands (average in seconds)[c]
Public restrooms	Men	July (37)	30	1.7	5.6	8.8
		January (26)	27	2.3	3.4	6.0
	Women	July (45)	11	2.8	3.2	11.8
		February (49)	10	2.8	2.6	5.2
Sink of an elementary school	Students	July (24)	46	2.7	5.5	4.8
		December (44)	9	1.6	2.8	5.3

[a]Average of all subjects: 2.3 s.
[b]Average of all subjects: 4.3 s.
[c]Average of all subjects: 6.9 s.

Table 12. Time spent for washing hands when cooking at home (seconds')

	Pre-washing (water only)	Lathering	Rinsing (water only)
Soap users ($n = 4$[b])	3.7 ± 1.9	3.6 ± 2.5	5.6 ± 2.4
Non-soap users ($n = 8$[c])	–	–	4.2 ± 4.0

[a]Mean ± S.D.
[b]Persons handling ground meat ($n = 2$), raw shrimp ($n = 1$), raw squid ($n = 1$).
[c]Persons handling raw chicken ($n = 1$), raw squid ($n = 7$).

Table 13 shows a summary of colony counts using the glove juice method for office workers at work, housewives between their daily chores, and fifth and sixth grade school children just after their athletic practices. The aerobic mesophilic counts were $10^5 – 10^7$ cfu/hand. The count for elementary school students in summer was greater than that of housewives ($P < 0.05$), and that of housewives was greater than that of office workers ($P < 0.01$).

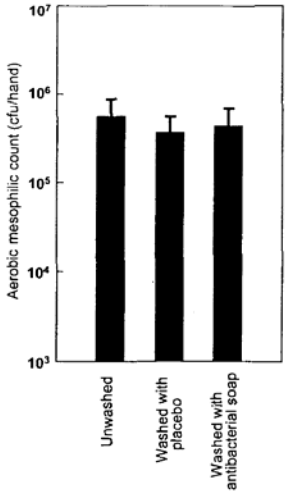
Fig. 4 shows the average bacterial count on hands immediately after the long washing technique (described in Design and Methods) with an antibacterial soap, and shows the average bacterial count after washing with a placebo. No significant difference was found between counts before and after long washing with the antibacterial soap. The bars denote averages and the lines 95% confidence intervals. No significant differences were found to exist among the three groups ($P < 0.05$).

Table 13. Bacterial counts of unwashed hands by the glove juice method (cfu/hand)

Bacteria[a]		Company employees (20)[b]		Housewives (10)	Elementary school students	
		August	November/ December	August	August (8)	January (4)
Aerobic mesophilic count	Average	1.18×10^6	6.9×10^5	3.1×10^6	7.9×10^6	1.2×10^7
	95% Confidence interval	$\pm 5.3 \times 10^5$	$\pm 4.2 \times 10^5$	$\pm 1.5 \times 10^6$	$\pm 4.9 \times 10^6$	$\pm 2.0 \times 10^7$
Total coliforms		150,150 [2][c]	30,30 [2]	60,540 [2]	–[d]	–
Salmonella		–	–	–	–	–
V. parahaemolyticus		–	–	–	–	–
E. coli O157		–	–	–	–	–
Campylobacter		–	–	–	–	+[e][2]
S. aureus		–	–	–	5.5×10^5 [1]	2.5×10^6 [1]

[a]All identification of pathogenic bacteria are tentative.
[b]Number of hands assayed/10 company employees × 2(both) hands, 5 housewives × 2(both) hands, 4 elementary students × 2(both) hands, and 4 elementary students × 1 hand.
[c]Number of positives.
[d]–: Not detected.
[e]Positive result after enrichment culture.

Fig 4. Effect of hand-washing with antibacterial soap on aerobic mesophilic counts of bacteria naturally occurring on hands. Ten participants x one hand.



Comments:

1. This study documents the amount of time that people take to wash their hands. This data may have implications for the use and labeling of consumer antiseptics, particularly regarding directions for the minimum washing time.

2. This study did not look at infection rates in the participants, thus precluding an assessment of clinical benefit from handwashing with or without the benzalkonium plus triclocarban antibacterial soap.

Summary

A Pub Med search of the medical literature did not provide any studies that linked use of a specific consumer antiseptic with a reduction in infection rates. Further, the literature indicates that consumer handwashing techniques may not result in a clinically significant bacterial log reduction. The data suggests that use of triclosan may lead to a trend of increased triclosan MICs in some, but not all, bacteria isolated from the hands of consumers.

Conclusions

The data is lacking to demonstrate that the use of specific consumer antiseptics reduces the incidence of infection or transmission of disease. There are a limited number of studies published that compare the infection rates of users of antimicrobial versus nonantimicrobial soaps. None of the studies demonstrate a benefit of the antimicrobial soap over the nonantimicrobial soap with regard to infection reduction.

Recommendations

1. Based upon the literature reviewed, the consumer antiseptics cannot be generally regarded as effective (GRAE) for reducing the incidence of infections or preventing infectious disease transmission, and should not be listed as such in the final monograph.

2. Two well-conducted, randomized controlled trials studying the effect of each, individual, consumer antiseptic ingredient on the risk of transmitting a single type of infectious disease in the home should be performed. Data demonstrating efficacy for prevention of disease transmission should also demonstrate when, with regard to the timing of disease exposure, the product provides its effect. Also, these studies should evaluate the quantity of product, and the frequency and duration of washing required to prevent disease transmission.

Steven Osborne, M.D.
Office of Nonprescription Products
HFD-560

Concurrence:

References

1. Aiello AE, Cimiotti J, Della-Latta P, Larson EL. A comparison of the bacteria found on the hands of 'homemakers' and neonatal intensive care unit nurses. J Hosp Infect. 2003 Aug;54(4):310-5.

2. Aiello AE, Larson EL. What is the evidence for a causal link between hygiene and infections? Lancet Infect Dis. 2002 Feb;2(2):103-10.

3. Aiello AE, Marshall B, Levy SB, Della-Latta P, Larson E. Relationship between triclosan and susceptibilities of bacteria isolated from hands in the community. Antimicrob Agents Chemother. 2004 Aug;48(8):2973-9.

4. Curtis V, Cairncross S, Yonli R. Domestic hygiene and diarrhoea - pinpointing the problem. Trop Med Int Health. 2000 Jan;5(1):22-32.

5. Gibson LL, Rose JB, Haas CN, Gerba CP, Rusin PA. Quantitative assessment of risk reduction from handwashing with antibacterial soaps. J Appl Microbiol. 2002;92 Suppl:136S-43S.

6. Kagan LJ, Aiello AE, Larson E. The role of the home environment in the transmission of infectious diseases. J Community Health. 2002 Aug;27(4):247-67.

7. Larson E, Aiello A, Lee LV, Della-Latta P, Gomez-Duarte C, Lin S. Short- and long-term effects of handwashing with antimicrobial or plain soap in the community. J Community Health. 2003 Apr;28(2):139-50.

8. Larson E, Gomez Duarte C. Home hygiene practices and infectious disease symptoms among household members. Public Health Nurs. 2001 Mar-Apr;18(2):116-27.

9. Larson EL, Gomez-Duarte C, Lee LV, Della-Latta P, Kain DJ, Keswick BH. Microbial flora of hands of homemakers. Am J Infect Control. 2003; Apr;31(2):72-9.

10. Larson EL, Lin SX, Gomez-Pichardo C. Predictors of infectious disease symptoms in inner city households. Nurs Res. 2004 May-Jun;53(3):190-7.

11. Larson EL, Lin SX, Gomez-Pichardo C, Della-Latta P. Effect of antibacterial home cleaning and handwashing products on infectious disease symptoms: a randomized, double-blind trial. Ann Intern Med. 2004 Mar 2;140(5):321-9.

12. Lee GM, Salomon JA, Friedman JF, Hibberd PL, Ross-Degnan D, Zasloff E, Bediako S, Goldmann DA. Illness transmission in the home: a possible role for alcohol-based hand gels. Pediatrics. 2005 Apr;115(4):852-60.

13. Toshima Y, Ojima M, Yamada H, Mori H, Tonomura M, Hioki Y, Koya E. Observation of everyday hand-washing behavior of Japanese, and effects of antibacterial soap. Int J Food Microbiol. 2001 Aug 15;68(1-2):83-91.