TAB 11 **FDA Reviewer's Evaluation of CTFA/SDA Submission Regarding Log Reduction Performance Criteria (CP7 & C80):**

- **Healthcare Personnel Handwashes – Colleen Rogers, Ph.D.**
- **Surgical Hand Scrubs - Xin Zhou, Ph.D.**
- **Patient Preoperative Skin Preparations -Xin Zhou, Ph.D.**

HEALTHCARE ANTISEPTIC DRUG PRODUCTS REVIEW

Division of Over-The-Counter Drug Products (HFD-560)
Center for Drug Evaluation and Research • Food and Drug Administration

REVIEW DATE:	September 27, 2004
FDA DOCKET NO.:	75N-0183H
SUBMISSION:	CP7 and C80
PHARMACOLOGIC CATEGORY:	Healthcare Antiseptic Drug Products
INDICATION:	Healthcare Personnel Handwash
REVIEWER:	Colleen Kane Rogers, Ph.D.

Purpose:

The purpose of this review is to determine if data submitted by the Soap and Detergent Association (SDA) and Cosmetic, Toiletry, and Fragrance Association (CTFA) in both a citizen petition and comment to the healthcare antiseptic rulemaking support their request to revise the performance and effectiveness criteria in the Healthcare Antiseptic Drug Products Monograph. The SDA/CTFA Industry Coalition submitted technical reports and articles from the medical literature to support their recommendations. This review focuses on healthcare personnel handwashes. Tabular summaries of the same studies are provided following this abstract.

Background:

Industry believes that the performance criteria specified in the 1994 Tentative Final Monograph (TFM) for over-the-counter healthcare antiseptic drug products are overly stringent. They argue that two category I ingredients (iodine and alcohol) and an NDA-approved ingredient (chlorhexidine gluconate) do not meet the current TFM performance requirements. Therefore, the SDA/CTFA Industry Coalition has proposed the Healthcare Continuum Model (HCCM). The HCCM recommends that FDA lower the bacterial log reduction criteria for in vivo testing of healthcare antiseptic drug products. This recommendation is based in part on data submitted to FDA, which is reviewed here. Listed below are the current TFM bacterial log reduction criteria

for in vivo testing of healthcare personnel handwashes and the log reductions proposed in the HCCM (see table). Finally, the Industry Coalition feels that demonstration of a persistent effect should not be required for all active ingredients. Consequently, the HCCM also recommends that healthcare personnel handwashes should be shown to be effective after only a single use.

	Reduction after 1st wash	Reduction after 10th wash
TFM criteria	2 $\log_{10}$	3 $\log_{10}$
HCCM proposal	1.5 $\log_{10}$	2 $\log_{10}$

Summary:

The following table presents an overview of the quality of the data that was submitted by SDA/CTFA regarding the performance criteria of healthcare personnel handwashes. Fifty-six studies from forty references were evaluated. Regrettably, it has been impossible to compare the data across studies due to differences in methodology and other deficiencies. Despite these flaws, in general, products containing chlorhexidine gluconate were able to meet the current TFM standards. In contrast, alcohol-containing products consistently failed to meet the persistence requirement (i.e., 3-$\log_{10}$ reduction at the tenth wash). This is not surprising since it is well known that alcohol alone does not provide persistence. In fact, the TFM acknowledges that a preservative agent must be added to provide a persistent effect for alcohol-based products. The data from other ingredients (e.g., PCMX, triclosan) were too variable to make any generalizations.

Here we provide a summary of some of the deficiencies of the submitted data. Forty-seven studies (84%) did not provide an adequate description of the methods used or merely cited the American Society for Testing and Materials (ASTM) method. Even those studies that referenced TFM or ASTM methods incorporated some changes to the standard methods without explanation or validation. For example, nine studies claiming to follow the TFM did not have subjects rinse their hands after application of the product. This modification is not described in the TFM and has not been validated. None of the studies evaluated enough subjects and only 18 used at least 12 subjects per arm as required by ASTM. Nearly 60% of the studies (32) did not mention whether or not neutralizers were included. Twenty-two studies did not include an active control and only three studies included a vehicle control, however negative controls are not required by the TFM. Subjects' hands were not sampled after the first wash in 10 of the studies and another 10 studies did not sample hands after the tenth wash (or only sampled one wash). Due to the numerous deficiencies of the submitted studies, FDA has determined that the data are not sufficient to justify lowering the TFM performance criteria for healthcare personnel handwashes.

Evaluation of Healthcare Personnel Handwash Studies – Ability to Meet Proposed Performance Criteria.

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Aly & Maibach 1980 (Reference 1)	0.5% CHG/ 70% IPA† (Hibistat)	36/arm	Minor changes from TFM	70% IPA†	Diluent and plates	NT	4.7342	Used 6 mL inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; neutralizers not validated; did not test 1st wash
Ballard 1985	4% CHG	Reference not provided						
Ballard Undated Studies 1 and 2 (Reference 2)	4% CHG (Foam Care)	36/study	Not described	None	Not described	NT	3.84	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified in study 1; used *Bacillus subtilis* as test organism in study 2; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; did not test 1st wash ; not randomized; no statistical analysis
			Used *Bacillus subtilis*				3.08	
Ballard 1998 (Reference 3)	2% CHG (Foam Care)	NP	Not described	None	Not described	NT	4	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; did not test 1st wash; number of subjects not given; not randomized (only 1 arm); no statistical analysis
Bartzokas et al. 1987 (Reference 4)	4% CHG (Hibiscrub)	12	Similar to TFM	Plain soap	Stripping solution, diluent, and plates	2.61 ± 0.33	4.15 ± 0.34	Used high inoculum (10^9 CFU/mL); used a different ATCC strain of *Serratia*; baseline not measured after wash with plain soap; control soap only used for 1 wash; not randomized

[1] BKC = benzalkonium chloride; CHG = chlorhexidine gluconate; EtOH = ethanol; IPA = isopropanol; PCMX = parachlorometaxylenol; PVP-I = povidone iodine.
† Leave-on product (not rinsed off with water after use).
[2] NP = not provided.
[3] Glove juice procedure unless otherwise noted. TFM = 1994 Tentative Final Monograph; ASTM = American Society for Testing and Materials method.
[4] NA = not applicable; active ingredient control for the study. A negative control is not required by the TFM.
[5] Shading denotes samples that meet TFM criteria. NT = not tested.
[6] From baseline.

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
Billhimer et al. 1998 Studies 1 and 2 (Reference 5)	4% CHG	11	Hands contam. using spiked ground beef	Plain soap	Stripping solution	3.3 ± 0.89	NT	Poster. Methods are very different from TFM; inadequate description of methods; hands inoculated using 50g ground beef spiked with $5x10^7$ CFU *E. coli*; baseline not measured after wash with plain soap; hands sampled using touch plate method in study 2; neutralizers not validated; did not test 10 washes; study 2 results reported as # pixels/mm; several figures are missing; no statistical analysis
		5	Agar contact plate; hands contam. using spiked ground beef		Plates	1706 pixels/ mm		
Ciba-Geigy 1990 Study 1 Figure 4 (Reference 7)	4% CHG	12/arm	Not described	Plain soap Placebo	Not described	~2.5	~4	Technical report. Active control for triclosan; inadequate description of methods, media, and inoculum; used a different ATCC strain of *Serratia*; baseline not measured after wash with plain soap; no mention of neutralizers; no numbers given – interpreted from graph; not randomized; no statistical analysis
Ciba-Geigy 1995 Attachment C Studies 1 and 2 (Reference 8)	4% CHG	12/arm	Modified ASTM E1174-87	NA	Stripping sol'n of 10th wash and diluent	1.97	2.77	Technical report. Active control for two triclosan studies; inadequate description of inoculum; no description of media and neutralizers; baseline not measured after wash with plain soap
						2.16	2.93	
Dial Corp. Undated Study 1, Table 2 and Study 2, Figure 2 and Table 3 (Reference 10)	4% CHG (Luroscrub) (1)	NP	Not described	None	Not described	NT	4.09 (avg. of both hands)	Technical report. No active control for study 1, Hibiclens is the active control for study 2; inadequate description of methods; no description of media or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; did not test 1st wash in study 1; number of subjects not given; not randomized
	4% CHG (Luroscrub) (2)			Hibiclens (4% CHG)		3.44	4.79	
	4% CHG (Hibiclens) (2)					2.78	4.22	

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
Gojo 1999 Study 1 (Reference 12)	2% CHG (Provon)	6/arm	Modified ASTM & TFM	4% CHG	Not described	~1.8	>3	Technical report. 4% CHG is the active control for this study; inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; data only presented as graph/ % reductions; not randomized; no statistical analysis
	4% CHG					~1.65	>3	
Gojo 1999 Studies 2, 3, & 4 (Reference 12)	4% CHG	18/arm	Modified ASTM & TFM	NA	Not described	3	4	Technical report. Active control for PCMX (studies 2 & 3) or triclosan (study 4); inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; data only presented as graph/ % reductions; not randomized; no statistical analysis
						2	>4	
						2	>4	
Huntington 1992a (Reference 13)	2% CHG (Cida-Stat)	NP	Not described	None	Not described	NT	4	Technical report. No description of methods, media, or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; did not test 1st wash; number of subjects not given; not randomized (only 1 arm); no statistical analysis
Huntington 1994a (Reference 15)	4% CHG (Scrub-Stat)	6/arm	Several changes from TFM	Hibiclens (4% CHG)	Diluent & plates	NT	>5	Abstract. Hibiclens is the active control for this study; used 6 mL of a small inoculum (10^7 CFU/mL); *Serratia* strain not specified; baseline not measured after wash with plain soap; neutralizers not validated; did not test 1st wash; data presented only as % reductions; not randomized; no statistical analysis
	4% CHG (Hibiclens)						>4	

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Jampani et al. 1998 Figure 3 (Reference 19)	0.5% CHG/ 78% EtOH (Prevacare*)	NP	ASTM E1174-94	4% CHG	Not described	2.36?	4.06?	Poster. 4% CHG is the active control for this study; inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; data presented as an unlabeled graph; number of subjects not given; not randomized; no statistical analysis
	4% CHG (Prevacare*)					1.97?	2.77?	
Johnson & Johnson Medical 1998a Study 1 (Reference 20)	2% CHG	9	ASTM E1174	NA	Diluent and plates	1.92	2.84	Technical report. Active control for a triclosan study; inadequate description of methods, media, and inoculum; no description of neutralizers; baseline not measured after wash with plain soap; neutralizers not validated; no statistical analysis
Johnson & Johnson Medical 1998c Studies 1 and 2 (Reference 22)	0.5% CHG/ 70% alcohol† (Prevacare*R)	12/arm	Modified ASTM E1174	62% alcohol†	Stripping sol'n of 10th wash, diluent, and plates	3.29	2.56	Technical report. No description of media and neutralizers; baseline not measured after wash with plain soap; no controls in study 2; neutralizers not validated; no statistical analysis
				None	Diluent and plates	2.36	4.06	
Kaiser et al. 2000 (Reference 27)	CHG (% not stated)	18	ASTM E1174-94	None	Not described	2.0	3.3	Abstract. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; CHG concentration not given

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Kimberly-Clark 1998 (Reference 28)	2% CHG	NP	TFM	None	Not described	1.882	3.307	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; number of subjects not given; not randomized (only 1 arm); no statistical analysis
LaRocca et al. 1985 (SDA/CTFA 95) (Reference 29)	4% CHG (Hibiclens)	16	Minor changes from TFM	Plain soap	Diluent and plates	3.24	5.31	4% CHG is the active control for this study; used 6 mL inoculum; hands only rinsed for 15 sec (vs. 30 sec in TFM); *Serratia* strain not specified; baseline not measured after wash with plain soap; neutralizers not validated
Paulson 1994	4% CHG (Hibiclens)	Reference not provided						
Peterson et al. 1978 Table IV (Reference 32)	4% CHG (Hibiclens)	36/arm	Not described	NA	Not described	NT	5.49	Inadequate description of methods and inoculum; no description of media; *Serratia* strain not specified; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; did not test 1st wash; no statistical analysis
Purdue Frederick 1986 Study 2 (Reference 33)	4% CHG (Betasept)	6/arm	Not described	Hibiclens (4% CHG)	Not described	2.05	3.289	Abstract. Hibiclens is the active control for Betasept; inadequate description of methods; no description of media or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers
	4% CHG (Hibiclens)					1.629	3.115	

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Sheena & Stiles 1983a Table 2 Experiments I and II (Reference 35)	4% CHG (Hibitane)	4	Touch plate; otherwise not described	NA	Not described	1.0	NT	Active control for triclosan (Exp. I) or for iodine and PCMX (Exp. II); methods are very different from TFM; inadequate description of methods and media; no mention of artificial contamination; baseline not measured after wash with plain soap; no mention of neutralizers; did not test 10 washes; Latin Square design
		6				0.37		
Sheena & Stiles 1983b Table 4 Experiment I (Reference 36)	4% CHG (Hibitane)	7	Hands contam. using spiked ground beef, sampled in broth	Plain soap	Not described	1.60	NT	Active control; methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; Latin Square design
Steris 1995	4% CHG	Reference not provided						
Steris 1998	0.75% CHG	Reference not provided						
Stiles & Sheena 1985 Table 1 (Reference 38)	2% CHG (Hibitane)	NP	Hands contam. using spiked ground beef, sampled in broth	Plain soap Water rinse	Not described	1.48	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; number of subjects not given; Latin Square design
	4% CHG (Hibitane)					1.88		

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Stiles & Sheena 1985 Table 3 (Reference 38)	2% CHG (Hibitane)	NP	Hands not artificially contam., sampled in broth	Plain soap Water rinse	Not described	0.10	NT	Methods are very different from TFM; no artificial contamination of hands; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for micrococcaceae only; did not test 10 washes; number of subjects not given; Latin Square design
	4% CHG (Hibitane)					0.28		
Stiles & Sheena 1987 Table 1 (Reference 39)	2% CHG	4	Hands contam. using spiked ground beef, sampled in broth	Plain soap	Not described	2	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^7 CFU/g *E. coli* and 10^8 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; not randomized
	4% CHG					~2.5		
Stuart Pharma. 1986 Abstract 8 Table 4 (Reference 40)	4% CHG (Hibiclens)	36	Not described	None	Not described	NT	4.2649 15 sec wash	Abstract. No description of methods, media, or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; did not test 1st wash; not randomized (only 1 arm); no statistical analysis
							4.3192 30 sec wash	
Stuart Pharma. 1986 Abstract 11 Figure 1 (Reference 40)	4% CHG (Hibiclens)	16	Similar to TFM, but not enough detail	Plain soap	Not described	~3.2	~5.4	Abstract. Active control; inadequate description of methods; no description of media; used 6 mL inoculum; allowed inoculum to dry on hands for 1 hr before sampling; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; no numbers given – interpreted from graph; data appears to be taken from reference 29

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Dyer at al. 1998 (Reference 11)	0.13% BKC† (SAB)	21 (rinse)	Minor changes from TFM; used with and without rinsing	62% EtOH† 70% EtOH†	Diluent (by 3 min); although not needed for alcohols	2.8 ± 0.2	~4.5	No description of neutralizers; *Serratia* strain not specified; baseline not measured after wash with plain soap; plain soap control only used for one wash; neutralizers not validated; no numbers given – interpreted from graph; not randomized
		14 (leave on)				~2.25	~4.25	
	62% Ethanol†	17 (rinse)				2.8 ± 0.2	~2.4	
		16 (leave on)				~2.1	~1.8	
	70% Ethanol†	5 (rinse)				~2.8	~1.3	
		5 (leave on)				~2.5	~2.1	
Gojo 1999 Study 9 (Reference 12)	62% Ethanol† (Purell gel)	5	Modified ASTM E1174-87	None	None needed	~2.8	~1.85	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no active control; data only presented as graph/ % reductions; not randomized (only 1 arm); no statistical analysis
Huntington 1995a (Reference 17)	70% Ethanol† (Cida-Rinse)	6	Similar to TFM, but no rinsing	None	Plates, but not needed	2.59	1.97	Technical report. Inadequate description of methods and inoculum; baseline not measured after wash with plain soap; no controls; neutralizers not validated, but not necessary; not randomized (only 1 arm); no statistical analysis

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Johnson & Johnson Medical 1998c Study 1 (Reference 22)	62% Alcohol†	12/arm	Modified ASTM E1174	NA	Stripping sol'n of 10th wash, diluent, and plates, but not needed	3.04	2.72	Technical report. Active control for a CHG/ alcohol leave-on product; no description of media and neutralizers; baseline not measured after wash with plain soap; neutralizers not validated; no statistical analysis
Johnson & Johnson Medical 1998d (Reference 23)	60% Ethanol† (Prevacare* gel)	11	Modified ASTM E1174	None	Stripping sol'n of 10th wash, diluent, and plates, but not needed	2.97	2.74	Technical report. No description of media and neutralizers; baseline not measured after wash with plain soap; no controls; neutralizers not validated; not randomized (only 1 arm); no statistical analysis
Johnson Wax Undated a Studies 1 and 2 (Reference 24)	60% Ethanol† (Deliver gel)	NP	Not described	PCMX (study 1) None (study 2)	None needed for EtOH arm	~1.75	NT	Technical report. No description of methods, media, or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; inappropriate active control in study 1, no active control in study 2; no numbers given – interpreted from graphs; number of subjects not given; not randomized; no statistical analysis
						~2.5	~2	
Jones et al. 2000 Figure 1 (Reference 26)	60% Ethanol† (gel)	10	Modified ASTM	None	Stripping sol'n of 10th wash and diluent (by 5 min), but not needed	2.97 ± 0.36	2.74 ± 0.69	*Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; neutralizers not validated, but not necessary; not randomized (only 1 arm)
Kaiser et al. 2000 (Reference 27)	Alcohol (% not stated)	12	ASTM E1174-94	None	None needed	2.0	2.3	Abstract. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; active control not specified; alcohol concentration not given
Kimberly-Clark 1999	62% Ethanol	Reference not provided						

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Paulson 1994 (Reference 30)	62% Ethanol† (gel)	5/arm	Minor changes from TFM	Plain soap	Diluent and plates, but not needed	3.93 ± 0.04	2.16 ± 0.13	No rinsing for alcohol gel; hands were allowed to dry thoroughly before sampling; baseline not measured after wash with plain soap; no active control; neutralizers not validated in 1994 study, but not necessary; Note: 1999 data almost identical to 1994 data
Paulson et al. 1999 (Reference 31)						3.93 ± 0.04	2.15 ± 0.13	
SDA/CTFA 1995	60% Ethanol	Reference not provided						
SDA/CTFA 1995a	80% Ethanol	Reference not provided						
SDA/CTFA 1995a	Ethanol (Alcare Foam)	Reference not provided						
Aly & Maibach 1980 (Reference 1)	70% IPA†	36/arm	Minor changes from TFM	NA	Diluent and plates, but not needed	NT	1.6024	Active control for a leave-on CHG product; used 6 mL inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; neutralizer not validated; did not test 1st wash
Rotter 1984 Table 3 (Reference 34)	60% IPA†	15	Not described, used *E. coli*	NA	None needed	3.4 ± 0.9	NT	Active control for a PVP-I study; no description of methods, inoculum, or media; designed to compare glove juice to finger tip method of sampling; used *E. coli* as test organism; no mention of neutralizers; did not test 10 washes
Kaiser et al. 2000 (Reference 27)	I_2 (% not stated)	7	ASTM E1174-94	None	Not described	3.5	4.0	Abstract. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; iodine concentration not given

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
Sheena & Stiles 1983a Table 2 Experiment II (Reference 35)	0.005% I_2	6	Touch plate; otherwise not described	4% CHG	Not described	0	NT	Methods are very different from TFM; inadequate description of methods and media; no mention of artificial contamination; baseline not measured after wash with plain soap; no mention of neutralizers; did not test 10 washes; Latin Square design
	0.75% I_2					0.29		
Sheena & Stiles 1983b Table 4 Experiments I and II (Reference 36)	0.75% I_2	7	Hands contam. using spiked ground beef, sampled in broth	Plain soap 4% CHG	Not described	1.80	NT	4% CHG is the active control for Exp. I only; methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; Latin Square design
	25 ppm I_2 dip	5		Plain soap		1.34		
	0.005% I_2 wash					1.39		
Stiles & Sheena 1985 Table 1 (Reference 38)	0.01% I_2	NP	Hands contam. using spiked ground beef, sampled in broth	Plain soap Water rinse	Not described	1.50	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; number of subjects not given; Latin Square design
	0.1% I_2					1.79		
	0.3% I_2					1.50		
	0.5% I_2					1.71		
	0.75% I_2					2.12		
Stiles & Sheena 1985 Table 3 (Reference 38)	0.01% I_2	NP	Hands not artificially contam., sampled in broth	Plain soap Water rinse	Not described	0.02	NT	Methods are very different from TFM; no artificial contamination of hands; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for micrococcaceae only; did not test 10 washes; number of subjects not given; Latin Square design
	0.1% I_2					0.14		
	0.3% I_2					0.20		
	0.5% I_2					0.13		
	0.75% I_2					0.16		

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
Stiles & Sheena 1987 Table 1 (Reference 39)	0.02% I_2	4	Hands contam. using spiked ground beef, sampled in broth	Plain soap	Not described	~2.1	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^7 CFU/g *E. coli* and 10^8 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; not randomized
	0.12% I_2					~2.2		
	0.75% I_2					~2.7		
Gojo 1999 Studies 2 and 3 (Reference 12)	0.5% PCMX (Provon) (2)	18/arm	Modified ASTM & TFM	4% CHG	Not described	1.86	2.62	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; not randomized; no statistical analysis
	0.3% PCMX (Provon) (3)					2.57	2.83	
Huntington 1992b (Reference 14)	3% PCMX (Suite Scrub)	6	Similar to TFM	None	Plates	2.943	>3.130	Technical report. Inadequate description of methods and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; neutralizers not validated; not randomized (only 1 arm); no statistical analysis
Huntington 1994b Studies 1 and 2 (Reference 16)	0.6% PCMX (Medi-Scrub)	6	Similar to TFM	None	Plates	2.603	3.502	Technical report. Inadequate description of methods and inoculum; *Serratia* strain not specified; baseline not determined after washing with plain soap; no controls; neutralizers not validated; the data from study 2 is the average of different amounts of product; not randomized (only 1 arm); no statistical analysis
						NT	1.577 (avg)	

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Johnson Wax Undated a Study 1 (Reference 24)	PCMX (% not stated)	NP	Not described	NA	Not described	~1.5	NT	Technical report. Active control for alcohol gel; no description of methods, media, or inoculum; unclear if the product is used as a leave-on; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; no numbers given –interpreted from graph; number of subjects not given; not randomized; no statistics; PCMX concentration not given
Johnson Wax Undated b (Reference 25)	0.6% PCMX (Deliver)	NP	Not described	None	Not described	~1.5	~1.75	Technical report. No description of methods, media, or inoculum; *Serratia* strain not specified; baseline not determined after washing with plain soap; no controls; no mention of neutralizers; no numbers given – interpreted from graph; number of subjects not given; not randomized (only 1 arm); no statistical analysis
LaRocca et al. 1985 (SDA/CTFA 95) (Reference 29)	1% PCMX (Acute-Kare)	15	Minor changes from TFM	Plain soap 4% CHG	Diluent and plates	2.39	3.06	Used 6 mL inoculum; hands only rinsed for 15 sec (vs. 30 sec in TFM); *Serratia* strain not specified; baseline not measured after wash with plain soap; neutralizers not validated
Paulson 1994 (Reference 30)	0.6% PCMX soap (94)	5/arm	Minor changes from TFM	Plain soap	Diluent and plates	2.54 ± 0.22	2.76 ± 0.27	Hands were allowed to dry thoroughly before sampling; baseline not measured after wash with plain soap; no active control; neutralizers not validated in 1994 study; Note: 1999 data are almost identical to 1994 data
	2.5% PCMX soap (94)					1.99 ± 0.12	3.99 ± 0.59	
Paulson et al. 1999 (Reference 31)	0.6% PCMX soap (99)					2.50 ± 0.22	2.76 ± 0.27	

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
SDA/CTFA 1995	0.3% PCMX	Reference not provided						
SDA/CTFA 1995	0.5% PCMX	Reference not provided						
SDA/CTFA 1995	0.53% PCMX	Reference not provided						
Sheena & Stiles 1983a Table 2 Experiment II (Reference 35)	0.325% PCMX soap	6	Touch plate; otherwise not described	4% CHG	Not described	0	NT	Methods are very different from TFM; inadequate description of methods and media; no mention of artificial contamination; baseline not measured after wash with plain soap; no mention of neutralizers; did not test 10 washes; Latin Square design
	0.65% PCMX soap					0		
	3% PCMX gel					0		
Sheena & Stiles 1983b Table 4 Experiment I (Reference 36)	0.325% PCMX	7	Hands contam. using spiked ground beef, sampled in broth	Plain soap 4% CHG	Not described	1.40	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; Latin Square design
Stuart Pharma. 1986 Abstract 11 Figure 1 (Reference 40)	PCMX (Acute Kare)	15	Similar to TFM, but not enough detail	Plain soap 4% CHG	Not described	~2.4	~3	Abstract. Inadequate description of methods; no description of media; used 6 mL inoculum; allowed inoculum to dry on hands for 1 hr before sampling; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; no numbers given – interpreted from graph; data appears to be taken from reference 29; PCMX concentration not given

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Peterson et al. 1978 Table IV (Reference 32)	0.75% PVP-I (Betadine)	36/arm	Not described	NA	Not described	NT	3.89	Inadequate description of methods and inoculum; no description of media; *Serratia* strain not specified; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; did not test 1st wash; no statistical analysis
Rotter 1984 Table 3 (Reference 34)	0.75% PVP-I	15	Not described, used *E. coli*	60% IPA†	Not described	3.2 ± 0.5	NT	No description of methods, inoculum, or media; designed to compare glove juice to finger tip method of sampling; used *E. coli* as test organism; no mention of neutralizers; did not test 10 washes
Bartzokas et al. 1987 (Reference 4)	1.5% triclosan	12	Similar to TFM	Vehicle	Stripping solution, diluent, and plates	2.91 ± 0.42	3.78 ± 0.47	Used high inoculum (10^9 CFU/mL); used a different ATCC strain of *Serratia*; baseline not measured after wash with plain soap; control only used for 1 wash; no active control; not randomized
Calgon Vestal 1993 (Reference 6)	0.5% triclosan?	30	Similar to TFM, but not enough detail	None	Not described	2.31	2.53	Technical report. Active ingredient not mentioned in report; inadequate description of methods; no description of media or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; not randomized (only 1 arm)
Ciba-Geigy 1990 Study 1 Figure 4 (Reference 7)	1% triclosan (Irgasan DP300)	12/arm	Not described	Plain soap Placebo 4% CHG	Not described	~2.5	~3.7	Technical report. Inadequate description of methods, media, and inoculum; used a different ATCC strain of *Serratia*; baseline not measured after wash with plain soap; no mention of neutralizers; no numbers given – interpreted from graph; not randomized; no statistical analysis

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Ciba-Geigy 1995 Attachment C Studies 1 and 2 (Reference 8)	0.25% triclosan (1)	12/arm	Modified ASTM E1174-87	4% CHG	Stripping sol'n of 10th wash and diluent	2.03	1.75	Technical report. Inadequate description of inoculum; no description of media and neutralizers; baseline not measured after wash with plain soap
	1% triclosan (1)					2.54	2.61	
	0.25% triclosan (2)					1.94	1.76	
	1% triclosan A (2)					1.97	1.90	
	1% triclosan B (2)					2.13	2.19	
ConvaTec 1995 (Reference 9)	0.5% triclosan? (Soft'N Sure)	30	Similar to TFM, but not enough detail	None	Not described	2.31	2.53	Technical report. Active ingredient not mentioned in report; inadequate description of methods; no description of media or inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; no mention of neutralizers; not randomized (only 1 arm)
Gojo 1999 Study 4 (Reference 12)	0.3% triclosan (Provon)	18/arm	Modified ASTM & TFM	4% CHG	Not described	2.84	3.04	Technical report. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; not randomized; no statistical analysis
Huntington 1995b (Reference 18)	0.3% triclosan (Bacti-stat)	6	Similar to TFM	None	Plates	1.74	1.93	Technical report. Inadequate description of methods and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no controls; neutralizers not validated; not randomized (only 1 arm); no statistical analysis

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6] 1st wash	Log Reductions[6] 10th wash	
Jampani et al. 1998 Figure 3 (Reference 19)	1% triclosan (Prevacare)	NP	ASTM E1174-94	4% CHG	Not described	2.13?	2.14?	Poster. Inadequate description of methods, media, and inoculum; *Serratia* strain not specified; baseline not measured after wash with plain soap; no mention of neutralizers; data presented as an unlabeled graph; number of subjects not given; not randomized; no statistical analysis
Johnson & Johnson 1998a Studies 1 and 2 (Reference 20)	1% triclosan (Prevacare)(1)	8	ASTM E1174	2% CHG	Diluent and plates	2.13	2.14	Technical report. Inadequate description of methods, media, and inoculum; no description of neutralizers; baseline not measured after wash with plain soap; no active control in study 2; neutralizers not validated; study 2 not randomized (only 1 arm); no statistical analysis
	1% triclosan (1)	6				1.74	1.63	
	1% triclosan (Prevacare)(2)	12		None		2.28	2.79	
Johnson & Johnson 1998b Studies 1 and 2 (Reference 21)	0.25% triclosan (Prevacare)(1)	12/arm	ASTM E1174	None	Diluent and plates	1.94	1.75	Technical report. Inadequate description of methods, media, and inoculum; no description of neutralizers; baseline not measured after wash with plain soap; inappropriate active control (triclosan); neutralizers not validated; no statistical analysis
	0.5% triclosan (1)					1.95	1.57	
	1% triclosan A (1)					1.97	1.89	
	0.25% triclosan (Prevacare)(2)					2.03	1.75	
	1% triclosan B (2)					1.67	1.50	
SDA/CTFA 1995	0.3% triclosan	Reference not provided						

Author & Year	Study Design					Results[5]		Deficiencies
	Active Ingredient[1] (Tradename)	No. of Subjects[2]	Methods[3]	Controls[4]	Neutralizer	Log Reductions[6]		
						1st wash	10th wash	
Sheena & Stiles 1983a Table 2 Experiment I (Reference 35)	0.3% triclosan gel	4	Touch plate; otherwise not described	4% CHG	Not described	0.02	NT	Methods are very different from TFM; inadequate description of methods and media; no mention of artificial contamination; baseline not measured after wash with plain soap; no mention of neutralizers; did not test 10 washes; Latin Square design
	0.25% triclosan soap					0		
	0. 5% triclosan soap					0		
Sheena & Stiles 1983b Table 4 Experiment I (Reference 36)	0.3% triclosan gel	7	Hands contam. using spiked ground beef, sampled in broth	Plain soap 4% CHG	Not described	1.32	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^6 CFU/g *E. coli* and 10^7 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; Latin Square design
	0.25% triclosan soap					1.23		
Stepan Co. Undated (Reference 37)	Triclosan (% not stated)	NP	Not described	NA	Not described	~1.5	~1.5	Technical report. Active control for a BKC study; amount of triclosan not given; no description of methods, media, or inoculum; inappropriate active control; no mention of neutralizers; no numbers given – interpreted from graph; number of subjects not given; not randomized; no statistical analysis
Stiles & Sheena 1987 Table 1 (Reference 39)	0.3% triclosan gel	4	Hands contam. using spiked ground beef, sampled in broth	Plain soap Vehicle	Not described	~2.3	NT	Methods are very different from TFM; hands inoculated using 50g ground beef spiked with 10^7 CFU/g *E. coli* and 10^8 CFU/g *P. fluorescens*; samples plated on selective media; baseline not measured after wash with plain soap; active control not specified; no mention of neutralizers; data are for *E. coli* only; did not test 10 washes; not randomized
	0.5% triclosan soap					~2.4		

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