



Innovations in Hand Hygiene

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Teleclass Sponsor:

Deb Medical Hand Hygiene
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Skin As A Barrier

- **Stratum corneum**
composed of ~15 layers of
flattened dead cells
- **New layer formed daily**
- **Completely replaced every
2 wks**
- **Horny protective layer of
bricks and mortar**



From healthy skin....

- **10⁷ particles shed
daily**
- **10% contain viable
bacteria**
- **Acidic pH is
antibacterial**
- **Lipids prevent
dehydration**



Effects of Soap on Skin

- **Increased pH**
- **Reduced lipids**
- **Increased transepidermal
water loss**
- **Increased shedding of
squamous cells**



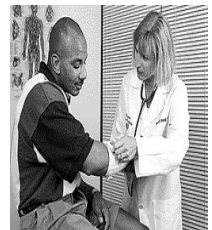
Effect of Scrubbing on Skin Shedding

- **CFU reduced
satisfactorily with either
surgical scrub or alcohol**
- **No increase in shedding
after alcohol**
- **18-fold increase in
shedding after scrub**



Meers & Yeo, 1978

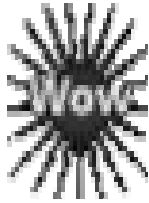
Studies of Hand Flora



Factors affecting skin condition

(Seitz, Newman, AJIC, 1988)

- Nurses in Arizona and Wisconsin
- Winter, northern locale, age >30 yrs increased risk of dry, chapped hands
- Washing only 1-2 times/hour increased severity of dry skin



Survey 1

- To describe prevalence and correlates of skin damage on hands of nurses
- Four hospitals: two in mid-Atlantic, two in northern U.S.
- 410 nurses working 30+ hr/week in acute care

Assessing Skin Damage: Irritant Contact Dermatitis

- Visual exam at 30X magnification by trained investigators
- Self-report questionnaire
- Reliability and validity confirmed with dermatologist assessment
- Diagnosed conditions (eczema, atopic dermatitis, psoriasis) excluded

Results

- Approximately one-fourth (106/410) had measurable, current skin damage
- 85.6% reported ever having problems
- Damage not correlated with age, sex, skin type, soap used at home, duration of handwashing, glove brand

Correlates of Damage

- Type of soap used at work (CHG < plain soap < other antimicrobial soap, $p=.01$)
- Frequency of handwashing ($p=.0003$)
- Frequency of gloving ($p=.008$)
- Study site (both community hospitals < both academic health centers, $p=.009$)

Logistic Regression

- Dependent variable: skin damage
- Independent variables: type of soap, frequency of handwashing and gloving, study site
- Independent correlates of damage:
Soap used at work ($p=.03$)
Frequency of gloving ($p=.01$)

Survey 2

- Compare microbial flora of hands of nurses with healthy and damaged skin
- Examine relationships between hand care practices, skin condition, and skin flora
- Subjects: 20 nurses with healthy skin, 20 nurses with damaged skin

Methods

- Prospective data collection for 3 work weeks over a 3-month time period
- Subjects kept detailed diary of hand care



- Skin condition scored by visual assessment and self-report
- Hands cultured with glove juice technique
- Random visits to subjects to confirm compliance



Microbiologic Methods

- Samples plated on general nutrient medium and six selective media
- Representative colonies gram-stained and identified with API systems or standard techniques
- Antimicrobial susceptibilities tested by disk diffusion

Results: Hand Care Practices

- Mean handwashes/hr: 2.1 (.68-4.8)
- 57.5% used non-antimicrobial soap
- Mean glovings/hr: 1.3 (.25-3.2)
- 87.5% used powdered gloves only
- 97.4% used hand lotion

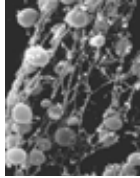


Hand Flora

- Mean CFUs: Undamaged 5.63
Damaged 5.60 p=.63
- # Species: Undamaged 6.2
Damaged 8 p=.11
- Colonizers Undamaged 2.6
Damaged 3.3 p=.03

Hand Flora

- Twice as many with damaged hands were colonized with *S. hominis* ($p=.02$) and *S. aureus* ($p=.11$)
- Twice as many carried gram-negative bacteria, enterococci, *Candida*



Comparison with Previous Studies

- 1986, oncology nurses
Mean CFU: 4.79
- 1992, nurses in Peru
Mean CFU: 5.74
- 1997, nurses in acute care
Mean CFU: 5.61

Comparison with Previous Studies: CNS

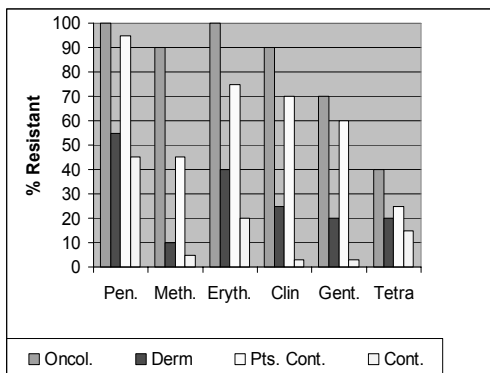
- Resistant to methicillin

1986 (n=50 isolates)	68.0%
1988 (n=81 isolates)	50.7%
1992 (n=163 isolates)	46.6%
1997 (n=123 isolates)	58.5%

Comparison with Previous Studies: CNS

- Resistant to tetracycline

1986 (n=50 isolates)	23.0%
1988 (n=81 isolates)	30.7%
1992 (n=163 isolates)	47.8%
1997 (n=123 isolates)	10.5%



Differences in Flora by Clinical Area

Horn, et al., ICHE, 1988

- BMT Staff (n=28)
 - Lower CFUs
 - Significantly more resistance in CNS
 - Significantly more JK coryneforms, GNBS, *Candida*
- Dermatology Staff (n=35)
 - Higher CFUs
 - Significantly more *S. aureus*



Differences by Discipline

Horn, et al., ICHE, 1988

- Physicians had higher counts than nurses
- Nurses had higher rates of antimicrobial-resistant CNS flora than physicians
- Rank order of antimicrobial resistance:
 - BMT staff
 - Patients hospitalized 30+days
 - Dermatology staff
 - Normal controls

Conclusions

- Colonizing hand flora of staff reflects patient population contacted
- Efforts to improve hand condition are warranted, since skin damage is associated with changes in flora
- Efforts should include monitoring of hand care practices, adoption of protectant products in policy, increased use of powderfree, hypoallergenic, and/or non-latex gloves

5 min PI vs. 1min PI/Alc

- 28 OR volunteers
- Mean CFU, 1 hr post: 1.5 and .83 (p=.59)
- Mean CFU, 2 hr post: 4.0 and 1.5 (p=.33)
- Conclusion: no significant difference

Mil Med 1998; 163:145



Comparison of Five Protocols

Pereira, JHI, 1997; 36:49

- 23 OR nurses, all protocols random order
- Protocols Tested:
 - CHG 5/3.5 min
 - CHG 3/2.5 min
 - PI Ti 3/2.5 min
 - CHG PA 2/0.5 min
 - CHG EA 2/0.5 min



Results....

- CHG-5 and ALC had lowest post-scrub counts
- No difference between CHG-5 and ALC at day 1, but ALC significantly lower post-scrub counts at day 5 (p=0.003)
- No significant difference in skin condition



Effect of Brush on Skin

Acta Derm Ven 1999; 79:230

- Compared brush scrub with wash for 11 days in different seasons
- TEWL, conductance, pH measured
- Significantly higher TEWL for brush in autumn

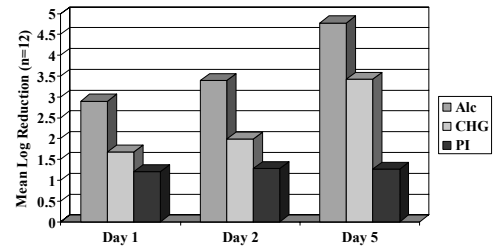


Antiseptic Scrub With or Without Brush *AJIC 1997; 25:11*

- 15 volunteers did 5 min scrub using CHG/ALC with and without brush (crossover design)
- No significant differences in CFU
- But, up to twice the number of subjects without a brush had greater CFU reductions



ALC (no brush), CHG, PI (brush) *Surg Serv Mgmt 1998; 4:36*



Alcohol Vs. Traditional Scrub: 30-Day SSI Rates

- Clean and clean- contaminated surgery
- Protocols: 75% propanol, 4% PI, 4% CHG
- Infection rates: 2.44% (55/2252) in alc group; 2.48% (53/2135) in other groups
- Compliance significantly better with alc (p=0.008), and hands were less dry with less skin irritation

» Parienti, JAMA 2002; 288:722-7

What About the Time?

AORN J 1997; 66:574

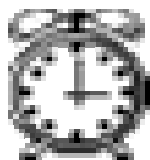
- 25 OR staff, randomized crossover
- 2 vs. 3 min scrub
- Difference <0.5 log
- Conclusion: clinically equivalent



Time Tests

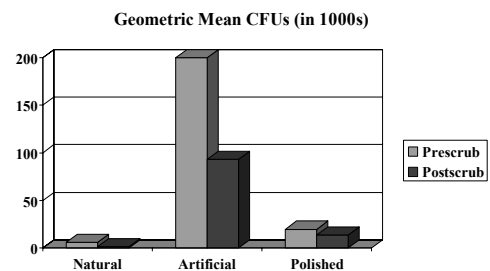
Aust New Zeal J Surg 1998; 68:65

- Single wash with 10% PI failed to provide lasting CFU reductions
- 30 sec wash as effective as longer washes
- Conclusion: "prolonged vigorous pre-operative scrubbing is unnecessary"



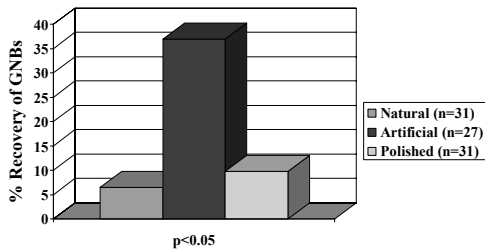
Effect of Fingernails on Counts

Nurs Res 1998; 47:54



Effect of Fingernails on GNBs

Nurs Res 1998; 47:54



Cleaning with artificial and natural nails

McNeil, CID, 2001; 32:367

- 21 nurses with, 20 without artificial nails
- Before cleaning, 85% with and 35% without had gnb, yeast or *S. aureus* (p=.003)
- For those with artificial nails, 14% cleared these organisms after cleaning with soap, 80% after alcohol

Prolonged outbreak traced to staff fingernails.....

Over 15 months, 10.5% of 439 neonates acquired *P. aeruginosa*, 35% died;

Significant association with two nurses: one with long natural nails and one with artificial nails; "Requiring short natural fingernails..is a reasonable policy"

Moolenaar, et al. ICHE, 2/00



Candida osteomyelitis and diskitis

- Three post-laminectomy patients got deep wound infection with identical strain of *C. albicans*
- Case-control study found significant relationship with one OR tech who wore artificial nails and carried *C. albicans* in nose

CID 2001; 32:352.

S. marcesens wound infections

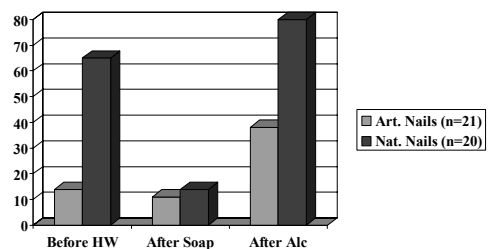
- 7 cardiovascular infections
- Risk factor: exposure to a nurse with artificial nails
- Exfoliant cream removed from nurse's home

Passaro, JID 1997; 175:992



Percentage free of *S. aureus*, gnb, yeast

CID, 2001; 32:367



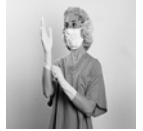
Pilot Study, NICU

- **Purpose:** Compare traditional antiseptic wash (CHG) and mild soap wash + alcohol rinse
- **Outcomes:** Microbial flora, skin condition
- **Random assignment** (n=8 in each group)



Hand Hygiene Practices

- | Traditional Wash | Soap/alcohol |
|------------------|--------------|
| • Mean Washes: | |
| • 21.2 | • 23.8 |
| • Mean Glovings: | |
| • 12.4 | • 12.4 |



Microbiology

- NS differences in mean CFU counts at baseline, 2, 4 wks
- NS differences in types of organisms isolated
- All $p > 0.44$



Skin Condition

- **By week 4, significant improvement in skin condition of alcohol group**
 - by observer assessment (p=0.001)
 - by subject assessment (p=0.007)



Larson, Heart and Lung, 2000

Sequential Trial of ALC and CHG

- **Two products:**
 - Detergent w/4%CHG (TSS)
 - 61% ethyl ALC, 1% CHG, and emollients (HP)
- **20 OR staff used each product for 3 weeks sequentially**



Background

- **Our study design**
 - Prospective single center clinical trial
 - 3 Operating Suites of the Hospital
- **Sample Size**
 - required 20
 - recruited 27
- **22 Randomly Assigned to Treatment**
- **5 Randomly Assigned to Reference**
 - Drop-outs 2
- **25 Completed Entire Study**

Background cont.

WEEK	MON	TUE	WED	THUR	FRI
	Hand Prep (HP)				
	Traditional Surgical Hand Scrub				

Outcomes....

- Skin condition
- Time required
- Hand microbiology
- Preference

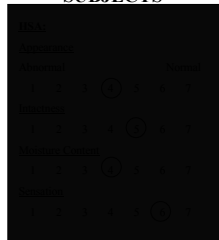
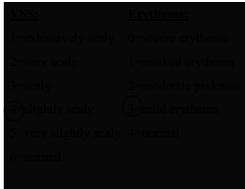


Data Collection

- Measurement Tools for Skin Condition
– VSS, Erythema

HSA
SUBJECTS

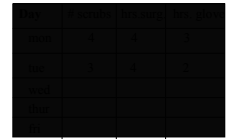
INVESTIGATORS



Data Collection

Microbiological Assay

Diary Card



Data Collection: Scrub Practices

61 Random Observations



Skin Condition

- Nine ratings during each phase for self-assessment, scaling and erythema
- Skin damage significantly reduced during HP testing period ($p=0.0005$)



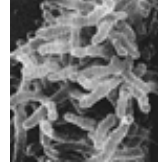
Time Required

- 61 observations of scrub technique (31 for HP, 30 for TSS)
- Direct contact time less for HP product (79.1 vs. 146.6 secs, $p=0.000$)
- Protocol deficiencies fewer for HP (6.5% vs. 50%, $p=0.0001$)

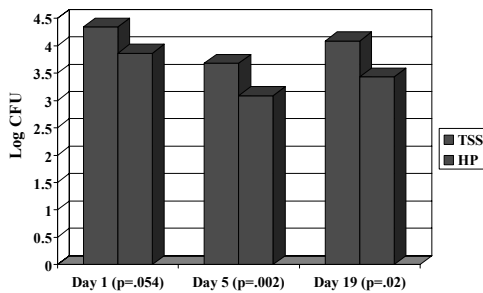


Hand Microbiology

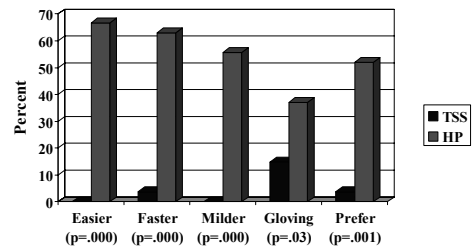
- Pre- and post-scrub cultures obtained on Day 1, 5, and 19 during both phases
- 33 isolates of GNB (83.7% *Acinetobacter*, *Enterobacter*, *Klebsiella*), 1 *S. aureus*, 11 yeast
- No MRSA or VRE



Post-Scrub Microbial Counts



Preferences



Costs for Scrubbing

Larson, AORN J, 2001; 73:412

- | | |
|------------------------------------|------------------------------------|
| • Traditional Scrub | • Alcohol Preparation |
| – ~\$60.40/application | – ~\$20.50/application |
| – Mean time required: 6 mins total | – Mean time required: 2 mins total |



Alc vs. Soap

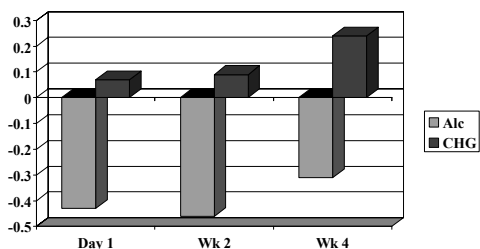
Zaragoza, AJIC, 1999; 27:258

- Mean reduction in counts:
 - plain handwashing: 49.6%
 - alcohol: 88.2% ($p<0.001$)
- Staff acceptance rate “good”:
 - plain handwashing: 9.3%
 - alcohol: 72%



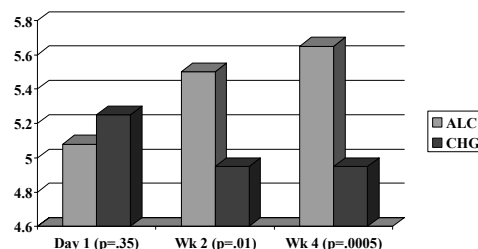
Log Counts, 50 MICU Staff

Larson, CCM, 2001



Mean Skin Scaling Scores, 50 MICU Staff

Larson, CCM, 2001



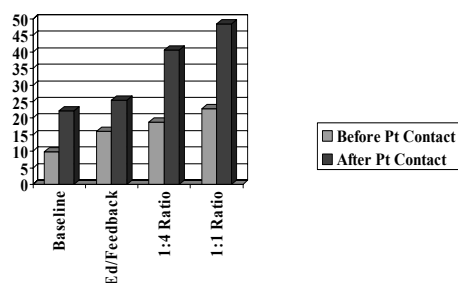
Improvement in Skin Condition

Boyce, ICHE, 2000; 21:442

- After 2 wk use, with soap and water
 - more skin irritation (p=.001)
 - more transepidermal water loss (p=.003)
- “Newer alcoholic hand gels that are tolerated better than soap may be more acceptable to staff and may lead to improved hand-hygiene practices.”

Improvement in Practice

Bischoff, Arch Intern Med 2000; 160:1017



Improvement in Practice

Maury, Am J Resp Crit Care Med, 2000; 162:324

- Frequency of appropriate hand hygiene
 - Conventional handwashing only: 42.4%
 - Addition of alcohol rinse: 60.9% (p=.001)
 - 3 months later: 51.3% (p=.007)



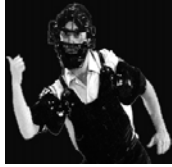
Time and Costs

Voss & Widmer, ICHE, 1997; 18:205

- 100% compliance with handwashing consumes 16 hr nursing time/day shift, whereas AHD requires 3 hr (p = .01)
- “AHD, with its rapid activity, superior efficacy, and minimal time commitment, allows 100% healthcare- worker compliance without interfering with the quality of patient care”

Conclusions

- Prolonged scrubbing unnecessary and damaging
- Brush unnecessary and damaging
- Alcohol products warrant greater use
- Link with outcomes absent



What About Moisturizers/Lotions?

- Prevent dehydration, damage to barrier properties, skin shedding, loss of skin lipids
- Restore water-holding capacity of keratin layer
- Increase width of corneocytes



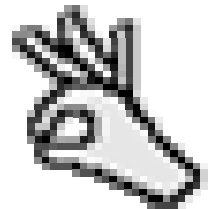
Moisturizers may even...

- Prevent cross-infection by improving barrier properties of skin, reducing shedding of viable bacteria, creating a mechanical or chemical barrier



Therefore...

- Use lotions
- Recommend lotions
- But choose wisely

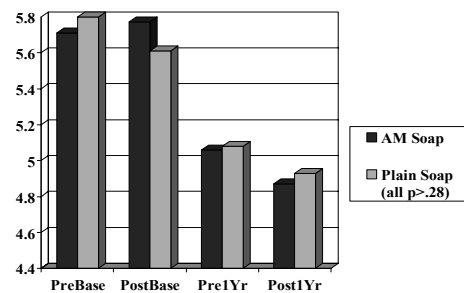


Participants were....

- About 97% Hispanic
- About half born outside U.S.
- Living in multi-unit apartment buildings in upper Manhattan
- 99% female heads of households



Comparison of mean pre and post handwash CFU counts between groups



Hand Hygiene Guideline For Healthcare Settings

- Published 10/25/02
- MMWR
- <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5116a1.htm>



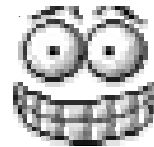
New emphases

- Skin health, including moisturizers
- Alcohol hand rinses
- Compliance issues
- Preoperative surgical hand preparation
- Fingernails

Next Challenges

- Adverse reactions?
- Fire hazards?
- Plain vs. antimicrobial soap?
- Skepticism
- Dispensers
- Selecting among products

*Just Because It Feels Good,
Doesn't Mean It's Bad*



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