

Open Refillable Bulk Soap Dispensers in Public Restrooms: A Public Health Risk?

Carrie A. Zapka, MS ¹, Sheri L. Maxwell, BS ², Jennifer L. Cadnum, BS ³, David R. Macinga, PhD ¹, Curtis J. Donskey, MD ³, Michael J. Dolan, BS ¹, **Charles P. Gerba, PhD*** ².

*Presenting author

(1) Research & Development, GOJO Industries, Inc. One GOJO Plaza, Akron, OH 44311.
 (2) Soil, Water & Environmental Sciences, University of Arizona, 429 Shantz Building, Tucson, AZ 85721.
 (3) Cleveland VA Medical Center, 10701 East Blvd, Cleveland, Ohio 44106

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

Presenter Disclosures

Dr. Charles P. Gerba

The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

GOJO Industries, Inc.
Sponsored Research

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

Learning Objectives

1. Describe how to identify open refillable bulk soap dispensers
2. Explain why open refillable soap dispensers are susceptible to bacterial contamination
3. Discuss why contaminated bulk soap in community settings could be a public health risk, particularly for susceptible populations

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

Soap Microbial Quality

- Handwash products are regulated by the FDA. Excessive contamination is a violation.¹
- Soap is not expected to be sterile.
 - “It is the responsibility of the manufacturer to assure that... the species and quantity of microbes do not present a hazard to the consumer when using the product as directed...”²
- Guidelines recommend <1000 total bacteria/mL & the absence of pathogens.²

1) <http://www.cfsan.fda.gov/~dms/cos-218.html>
 2) The Cosmetic, Toiletry, and Fragrance Association. Technical Guidelines. Microbial Limits for Cosmetics and Toiletries. 2001
 APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

Soap Dispensers

- Open Refillable Bulk
 - Refilled by pouring soap from a larger volume container
 - Open to environment
 - Same nozzle used indefinitely
- Closed Sealed Systems
 - Soap provided in a disposable sealed bag or cartridge refill
 - New nozzle with each refill



APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

How Does the Soap Become Contaminated?



APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania

Contaminated Soap Causes Infection in Health-Care Settings

- Many reported infections and outbreaks¹
 - Fatal *Pseudomonas aeruginosa* infection from use of contaminated shampoo²
 - *Serratia marcescens* infections linked to contaminated soap. Hands 54 times more likely to be contaminated after washing³
- Susceptible populations are at greatest risk
 - >20% of US population is immune-compromised⁴

1) Weber D, Rutala W, and Sickbert-Bennett E. Antimicrobial Agents and Chemotherapy 2007 Dec;51(12):4217-4224.
2) Fainstein V, Andres N, Umphrey J, and Hopfer R. J. Infect. Dis. 158:655, 1988.
3) Sartor C, Jacome V, Duwrier C, et al. Infect. Control Hosp. Epidemiol. 2000 March;21(3):196-9.
4) Gerba, D, Ross, J, Haas C. International Journal of Food Microbiology 30 (1996) 113-123.
APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

CDC Health-Care Recommendation

- “Do not add soap to a partially empty soap dispenser. This practice of “topping off” dispensers can lead to bacterial contamination of soap¹.”
- Since the risk is well-documented bulk dispensers are rare in Health-Care

1) Guideline for Hand Hygiene in Health-Care Settings, Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Morbidity and Mortality Weekly Report, October 25, 2002 / Vol. 51 / No. 88-14.
APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

Is it Safe to Use Bulk Soap Dispensers in Community Settings?

- Prior to our research, no studies had been conducted in the US to assess this potential risk.
- Our studies indicate that patrons of public restrooms are routinely exposed to unsafe levels of bacterial contamination.
- This represents an unnecessary health risk, particularly for the immunocompromised susceptible population.

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

Bulk Soap Contamination is Widespread

- Soap from over 500 bulk dispensers in public restrooms were tested from across the US
- Unsafe levels of bacteria occur in 23 - 25% of bulk soap dispensers^{1,2}
 - Fecal-based organisms found in over 16% of the soap samples
 - Average user exposed to >one million bacteria per handwash
 - Soap from sealed systems showed no contamination

1 M. Chattman, S. Maxwell and C. P. Gerba; Bacterial Contamination of Liquid Hand Soaps, University of Arizona, Tucson, AZ, American Society for Microbiology 107th General Meeting Toronto, ON, Canada, May 21-25, 2007.
2 C. P. Gerba and S. Maxwell, University of Arizona, Tucson, AZ; National Environmental Health Association 71st Annual Educational Conference & Exhibition, Atlantic City, NJ; June 18-21, 2007.
APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

Bacteria Remain on Hands After Washing with Contaminated Soap

- Bacterial contaminants remain on hands after handwashing and are transferred to touched surfaces^{1,2}



After washing with liquid soap that was not contaminated

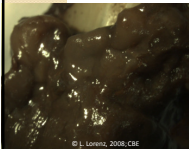

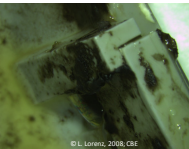


After washing with contaminated liquid soap

1 BioScience Laboratories, Inc.; Bozeman, MT; Study #071209-1 00; Feb 22, 2008.
2 BioScience Laboratories, Inc.; Bozeman, MT; Study #080307-1 50; May 22, 2008.
APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

Contaminated Dispensers Should Be Replaced, Cleaning Is Ineffective

- New soap is re-contaminated by biofilm bacteria adhering to inside of dispenser
- Even dispensers scrubbed with hot water and sanitized with 5000 mg/L bleach were contaminated 7-10 days after new uncontaminated soap was added

Lorenz et al. Evaluation of Contaminated Bulk Soap Dispensers for Biofilm Bacteria: Comparison of Two Methods of Analysis and Effectiveness of Dispenser Washing Procedures. Montana State University Center for Biofilm Engineering Poster to be presented at the 5th ASM Conference on Biofilms, Nov 2009.
APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania


Study Objectives

- Assess the factors contributing to contamination
 - Are some types of soap more likely to become contaminated?
 - Are certain types/models of bulk dispensers more susceptible to contamination?
 - How do contamination rates compare between different types of facilities?
- Test for the presence of specific organisms of public health concern
 - Food-borne pathogen *E. coli*
 - Antibiotic-resistant organisms

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 13

Method- Soap Sampling

- ~ 10 mL of soap collected into sterile collection containers and tested <1 week
- 155 bulk samples collected from Ohio
 - restaurants, bars, gas stations, schools, office buildings, retail stores, health clubs, grocery stores, theaters, etc.



APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 14

Method- Soap Analysis

- Microbial load
 - Dilute into buffer with neutralizers and plate onto R2A
 - >1000 CFU/mL threshold for contamination
 - Dominant colony types identified
- Active ingredient
 - HPLC used to determine % PCMX or Triclosan
- Food-borne pathogen screen
 - Enrichment based water quality test used to determine if *Escherichia coli* bacteria were present
- Antibiotic resistance
 - Contaminants were tested for their ability to grow on media containing antibiotics, two classes were tested

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 15

Results- High levels of Contamination Observed

- 21% (32/155) of bulk soap samples were contaminated with >1000 CFU/mL bacteria
- Average level 6.3 x 10⁶ CFU/mL
- 13 different gram negative species isolated including *Pseudomonas*, *Providencia*, *Achromobacter*, *Citrobacter* and *Serratia*
 - These opportunistic pathogens can cause respiratory tract infections, pneumonia, urinary tract infections, pink eye, skin ulcers, gastroenteritis, soft tissue infections, etc.

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 16

Results- All Types of Bulk Dispensers from All Types of Facilities Were Contaminated

Type of Facility	Total	Contaminated	%
Shopping	22	4	18%
Recreation	15	3	20%
Dining	28	6	21%
Other/Unknown	90	19	21%

Dispenser Type	Total	Contaminated	%
Counter	21	3	14%
Wall plastic	48	8	17%
Wall metal	16	4	25%
Other/Unknown	70	17	24%

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 17

Results- All Types of Soap Were Contaminated

Type of Soap	Total	Contaminated	%
Bland	110	23	21%
Antimicrobial- Triclosan	26	8	31%
Antimicrobial- PCMX	14	1	7%
Other/Unknown	5	0	0%

Color of Soap	Total	Contaminated	%
Blue	6	1	17%
clear/white	33	2	6%
green	13	4	31%
orange	31	12	39%
pink	55	11	20%
peach	9	0	0%
yellow	6	2	33%
Other/Unknown	2	0	0%

APHA 137th Annual Meeting and Expo: November 7-11, 2009, Philadelphia, Pennsylvania 18

Results- *E. coli* and Antibiotic Resistant Bacteria Were Found

- *E. coli* was detectable in 28% (7/25) of the contaminated soaps tested
- Resistance to quinolones or ceftazidime was observed in 28% (22/78) of the isolates, most frequently in species of *Pseudomonas*, 68% (15/22), but also in *Klebsiella*, *Serratia*, *Burkholderia* and *Enterobacter* species.
 - 5% (4/78) of the isolates were resistant to both antibiotics.

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

19

Conclusions

- Bulk hand soap is prone to bacterial contamination.
- Contamination is associated with the open design of the dispenser.
 - it is not limited to any particular type of soap or type of bulk dispenser
- Contaminated soap can harbor food-borne pathogens and antibiotic resistant organisms.

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

20

Conclusions

- The species typically found in contaminated soap can cause infections.
- Immune-compromised handwashers with poor skin integrity are at greatest risk of acquiring an infection.
- Further research is warranted to determine the extent to which contaminated bulk soap in public restrooms poses an unnecessary public health risk.

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

21

What Can You Do?

- Notice what type of soap dispensers are used in the areas you service
- Educate facilities about the potential risk
- If reoccurring infections due to gram negative pathogens occur, consider testing the soap as a possible reservoir
- Particularly in settings with high proportions of susceptible patrons, recommend the use of sealed systems

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

22

Acknowledgements

In addition to the authors, the following persons have also contributed to the research presented here

- GOJO Industries
 - Dr. James Arbogast
 - Dan Jarrell
 - Sarah Langley-Sopchak
 - Elze Rackaityte
- Bioscience Laboratories, Inc.
 - James McDowell
 - Esther Campbell
- Montana State University Center for Biofilm Engineering
 - Dr. Darla Goeres
 - Lindsey Lorenz
 - Dr. Matthew Fields
 - Brad Ramsay

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

23

Thank You

- For more information contact
 - Dr. Charles Gerba gerba@Ag.arizona.edu
 - Carrie Zapka zapkac@gojo.com

APHA 137th Annual Meeting and Expo: November 7-11, 2009; Philadelphia, Pennsylvania

24