

How Safe is Your Soap?

Opportunistic Pathogens From Contaminated Bulk Soap on the Hands of Students and Staff in an Elementary School

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Abstract

Previous research revealed that approximately 25% of open refillable bulk soap dispensers in public restrooms are contaminated with an average of 3,000,000 bacteria/ml soap. This study was performed to evaluate hand contamination and bacterial transmission by hands after washing with bulk soap. Gram-negative bacteria on the hands of 10 students and 10 staff were quantified before and after using either contaminated bulk soap or uncontaminated control soap. In addition, the transfer of gram-negative bacteria from the hands to an agar surface was evaluated. Hands were found to harbor over 10-fold more gram-negative bacteria after washing with contaminated bulk soap than before washing (2047 vs 179). An average of 1-2 gram-negative bacterium for one portion was transferred to surfaces touched by students or staff either before the handwash or after washing with uncontaminated control soap. After washing with the contaminated soap, the average number of gram-negative bacteria transferred to surfaces increased to 38 for children and 9 for adults. These results suggest that contaminated bulk soap may play a role in the transmission of bacteria in schools, particularly among children.

Background

Hand soap dispensers used in school restrooms can be refilled with soap that is either bulk or sealed. Bulk dispensers are refilled by pouring soap from a large container into the open reservoir and typically the nozzle that the soap is ejected through is not replaced. In contrast, sealed dispensers are refilled by replacing bags or cartridges that contain soap sealed inside with a new nozzle. Soap in bulk dispensers is prone to contamination because it is constantly exposed to bacteria from the environment, such as from the hands of the person refilling the soap, the spray of toilet water after flushing, or from dust in the air. Since contaminated bulk soap dispensers have caused outbreaks in hospitals, the CDC recommends against their use in healthcare settings. However, no such guidelines exist to protect patrons of public restrooms in the community or our students in schools. In our previous studies, we tested soap from over 500 dispensers across the United States to evaluate the prevalence of contaminated soap in public restrooms. We were surprised to learn that 25% of bulk dispensers are contaminated with an average of 3 million bacteria, most of which are known to be opportunistic pathogens. Exposure to such high levels of these organisms may be a health risk to individuals with compromised immune systems which is estimated to be at least 20% of the population.² In contrast, soap from sealed dispensing systems was free from contamination. We identified an elementary school in which the antibacterial soap in all of their plastic wall mounted bulk soap dispensers were highly contaminated with 19 different species of *Pseudomonas*, *Providencia*, *Citrobacter*, *Stenotrophomonas*, *Aeromonas*, *Enterobacter*, *Pasteurella*, and *Serratia* bacteria. The objective of this study was to evaluate bacterial hand contamination and hand transmission among children and adults in an elementary school with a contaminated bulk soap problem.

Methods



10 staff and 10 students each participated in up to 4 handwashes each using one of 14 contaminated bulk soap dispensers. 11 staff participated in up to 2 handwashes each during the follow up study which was conducted 4 months after the contaminated bulk soap dispensers were replaced with sealed soap dispensing systems. Participants were instructed to wash and dry their hands as they normally would after using the restroom. All hands were tested both before and after handwashing using one of two methods.



Open refillable bulk soap dispenser



Dispenser with factory sealed refill

1. Gerba, CP; Maxwell, S. Bacterial Contamination of Liquid Hand Soaps Used in Public Restrooms. The National Environmental Health Association 71st Annual Educational Conference & Exhibition. Atlantic City, NJ; June 18-21, 2007.

2. Gerba, CP; Rose, JB; Haas, CN. Sensitive populations: Who is at the greatest risk? *International Journal of Food Microbiology*. V30. 1996. p113-123.

Method A



Method A: The number of bacteria on one hand of each participant was measured using the glove juice procedure.

Results were obtained from counting bacteria that grew on MacConkey's agar. Statistical comparisons were performed using the Student's t-test on the Log_{10} transformed bacterial colony counts.

Method B

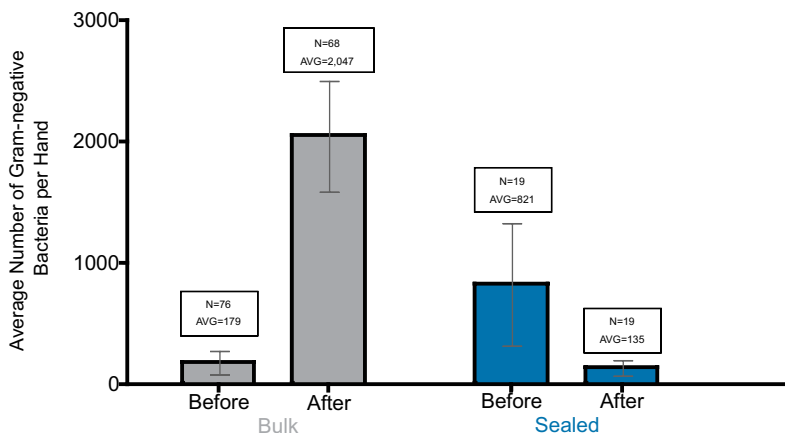


Method B: Bacterial transfer to a surface was measured with the opposite hand using the hand stamp procedure.

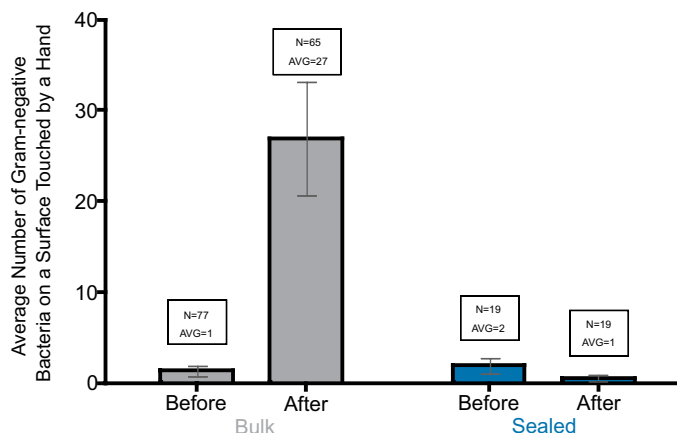
Results

- Washing with contaminated bulk soap significantly increased the number of gram-negative bacteria per hand from 179 to 2047 on average for all students and staff ($P < 0.0001$). Students' hands retained significantly more bacteria than the staff, 3148 vs. 474 ($P < 0.01$).
- Washing with sealed soap significantly reduced the number of bacteria from 821 to 135 ($P < 0.05$).
- Hands had significantly less gram-negative bacteria after washing with sealed soap compared to after washing with contaminated bulk soap, 135 vs. 2047 ($P < 0.0001$).
- Washing with contaminated bulk soap significantly increased the number of gram-negative bacteria transferred to a surface from 1-2 before washing to 27 after on average for all students and staff ($P < 0.0001$). Students transferred significantly more bacteria to the surface they touched after washing with contaminated bulk soap than the staff did, 38 vs. 9 ($P < 0.01$).

A) Relative Effectiveness of Handwashing with Contaminated Bulk vs. Sealed Soap



B) Bacteria Transferred by Hands to a Surface as a Result of Washing with Bulk vs. Sealed Soap



Conclusions

- Hand soap dispensers which are refilled by pouring bulk soap into an open reservoir are prone to contamination with opportunistic pathogens.
- Washing with contaminated bulk soap resulted in a 10-fold increase in the number of gram-negative bacteria that were found on the hands of students and staff in an elementary school.
- Hands washed with contaminated bulk soap transferred a significantly higher number of gram-negative bacteria to touched surfaces compared to hands washed with soap from a sealed refill.