

Infection prevention myths demystified

Laura Hinz (*Meds 2011*) and Jennifer N. Bondy (*Meds 2012*)

Faculty Reviewer: Dr. John Howard

In the mid-20th century, industrialized countries underwent the ‘epidemiological transition’ whereby the leading cause of death evolved from infectious and parasitic to chronic and degenerative diseases.¹¹ This transition, however, has not yet occurred in many developing countries.¹¹ In 2002, infectious and parasitic diseases caused the greatest burden in disability-adjusted-life years (DALYs) to human beings worldwide.¹⁶ Although the threat of infectious and parasitic diseases in developed countries such as Canada has decreased since the middle of the last century, protecting ourselves against such diseases should remain a priority since we reside in a global community. We take this opportunity to explore three “urban legends” of day-to-day infection prevention and determine whether there is truth to these myths.

Hand towels vs. air dryers

The Myth

The Centres for Disease Control and Prevention (CDC) has a list of recommendations regarding hand-washing, which includes drying hands using a paper towel or air dryer.²³ This step in the procedure has sparked considerable debate in the infectious disease realm. Are paper towels or air dryers more effective? Proponents of towels argue that you may as well not wash your hands if you insist on using air dryers as they just blow the germs back on. Proponents of air dryers lament the environmental impact of towels. Unfortunately, the literature is similarly divided on the issue.

The Evidence

Early studies on this topic were strongly in favour of hand towels. In 1984, one of the first comparisons of the two drying methods found that paper towels could reduce bacteria on hands by 55% while air dryers achieved a dismal 9% reduction.⁴ Subsequent studies found towels to be safer and more hygienic than air dryers,^{6,7} while one study even found that not only were air dryers less effective, but they actually *increased* the number of microorganisms left on hands.⁴

Uncertainty began to mount in 1991 when a study in the *American Journal of Infection Control* reported that air dryers were more

effective in reducing the numbers of *Escherichia coli* and rotavirus from hands.³ The argument was levelled when a randomized control trial conducted in 2000 failed to find a significant difference in bacterial numbers when the use of rotary dispenser towels, stacked paper towels, air dryers, and spontaneous evaporation were compared.² It is interesting to note that in a separate study, it was found that hands that were held stationary under the dryer retained fewer bacteria than rubbed hands.⁴ This difference was explained by the fact that rubbing allows bacteria to migrate from the hair follicle to the skin surface, thus the finding may simply be a measurement bias. Nonetheless, they concluded that stationary hands under an air dryer was the best method, followed by a tie between paper towels and rubbed hands.⁴

When investigations were broadened from microbes remaining on hands to microorganisms in the washroom environment, the equivocality remained.⁴ Taylor *et al* concluded that in bathrooms equipped with paper towels, the germs were transferred from the hands to the towels, which were then disposed of in open receptacles where they acted as reservoirs of bacteria. In contrast, while the air dryers killed a sizable proportion of microorganisms by virtue of the heater, the splattering of water droplets onto the wall behind the dryer made this one area of the

bathroom to avoid. This dispels the myth put forth by towel proponents: air dryers do not just concentrate microorganisms from the air onto the users' hands, as evidenced by the fact that dryer outflow contained significantly fewer organisms than inflow.⁴

The Verdict

Despite the controversy, all studies were in agreement about the importance of hand washing. Proponents of towels can argue using evidence from early literature, the finding that paper towels were more effective in removing bacteria from the fingertips in particular¹ and the CDC recommendation that one use a paper towel to turn off the tap.²³ They may also argue that air dryers are not recommended in critical care environments due to the possibility of air dispersal of bacteria-laden droplets.⁸ Air dryer enthusiasts can cite findings from more recent studies, environmental considerations, and the capacity to remove bacteria from the air. However, there is no clear victor in this debate. The important takeaway points are to wash your hands well; if you choose a towel, dispose of it in a closed receptacle; if you choose an air dryer, try to use an automatic model and don't rub your hands.

Antiseptic hand sanitizers vs. soap and water

The Myth

Since Semmelweis' groundbreaking observations in 1847 that proper hand sanitization measures can reduce infection rates, health professionals have been provided with procedures and guidelines aimed to perfect the hand washing process.⁴ These guidelines are applicable both in the hospital and the community since hands serve as the main vector for micro-organism transfer.⁶ However, poor compliance with hand hygiene has been attributed to a variety of factors including lack of time and skin irritation.²² Antiseptic sprays and rubs have been introduced as a means to confront these problems, however the question remains: do the new methods work as well as traditional hand-washing?

The Evidence

Hand-washing involves the use of plain soap and water to clean hands, whereas antiseptic

hand-washing employs a soap containing an antiseptic agent, which differs from an antiseptic hand rub in that the latter does not require water.²⁵

Plain (non-antimicrobial) soaps are an effective means by which to reduce both the transient bacteria colonizing the superficial layers of skin and the transmission of these pathogens.²⁴ These soaps do not, however, remove the resident flora found in the deeper layers of skin.²⁴ Prior to surgery, antiseptic hand-washing scrubs are typically employed, as these are more effective in eliminating bacteria.²⁵ Some centres have introduced pre-surgical rubs, further highlighting the inconclusive nature of the literature.

With respect to hand rubs, chlorhexidine- and alcohol-based products are two common varieties. Chlorhexidine rubs are efficient in eliminating gram positive bacteria, but are not as effective for gram negative bacteria and nonenveloped viruses.²⁵ Further, certain bacteria have been demonstrated, *in vitro*, to adapt and develop resistance against chlorhexidine, leading to resistance to other anti-infective agents.²⁴ The epidemiological implications of these findings in humans are not yet fully understood and require further study.²⁵

Conversely, while alcohol-based rubs have minimal residual activity²⁵ and do not effectively eliminate bacterial spores, protozoan oocytes or certain nonenveloped viruses²⁵, there have been no reported cases of acquired resistance to these rubs. Furthermore, alcohol does prevent the transfer of certain nosocomial pathogens and effectively reduces bacterial load on hands.²⁵

The Verdict

Conflicting evidence exists in the literature as to the effectiveness of the various antiseptic agents used for handwashing, which is due in part to the fact that not all studies assess effectiveness in the same manner.^{26,27} However, a review by the CDC found agreement among studies that alcohol-based handwashes and rubs are more effective in eliminating bacteria on hands than plain soap, and often more so than antimicrobial soaps.²⁵ Their effectiveness,

however, is dependent on a variety of factors including the type, concentration, and volume of alcohol used.

Plastic water bottles

The Myth

Plastic water bottles have recently been the subject of much debate in the media. The litany of offences attributed to the vessels include: acting as a reservoir for germs, leaching toxic chemicals, and posing unnecessary stresses on the environment.^{10,13,18} Waterloo has banned the sale of plastic water bottles in schools and Toronto appears poised to follow suit in 2009.¹⁸ Despite these controversies, bottled water continues to be a \$35 billion industry, with 1.7 billion gallons consumed last year (nearly 3000 Olympic swimming pools' worth).¹⁷ This exorbitant consumption also means that 150 million water bottles are disposed of each day.⁹ A seemingly probable solution would be to reuse the water bottle, but the literature suggests that this environmentally friendly solution could wreak havoc on our health.

The Evidence

Researchers in Calgary selected an elementary school as their source of water bottles for analysis in 2002.¹⁰ They found that total coliforms exceeded Canadian Drinking Water Quality guidelines in 13.3% of water bottles examined; 8.9% contained fecal coliforms, and 64.4% contained heterotrophic bacteria. While heterotrophic bacteria are not necessarily pathogenic, they are a marker of overall water quality.²⁰ Some of the students had left water bottles for months without a proper cleaning-significantly longer than the eight hours that the literature suggests it takes for bacterial regrowth.¹⁰ When combined with the finding of no significant microbial content of water sources (taps and fountains), the researchers determined that the germs were coming from the bottles.

Several studies have suggested that plastic water bottles provide a better breeding ground for bacteria than glass or metal.¹² Plastic bottles tend to contain fast-growing bacteria (pseudomonads, Flexibacter, and Acinetobacter), numbering in the realm of 10^5 cfu/mL after one week of growth.¹²

In contrast, glass bottles contained slow-growing bacteria (mainly Acinetobacter) and were an order of magnitude less in quantity. Not only is the type of material important, but the quality. Jones *et al.* isolated mainly coccoid bacterial cells from the caps of plastic water bottles, while rod-shaped cells were found adherent to the walls of PET bottles.¹⁵ Rougher surfaces were associated with a significant increase in bacterial numbers.

The issue in the Calgary study was not the *use* of plastic water bottles, but the subsequent *reuse*. Both nonpartisan researchers and the Canadian Bottled Water Association have established that bottled water does not contain *E.coli*, coliforms, *Giardia*, or cryptosporidium at the time of bottling.^{13,19} The real problem lies in the fact that water at room temperature is an ideal environment for microbial growth. A simple solution would seem to be meticulous washing of the water bottles. However, this solution was discredited by a 2001 presentation by a University of Idaho student who found that realistic reuse simulation (sunlight, heat, physical degradation) released a number of chemicals from the plastic water bottles into the drinking water.¹³ The longer water bottles were reused, the more organic chemicals were leached from the material.

The environment vs. health debate has thus seemingly reached an impasse- reusing water bottles is good for the environment but sets up a bacterial breeding environment, necessitating vigorous cleansing, which in turn liberates toxic chemicals. One appears to have the choice between infection, intoxication, or pollution.

The Verdict

The evidence is fairly clear that water bottles pose a threat both to human health and to the environment. However, a little common sense may go a long way in settling the clash of values. Soft-plastic water bottles such as those sold in vending machines should not be reused as their ability to stand up to the vigorous washing needed in order to prevent colonization has not been established. Hard-plastic, glass and metal water bottles may be more well suited to the challenge of multiple uses and their use is condoned by the Minister of Health Canada.²¹ Water bottles

should be thoroughly washed in hot soapy water after each day of use.

It is very difficult to come to generalized conclusions as to the safety of water from municipal taps and from rural wells as compared to bottled water. The importance of the presence of trace amounts of chemicals in tap water as compared to bottled water is not known. Moreover, the entire picture needs to be examined – the energy required in making, bottling, and distributing bottled water is immense and this may impact not only the individual consumers, but also the health of human populations. The safety of the individual must be weighed with the potential harm the use of water bottles has on the environment. For water bottles, whether single use or washed multi-use, the evidence is inconclusive.

Three common societal beliefs have been discussed that may impact our lives as individuals or as a population. This paper attempted to use an evidence-based approach to make recommendations. It is also important to review the evidence as a whole to consider the threats to the individual, to the people in the immediate environment, and to the broader global community. Given the human health importance of hand-drying techniques, hand sterilizers and water bottles, it is suggested that the apparent simplicity of these issues not deter future research.

References

1. Yamamoto Y, Kazuhiro U, Takahashi Y. Efficiency of hand drying for removing bacteria from washed hands: Comparison of paper towel drying with warm air drying. *Infect Control Hosp Epidemiol.* 2005;26:316–320 .
2. Gustafson DR, Vetter EA, Larson DR, Ilstrup DM, Maker MD, Thompson RL, Cockerill FR 3rd. Effects of 4 hand-drying methods for removing bacteria from washed hands: a randomized trial. *Mayo Clin Proc.* 2000; 75(7): 705-8.
3. Ansari SA, Springthorpe VS, Sattar SA, Tostowaryk W, Wells GA. Comparison of cloth, paper, and warm air drying in eliminating viruses and bacteria from washed hands. *Am J Infect Control.* 1999; 19(5):243-9.
4. Taylor JH, Brown KL, Toivenen J, Holah JT. A microbiological evaluation of warm air hand driers with respect to hand hygiene and the washroom environment. *J Appl Microbiol.* 2000; 89(6):910-9.
5. Matthews JA, Newsom SW. Hot air electric hand driers compared with paper towels for potential spread of airborne bacteria. *J Hosp Infect.* 1987;9(1):85-8.
6. Gould D. The significance of hand-drying in the prevention of infection. *Nurs Times.* 1994; 90(47):33-5
7. Lee M. Paper and cloth towels found to be more hygienic than air dryers. *Health Facil Manage.* 1994; 7(8):114, 116
8. Ngeow YF, Ong HW, Tan P. Dispersal of bacteria by an electric air hand dryer. *Malaysian Journal of Pathology.* 1989; 11:53-6.
9. Plastics. (Internet) Delicious Organics, Inc. 2005. Available from: <http://www.deliciousorganics.com/Controversies/plastic.htm#Reused%20Water%20Bottle%20Study>.
10. Oliphant JA, Ryan MC, Chu A. Bacterial water quality in the personal water bottles of elementary students. *Canadian Journal of Public Health.* 2002; 93(5): 366.
11. Omran AR. The Epidemiologic transition: A theory of the epidemiology of population change. *The Milbank Quarterly.* 2005;83(4):731-757.
12. Bischofberger T, Cha SK, Schmitt R, König B, Schmidt-Lorenz W. The bacterial flora of non-carbonated, natural mineral water from the springs to reservoir and glass and plastic bottles. *Int J Food Microbiol.* 1999; 11(1):51-71.
13. Lilya D. Environmental Engineering Program Society for Risk Analysis 2001 Annual Meeting. *Society for Risk Analysis.* 2001; Available from: <http://www.riskworld.com/Profsoci/ps5me002.htm>.
14. Canadian Bottled Water Association. 2008. Available from: <http://www.cbwa.ca/en/definitions.htm#safety>
15. Jones CR, Adams MR, Zhdan PA, Chamberlain AH. The role of surface physicochemical properties in determining the distribution of the autochthonous microflora in mineral water bottles. *J Appl Microbiol.* 1999; 86(6):917-27
16. The World Health Report 2004 – changing history [database on the Internet]. The World Health Organization. C2004; [cited 2008 Nov 9]. Available from:

- http://www.who.int/whr/2004/annex/topic/en/annex_3_en.pdf
17. Evans MR, Ribeiro CD, Salmon RL. Hazards of Healthy Living: Bottled water and salad vegetables as risk factors for *Campylobacter* infection. *Emerging Infectious Disease*. 2003; 9(10): 1219-1225.
 18. Alcoba N. TDSB to examine ban on sale of plastic water bottles. *National Post*. May 13, 2008. Available from: <http://network.nationalpost.com/np/blogs/toronto/archive/2008/05/13/tdsb-to-examine-ban-on-sale-of-plastic-water-bottles.aspx>.
 19. Hunter PR, Burge SH. The bacteriological quality of bottled mineral waters. *Epidemiol Infect*. 1987; 99(2): 439-43.
 20. Jetten J. Quality and safety aspects of reusable plastic food packaging materials: A European study to underpin future legislation. *Food Additives and Contaminants*. 1999; 16(1): 25-36.
 21. Clements. Minister's Remarks of Bisphosphenol A. Health Canada. 2008; Available from: http://www.hc-sc.gc.ca/ahc-asc/minist/speeches-discours/2008_04_18-eng.php.
 22. Pittet D. Improving compliance with hand hygiene in hospitals. *Infection Control and Hospital Epidemiology*. 2000;21(6):381-386.
 23. An Ounce of Prevention Keeps the Germs Away: Seven keys to a safer healthier home. Centre for Disease Control and Prevention. 2008; Available from: http://www.cdc.gov/ounceofprevention/docs/ooop_brochure_eng.pdf.
 24. Kampf G, Kramer A. Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clinical Microbiology Reviews*. 2004;17(4):863-893.
 25. Centers for Disease Control and Prevention. 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. *MMWR* 2002;51 (No. RR-15).
 26. Hajipour L, Longstaff L, Cleeve V, Brewster N, Bint D, Henman P. Hand washing rituals in trauma theatre: clean or dirty? *Ann R Coll Surg Engl*. 2006;88:13-15.
 27. Larson EL, Cimiotti J, Hass J, Parides M, Nesin M, Della-Latta P, Saiman L. Effect of antiseptic handwashing vs alcohol sanitizer on health care-associated infections in neonatal intensive care units. *Arch Pediatr Adolesc Med*. 2005;159:377-383.



194 TALBOT STREET WEST LEAMINGTON, ON N8H 1N9 T: 519-326-2373 F: 519-322-5584

3 Full-time Family Physician Positions

Family Medicine - space is currently available for family physicians to join the Family Health Network Model and Family Health Team. The Clinic is currently located in tile hospital with full office services available. The Clinic provides services to a wide variety of patients (families, seniors and everything in between). Overhead assistance for practice start-up is available. The clinic is also able to accommodate flexible scheduling in order to accommodate a candidate's additional interests (ie: ER coverage, surgical assist etc.). Construction is soon to begin on a new facility adjacent to the hospital which is slated to become the base for a Family Health Team. The community can also accommodate other models of general and family practice if that is more suited to your needs. In-hospital care, surgical assist and obstetrics coverage are optional but also available.

Funding:

- As a designated "under-serviced" area by the Ministry of Health and Long-Term Care's Underserved Area Program (UAP) physicians are eligible for grant of up to \$10,000 per eligible year to a maximum of \$40,000 paid over a four-year period.
- Relocation Expenses - support available on negotiation
- Practice and Income assistance program - support for practice start-up and income stabilization assistance is available upon negotiation.
- Other assistance is available upon negotiation. Come see what we have to offer!

For more information please contact

Sarah Padfield, Vice President Corporate Services, Leamington District Memorial Hospital
(519) 326-2373 ext. 4249 spadfield@ldmh.org