

# Why 99.999% is Important

By Dr Pierre Grascha PhD, Chief Scientist, Deb Group Ltd

**Deb InstantFOAM has been scientifically tested to kill 99.999% of transient bacteria. The following information will explain why this kill rate is important.**

While it is unknown to most people, humans live in a sea of micro-organisms. Bacteria, the most primitive of all living cells, have lasted on the planet two thousand times longer than human beings. More bacteria live inside our mouths than the total number of people that have ever lived<sup>[1]</sup>. A single sneeze can carry millions of bacteria or viruses on to hands, surfaces or into the air, at speeds of hundreds of miles an hour<sup>[2]</sup>.

Bacteria are extremely prevalent on the planet with humans having ten times more bacteria living on them than human cells, (total bacteria estimated at one hundred trillion - 100,000,000,000,000)<sup>[3,4,5,6]</sup>. Yet according to some estimates, the total number of viruses exceeds the total number of cells in every other life form (including bacteria) by a factor of ten<sup>[7]</sup>.

Keeping track of all these numbers is a chore even for the microbiologists who study them while seeking to prevent human disease. To make it easy scientists tend to use exponential numbers or logarithms to the base of 10, with one hundred trillion becoming,  $10^{14}$  or 14  $\text{Log}_{10}$ . For example, our faeces are 90% bacteria with some 500 or so species making up the majority of that  $10^{14}$  number. But when we become ill, bacteria or viruses that cause disease (pathogenic) may be present in numbers of  $10^{11}$  per gram of faeces<sup>[8]</sup>.

Significant numbers of bacteria or viruses which live on our skin, are found in our food and on surfaces which have been contaminated by contact from our hands. When we cook food, wash hands or sanitise contact surfaces, harmful micro-organisms are killed or removed. Depending on food type, food safety experts and public health authorities call for 5 to 7  $\text{Log}_{10}$  or up to 99.99999 %

reduction of bacteria in food, while food contact or medical surfaces require a 5  $\text{Log}_{10}$  or 99.999% reduction to be termed 'sanitised' or safe from the possibility of human disease transmission<sup>[10,11,12,13]</sup>. This critical 99.999% reduction level is termed a 100,000 fold reduction.

The skin on our hands contains a combination of transient and resident bacteria. Resident bacteria (mainly Gram positives such as *Staphylococcus epidermidis*, *Corynebacterium minutissimum*, *Propionibacterium acnes*... and yeasts such as *Malassezia furfur*)<sup>[14,15,18,20]</sup> are part of our normal skin flora and help the body's natural defence system. They usually sit relatively deep into the skin's surface.

Transient bacteria (i.e. Gram positives such as *Staphylococcus aureus*, streptococci A... and Gram negatives such as enterobacteria,)<sup>[16,18,20]</sup> are not natural inhabitants to the body and are usually 'picked-up' from contaminated surfaces. They generally sit on the surface of the skin and can be easily spread to other surfaces. They can survive for up to several hours on the skin and are usually the cause of infectious illness in humans. In total, resident and transient species are believed to total over 500 different types<sup>[18]</sup>.

When trying to keep the skin clean of bacteria our major concern is usually for transient bacteria. In fact, removing and or killing resident bacteria can have a negative effect on our natural defence system<sup>[14,17]</sup>.

**FACT: It is common to find as many as 10 million transient bacteria cells on the end of just one finger.**

There are three general types of skin care products that can be used to kill or remove bacteria from the skin<sup>[19,21]</sup>.

1. **Wash-off ‘simple’ soaps** – to be rinsed off with water.
2. **Wash-off antibacterial soaps** - to be rinsed off with water.
3. **Leave-on hand sanitisers, or hand disinfectants** – no rinsing-off with water required.

Hand washing with ‘simple’ soaps can normally be expected to remove around 90% of the number of transient bacteria. The normal mode of action for common hand washing ‘soaps’ is to **physically remove** bacteria from the hands, along with any visible contamination. This is achieved mechanically by the ‘detergency’ action of the soap. There are two aspects that contribute significantly to reducing the number of bacteria when hand washing, as follows:

1. Creating a good ‘soapy’ lather to lift and suspend bacteria prior to rising with clean running water – this can be enhanced by the use of foaming soaps that provide an instant lather.
2. Using a proper hand washing technique to ensure all parts of the hands are thoroughly cleansed.

General purpose antibacterial soaps work by **chemical and/or physical action as well as mechanical action**. The ‘soap’ will aid the physical removal by mechanical effect and the antibacterial active will provide the microbiological action by chemical (i.e. denaturation of proteins, DNA..) and/or physical (i.e. solubilisation of the membranes phospholipids) action. General purpose antibacterial soaps can normally be expected to remove/kill around 99% or 99.9% of bacteria. However, some specialist antibacterial soaps, or ‘rubs’ as they are often referred to in healthcare environments, can remove and kill up to 99.99% of bacteria.

Hand sanitisers/disinfectants, such as Deb InstantFOAM, are formulated to be used without water and work by **physical and chemical action**. They work by directly dissolving the bacterial membrane and by denaturing the constitutive proteins and enzymes, killing the bacteria cells extremely quickly, without any risk of inducing antibacterial resistance. The most effective hand sanitisers are alcohol based, with a level of around 70-80% of alcohol. Hand sanitisers usually kill up to 99.99% of bacteria, but Deb InstantFOAM kills 99.999%.

**FACT: When growth conditions are good (body temperature, nutrients and moisture), most bacteria can double every 20 minutes given sufficient food and water. Therefore, in less than just eight hours one cell can potentially multiply to over 10 million.**

For many common illnesses, counts of just 10 to a 100 cells or particles may be enough to cause illness. In addition, the risk of spreading bacteria to others increases as the number on the host increases. The count capable of causing infection is termed the infectious dose (ID). With very minor contamination levels, a single dirty hand is capable of making 100,000 people sick, if that hand contamination could be delivered uniformly to that number of people within the window of opportunity for transmission, based on survival characteristics of the microbe in question. Some microbes die-off quickly in the environment while others survive well or even multiply as described above.

If we assume hands are contaminated with one million bacteria cells ( $10^6$ ), the following table shows the quantity of bacteria left immediately after washing with various types of soap or sanitiser, and the number of people who could be infected (assuming infectious doses of 100 & 10).

<b>Potential for Reducing The Risk of Disease Transmission</b>					
<b>Product Type Examples</b>	<b>Kill Rate</b>	<b>Log<sub>10</sub> Reduction</b>	<b># Bacteria Remaining</b>	<b># People Infected w/ ID =100</b>	<b># People Infected with ID =10</b>
<b>No Treatment</b>	0%	0	1,000,000	10,000	100,000
<b>Simple Soap</b> <sup>[22,23,24,25,26,27,28]</sup>	90%	1	100,000	1,000	10,000
<b>General Antibacterial Soap</b> <sup>[28,29]</sup>	99%	2	10,000	100	1000

<b>Specialist Antibacterial Soap</b> <sup>[30,31,32]</sup>	99.9%	3	1,000	10	100
<b>Specialist Antibacterial Soap &amp; Hand Sanitisers</b> <sup>[32,33]</sup>	99.99%	4	100	1	10
<b>Deb InstantFOAM</b> <sup>[34]</sup>	99.999%	5	10	0	1

With 99.999% reduction, as provided by Deb InstantFOAM, even with a human pathogen having a high infectious dose (10) the numbers of surviving microbial cells or particles are reduced to a level that makes transmission exceedingly unlikely, if not altogether impossible considering the factors involved in disease transmission. With Deb InstantFOAM, the extra '9' means that risks of transmission are reduced by an additional ten times. Therefore, Deb InstantFOAM which is scientifically tested to be 99.999% effective is:

**10 times** more efficacious than a product that is only 99.99% effective

**100 times** more efficacious than a product that is only 99.9% effective

**1,000 times** more efficacious than a product that is only 99% effective

**10,000 times** more efficacious than a product that is only 90% effective

#### Bibliography

1. A.J. Tobin & J. Dusheck. *Asking About Life* third edition (2005) Cengage Learning, Florence, Kentucky.
2. M. Jennison. *Atomizing of the mouth and nose secretions into the air revealed by high-speed photography*. *Aerobiology* (1942)17:106.
3. H. Clarke. *A few good viruses* *Cosmos*, (2007) 7 February, p. 8.
4. D.C. Savage. *Microbial Ecology of the Gastrointestinal Tract*. *Annual Review of Microbiology* (1977) 31:107-133.
5. R. Berg. *The indigenous gastrointestinal microflora*. *Trends in Microbiology*, (1996) 4:430-35.
6. C.L. Sears. *A dynamic partnership: Celebrating our gut flora*. *Anaerobe*, (2005) 11(5):247-51.
7. AM O'Hara & F. Shanahan. *The gut flora as a forgotten organ*. *European Molecular Biology Organization Reports* (2006) 7:688-93.
8. E.C.Todd, J.D. Greig, C.A. Bartleson, and B.S. Michaels. *Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 4. Contamination of the food environment and the transmission of pathogens*. *Journal of Food Protection*, (2008) 71(11):2339-73.
9. US FDA (Food & Drug Administration). *Pasteurized Milk Ordinance* (2007 Revised)  
<http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/MilkSafety/NationalConferenceonInterstateMilkShipmentsNCIMSMModelDocuments>
10. Food Standards Agency UK. *Report of the national study on the microbiological quality and heat processing of cow's milk 2003*. Food Standards Agency UK, London UK.(2003)  
<http://www.foodstandards.gov.uk/multimedia/pdfs/milksurvey.pdf>.
11. US DA (Department of Agriculture). *Performance Standards for the Production of Certain Meat and Poultry Products*. Title 9 Code of Federal Regulations 318.17.
12. US FDA US FDA (Food & Drug Administration). *Warning and Notice Statement: Labeling of Juice Products Small Entity Compliance Guide*. (1998) September 18.
13. R. Berube & G.S. Oxborrow. Chapter 60: Methods of Testing Sanitizers and Bacteriostatic Substances. *Disinfection, sterilization, and preservation*, Block, IV<sup>th</sup> Edition (1992) p. 1058-68.
14. J. Davies, J.R. Babb, G.A.J. Ayliffe and S.H. Ellis. *The effect on the skin flora of bathing with antiseptic solutions* *Journal of Antimicrobial Chemotherapy* (1977) 3, n°5, p. 473-481
15. C.A. Evans and R.J. Stevens. *Differential quantitation of surface and subsurface bacteria of normal skin by the combined use of the cotton swab and the scrub methods*. *J Clin Microbiol*. (1976) June; 3(6): 576–581.
16. E.A. Grice, H.H. Kong, G. Renaud, A.C. Young, G.G. Bouffard, R.W. Blakesley, T.G. Wolfsberg, M.L. Turner, and J.A. Segre

**A diversity profile of the human skin microbiota.** Genome Research (2008)- p. 1043-1050

17. T. Hirsch M.D., A. Koerber M.D., F. Jacobsen Ph.D., J. Dissemond M.D., Hans-Ulrich Steinau M.D., S. Gatermann M.D., S. Al-Benna M.D., M.o Kesting M.D., H-M. Seipp Ph.D. and L. Steinstraesser M.D. **Evaluation of Toxic Side Effects of Clinically Used Skin Antiseptics In Vitro.** Journal of Surgical Research, 27 January 2009

18. G. Judah, P. Donachie, E. Cobb, M. Holland and V.Curtis. **Isolation of bacteria of faecal origin on commuter's hands: a preliminary study** (2009) [http://www.hygienecentral.org.uk/pdf/dirty\\_hands\\_mini-paper.pdf](http://www.hygienecentral.org.uk/pdf/dirty_hands_mini-paper.pdf)

19. G. Kampf and A. Kramer. **Epidemiologic Background of Hand Hygiene and Evaluation of the Most Important Agents for Scrubs and Rubs.** Clinical Microbiology Reviews, (2004) Oct. p. 863–893

20. S. Stanton. **Disinfection, sterilization, and preservation.** Block, V<sup>th</sup> Edition (2001) p. 245

21. World Health Organization. **WHO Guidelines on Hand Hygiene in Health Care.** (2009)WHO Library Cataloguing-in-Publication Data,

22. R.N. Michaud, N.M. McGrath, and W. A. Goss. **Improved experimental model for measuring skin degerming activity on the human hand.** Antimicrob. Agents Chemother. (1972) 2:8-15.

23. K. Sprunt, W. Redman, and G. Leidy. **Antibacterial Effectiveness of Routine Hand Washing.** Pediatrics (1973) 52:264-271.

24. J.C. de Wit and E. H. Kampelmacher. **Microbiological aspects of washing hands in slaughter-houses.** Zentralbl. Bakteriol. (Orig B). (1982) 176:553-561.

25. J.C. de Wit and F.M. Rombouts. **Faecal micro-organisms on the hands of carriers: E. coli as a model for Salmonella.** Zentralbl Hyg Umweltmed, (1992) 193(3):230-6.

26. M. Stiles and A. Z. Sheena. **Efficacy of germicidal hand wash agents in use in a meat processing plant.** J. Food Prot. (1987) 50:289-295.

27. D. Coates, D. N. Hutchinson, and F. J. Bolton. **Survival of thermophilic campylobacters on fingertips and their elimination by washing and disinfection.** Epidemiol. Infect. (1987) 99:265-274.

28. C.L. Cardoso, H. H. Pereira, J. C. Zequim, and M. Guilhermetti. **Effectiveness of hand-cleansing agents for removing Acinetobacter baumannii strain from contaminated hands.** Am. J. Infect. Control (1999) 27:327-331.

29. B. Michaels, V. Gangar, T. Ayers, E. Meyers, and M. Curiale. **The significance of hand drying after handwashing.** In: J.S.A. Edwards and M.M. Hewedi, eds. 3rd International Conference on Culinary Arts and Sciences Global and National Perspectives, Cairo, Egypt. Worshipful Company of Cooks Centre for Culinary Research, Bournemouth University, U.K. (2001) 294-301.

30. E. J. L. Lowbury, H. A. Lilly, and J. P. Bull. **Disinfection of hands: removal of transient organisms.** Brit. Med. (1964) 2:230-233.

31. M.L. Rotter. **Hygienic hand disinfection.** Infect. Control (1984) 5:18-22.

32. D.S. Paulson. **A comparative evaluation of different hand cleansers.** Dairy Food Environ. Sanitat. (1994) 14:524-528.

33. B. Michaels, V. Gangar, C.M. Lin, M. Doyle. **Use Limitations of Alcoholic Instant Hand Sanitizer as Part of a Food Service Hand Hygiene Program.** Food Service Technology (2003) 3(2):71-80.

34. B. Michaels. **Cutan® foam alcohol hand sanitiser alcohol foam hand sanitiser having improved efficacy and significantly enhanced hand hygiene compliance capability.** Submitted to U.K. National Health Service Rapid Review Panel, (2007) September 24.