

99.99%, OR THE MYTH OF ERADICATION

by David A. Watson, Ph.D.

I'm no mathematician, though I did muddle through a host of required coursework on my way to a life science degree, such that I acquired some facility with numbers. It was therefore with skepticism borne of a background in math and microbiology that an advertisement for a new antibacterial kitchen wipe caught my eye recently. The pitch was that this new cleaner would kill 99.99 % of germs with which it came into contact. An impressive figure, certainly, were it to appear on a report card or in an efficiency study, but how does such a number rate as a measure of germ control? Not so great, I'm afraid. Looking at the numbers, if a given surface area contains one million germs then getting rid of said percentage means that 100 bugs remain alive. So what's the big deal, you say, 100 represents a whole lot fewer bacteria or virus particles than one million. Agreed, but even so a bit more math reveals that if the bugs can replicate themselves every 30 minutes (a reasonable doubling time), then in 400 minutes (less than seven hours) one million germs will once again be present! Is the fight against the bugs a war, and if so, is it one we can win?

The simple answer is no. We're not in a heated battle against germs (the threat of bio-terrorism notwithstanding) and it is likely not even appropriate to talk about winning or losing. What is true is that the antibiotic era is still less than a century old, yet the whisperings grow louder of the approaching end of the effectiveness of antibiotics. In [The Antibiotic Paradox: How the Misuse of Antibiotics Destroys Their Curative Powers](#), Dr. Stuart Levy (a professor at Tufts University and founder and president of the Alliance for the Prudent Use of Antibiotics) states that while a variety of consumer products

incorporate antibacterial compounds and probably do not lead to resistant bacteria (provided the product leaves no residue), this level of vigilance is probably not necessary. He points out that most bacterial species are in fact harmless, even beneficial, and that their presence may well act as a barrier to attack by pathogenic species. He further mentions recent data suggesting that if a household is kept too clean during early childhood, individuals may be at greater risk for development of allergies later in life. This degree of cleanliness is also known to delay exposure of children to the microbe known as Epstein-Barr Virus (EBV) until their teen years, when it causes mononucleosis, as opposed to a milder infection if contracted earlier in childhood (as is usually the case in the developing world).

But what then accounts for the rise in certain bacterial infections of pre-adolescence here in the USA over the past few decades? We can answer this question for otitis media, the dreaded ear infection of preschoolers. Each year (and with increasing frequency) millions of small children suffer from ear problems severe enough to see a physician; these infections are treated with antibiotics so that the kids can return to day care centers around the country, since (also increasingly) both spouses work outside the home. Unfortunately, the efficacy of this approach is often marginal; the combination of antibiotics and NSAIDs (non-steroidal anti-inflammatory drugs) reduces fever, but may not completely eradicate the bacteria (see our discussion above regarding less than 100 % killing of germs). An important result of this cycle is the slow, but inexorable development of bacteria resistant to antibiotics (ironically enough, among higher socioeconomic groups).

Whether it is through the use of antibacterial wipes or hand washing, the ugly fact is that we can't escape the microbes. If I scrub long enough to remove 99.99999 % of the microbes present on my hands (statistically this would mean that there is only a one in ten chance that a viable bacterium remains on my hands, given a total initial load of one million bugs), I am nevertheless likely to irritate my skin. Subsequently, in several hours when the bug population is replenished following the re-seeding of my hands by one random bacterium, the germs will better adhere to my dermis. Of course, we should still wash our hands, cover our mouths when we cough, and cook our food well, but we should also recognize that we'll never wipe out the microbes. Nobel prize-winning bacteriologist Joshua Lederberg perhaps said it best "...We have too many illusions that we can, by writ, govern the remaining vital kingdoms, the microbes, that remain our competitors of last resort for dominion of the planet."