

Health concerns of heterotrophic plate count (HPC) bacteria in dental equipment water lines

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ABSTRACT: There is an unsubstantiated concern as to the health relevance of HPC (heterotrophic plate count) bacteria in dental equipment waterlines. The American Dental Association (ADA) web site includes guidelines for controlling HPC populations and implies that HPC populations >500 CFU/mL as a “health” benchmark. The world-wide published literature including the United Nations fully examined this situation and concluded that HPC bacteria are not a health risk, but merely a general water quality parameter for all waters including dental water lines. This review provides documentation that the standard measurement of HPC bacteria in waters alone do not pose a health risk and the ADA already provides appropriate practices to minimize HPC bacteria in dental equipment water. (*Am J Dent* 2016;29:137-138).

CLINICAL SIGNIFICANCE: This review provides documentation that the standard measurement of HPC bacteria in waters alone do not pose a health risk and the ADA already provides appropriate practices to minimize HPC bacteria in dental equipment water.

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Introduction

Ensuring the water quality used in dental equipment waterlines to minimize any potential health risk to the patient, dental hygienist, or dentist is important. There are standard practices to accomplish this, e.g. using water from public water systems that meet drinking water standards, daily flushing of water lines, disinfecting dental equipment after each use, etc.¹ These practices are recommended to control and minimize the formation of microbial biofilms on tubing/equipment surfaces.

Biofilms form on the interior surfaces of all drinking water utility pipes, water pipes in residences, buildings, home water treatment devices, and dental equipment water lines, but usually present no health risk since the drinking water source was effectively treated and disinfected for human pathogens prior to being distributed to consumers and dental offices. Biofilms include a multitude of heterotrophic bacterial species including *Aeromonas*, *Klebsiella*, and *Pseudomonas*, all of which are commonly found in foods and beverages that are consumed daily.² In the U.S.A. and other countries, these microorganisms are commonly referred to as “heterotrophic plate count” bacteria (HPC) and include a large number of species.² As a comparison between HPC bacterial populations in water and microbial flora in the body, the Table provides information on the permanent microbial flora of the human body including the oropharynx with bacterial populations at >10⁸ per cm².

In 1978, a U.S. Environmental Protection Agency (USEPA) study³ found that heterotrophic plate count bacteria (HPC) when present in treated drinking water at >500 colony forming units (CFU)/mL could interfere with standard total coliform detection methods using m-Endo medium, i.e. false negative (total coliforms present in water but masked by HPC populations). For this reason, it was recommended then that drinking water utilities monitor for HPC populations when using the m-Endo medium. In addition, USEPA suggested HPC bacterial populations as a surrogate for sufficient chlorine concentrations in drinking water. In either case there was never any association that HPC bacteria > 500 CFU/mL posed an increased health risk. Nevertheless the “500 CFU/mL” value was

Table. Normal permanent resident microbial flora of the human body.

Anatomic site	Total number/gram or cm ²	Predominant species
Skin	10 ³	<i>S. epidermidis</i> <i>Corynebacterium sp.</i> <i>P. acnes</i> Fungi
Oropharynx	10 ⁸ - 10 ⁹	<i>Viridans streptococcus</i> <i>Neisseria sp.</i> <i>Fusobacterium sp.</i> <i>Bacteroides sp.</i>
Small intestine	10 ⁵ - 10 ⁸	<i>Lactobacillus</i> <i>Enterobacteriaceae</i> <i>Bacteroides sp.</i>
Large bowel (feces)	10 ¹¹	<i>Bacteroides sp.</i> <i>E. coli</i> <i>Clostridium sp.</i> <i>Enterococcus</i>

misused by a number of national, international health, and medical organizations as a “public health parameter.” The American Dental Association’s web site includes a discussion entitled “Dental Unit Waterlines” and refers to a 500 CFU/mL guideline; <http://www.ada.org/en/member-center/oral-health-topics/dental-unit-waterlines>. There are now other non-Endo, non-membrane filter-based methods⁴ that are not adversely affected by HPC populations, i.e. false negatives. These methods for total coliforms and *Escherichia coli* are more sensitive, more specific, less-costly, more rapid, and have generally supplanted the use of m-Endo based methods for USEPA-required monitoring of drinking water. It is still recommended that drinking water utilities monitor for HPC populations if still using the membrane filter m-Endo method since elevated HPC population may result in “false negative” results.

The historical body of research has consistently shown that all HPC enumeration methods vastly underestimate the actual (true) microbial populations of all types of bacteria in all waters, and every HPC method enumerates a different subset of the total HPC populations depending on the media (nutrients) used, incubation time, and incubation temperature. For drinking

water, R2A medium⁴ provided the “best” measurement of aerobic/facultative anaerobic HPC bacteria but still underestimates the total HPC bacterial population.

Drinking water systems may experience elevated HPC populations greater than 500 CFU/mL as a result of low disinfection concentrations in the periphery of the water distribution system, long residence times (days or weeks) within the water storage/distribution network, organics that can serve as an energy source of HPC bacteria, warmer water temperatures during the summer months that favor the growth of HPC bacteria, infiltration of contaminated water into the distribution system through a pipe break or failed seals in association with a negative pressure event, etc. Some of these factors may also be applicable to dental water systems, i.e., warm temperatures in the dental facility, or nonuse on weekends. There is no actual health-based HPC limit in the USEPA regulations nor do they specify any HPC enumeration method to be used, and thus laboratories may choose a method that is least sensitive, i.e. is biased toward lower HPC measurements.

By comparison, everyday foods contain bacterial densities of 10^{3-6} /gm and uncooked vegetables (broccoli, carrots, lettuce, tomatoes) have HPC populations $>10^{4-6}$.⁵ So how plausible would it be that HPC populations >500 CFU/mL in dental waters would pose a health risk? A continuing issue is that health or other organizations dealing with water quality often do not necessarily base regulations or recommendations on the science as they should. Moreover, the probability of contracting any disease requires the presence of a virulent human organism, an infective dose, and a compromised immune system, quite improbable from dental waters.⁶⁻⁸

In April 2002, the public health significance of HPC was reviewed by the World Health Organization (WHO). A group of microbiology and public health experts, including those with regulatory and medical expertise, was convened by WHO in Geneva, Switzerland, to consider the utility of HPC measurements in addressing drinking water quality and safety. The workshop was attended by 31 participants from Australia, Canada, France, Germany, Italy, Japan, the Netherlands, South Africa, Switzerland, United Kingdom, and the United States. In its resulting 2002 official WHO report⁹ and policy statement, “Heterotrophic Plate Count Measurement in Drinking Water Safety Management,” the WHO noted that while HPC counts are monitored during bottled water production, they are not a public health risk indicator. The WHO report states that: “There

is no evidence that HPC values alone directly relate to health risk either from epidemiological studies or from correlation with occurrence of waterborne pathogens. They are therefore unsuitable for public health target setting. The available body of evidence supports the conclusion that, in the absence of fecal contamination, there is no direct relationship between HPC values in ingested water and human health effects in the population at large.”

Thus, the recommended cleaning/operational practices¹ would be fully sufficient to control microbial water quality in dental equipment and waterlines, and HPC bacterial populations as monitored in the routine testing of dental waters would not appear to provide any actionable data for health protection.

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