THE DENTAL ADVISOR™

Improving Patient Care Through Research & Education

Infection Control

Dental Waterline Infection Control

The demonstration of high concentrations of microbial accumulation in coolant water for high-speed dental handpieces was first reported in 1963. Later research determined that the long narrow plastic tubing that delivers compressed air and water to handpieces provides an optimal environment for microbial growth.

This issue of THE DENTAL ADVISOR discusses the contamination of dental unit waterlines, potential risks associated with contaminated water, and infection control strategies. Representative products and processes for treatment of dental water are presented.

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MAIN TOPIC

CLINICAL EVALUATIONS

EDITORS' CHOICE

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RATINGS:

Excellent	+ + + + +
Very Good	+ + + +
Good	+ + +

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From the Desk of
Dr. Bunek, Editor-in-Chief

Over the last few years, the infection control group at THE DENTAL ADVISOR has tested bacterial levels of dental unit waterlines from numerous practices and it is always difficult telling a good dentist they have bad water. Usually the first reaction we see is astonishment or disbelief, which quickly turns to slight irritation. "How could this be? We treat our lines regularly with such and such cleaner, why is it not working?" Our best advice - when it comes to dental unit waterline cleaning systems - is to read the instructions thoroughly. Multiple approaches and new technologies have been introduced into the market to address dental waterline colonization and each product requires specific maintenance to attain optimal performance. For instance, some products require waterlines to be shocked prior to product use, while others require monthly or yearly treatment. Some systems use distilled water and others tap water. Sometimes you need to purge the lines at night other systems require a 2-3 minute flush in the morning. The purpose of the following discussion is to briefly discuss both the principles of dental waterline contamination and effective technologies and products that can address this potential problem. We welcome your comments and suggestions. Please contact us with questions, comments or concerns at *jmolinari@dentaladvisor.com* or *pnelson@dentaladvisor.com*.

Introduction

Medical literature contains extensive clinical and scientific evidence documenting waterborne infections in hospital settings, and as a result, the potential challenge presented by contaminated water has become a major concern during provision of dental treatment (Table 1). Ongoing studies continue to investigate the mechanisms of microbial colonization, potential health problems for dental health care workers and their patients, as well as possible approaches for reducing/ controlling microbial presence.

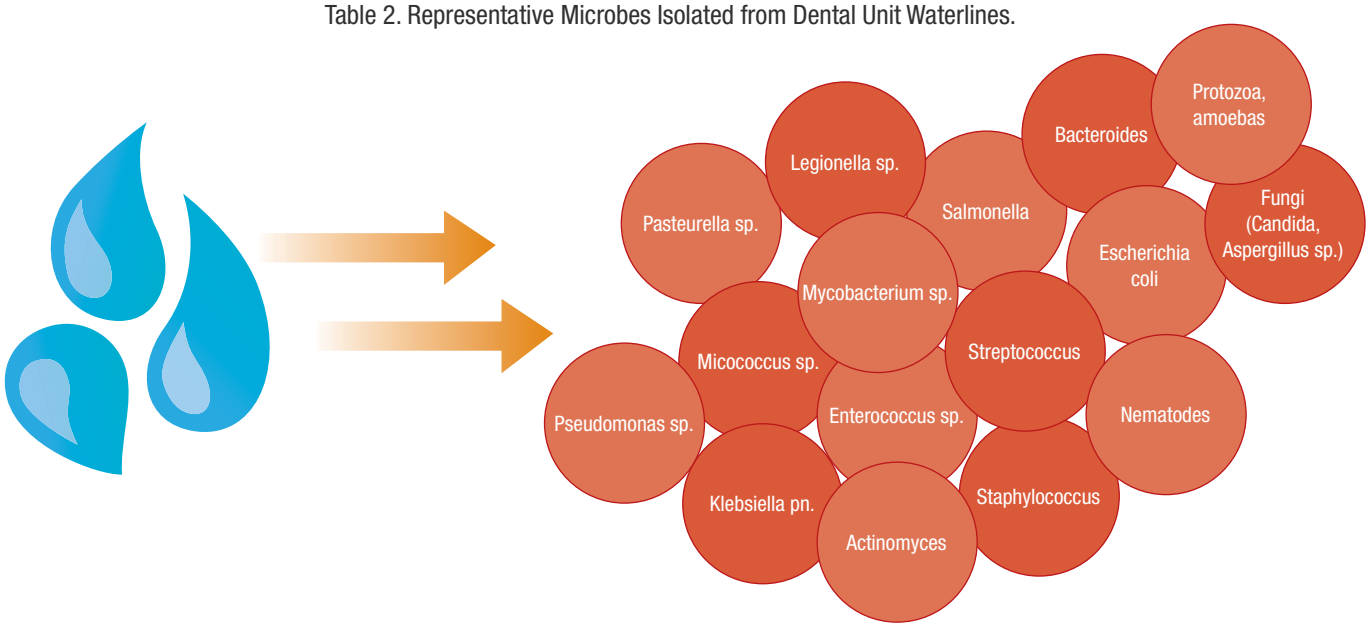
Table 1. Dental Unit Waterline Concerns.

Water coming into dental offices from city supplies contain bacteria and nutrients that support their growth.	Dental unit waterlines contain long lumens, with a high surface area for biofilms to develop	Biofilms thrive in moist and warm environments, making the dental unit waterline a perfect environment
Untreated dental units cannot reliably produce water that meets drinking water standards	Microbial counts can be > 200,000 cfu/ml within 5 days of DUW installation	Dental water exiting unit can be 100's to 1000's times more contaminated than incoming tap water
Waterline contamination consists of slime-producing bacteria, fungi and protozoans.	Immune compromised patients are at greater risk of opportunistic infections	In their natural habitat, 99.9% of all bacteria live as a community and attach to surfaces as biofilms

Contamination of Dental Water

Accumulated data have shown that dental unit waterlines can be rapidly colonized by organisms that thrive in aqueous environments and can form biofilms inside line lumens. This contamination occurs because certain unique waterline factors (e.g., system design, flow rates, materials) promote bacterial growth. Multiple classes of organisms have been identified in collected water samples, ranging from nonpathogenic to pathogenic species (Table 2). Although the incoming water from an external source is sanitized and meets public health safety standards for potable quality (<500 cfu/mL of bacteria and <1 coliform), water coming out of the waterline may eventually contain up to 1,000,000 cfu/mL.

Table 2. Representative Microbes Isolated from Dental Unit Waterlines.



Central to microbial contamination of aqueous environments is the formation of biofilms. A bacterial biofilm is defined as a "structured community of bacterial cells enclosed in a self-protective polymeric matrix and adherent to an inert or living surface." Biofilms begin when free-floating (planktonic) bacteria attach themselves to solid surfaces and establish early "pioneer" colonies. As microbial growth continues, an oligosaccharide matrix called a "glycocalyx" is also synthesized by some bacterial species. Biofilms tightly adhere to the walls of dental unit waterlines. This slime layer provides a structural framework that protects the organisms within the biofilm from desiccation, exposure to chemicals, and destruction from other microbes. Protected by this tenacious coating, bacteria continue to replicate, and form micro-colonies that continue to coalesce, producing continuous sheets of biofilm. As water flows through the lines and comes in contact with microbial accumulations, some clumps of biofilm may be dislodged and come out in exit water as solid material (Figure 1).

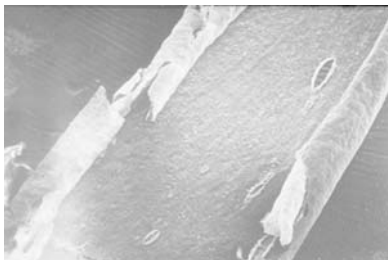


Figure 1. Scanning Electron Micrograph of Biofilm Breaking off Walls of a Dental Waterline.

Potential Risks from Highly Colonized Waterlines

While most of the isolated waterline microbes typically originate from the public water supply, oral bacteria from patient saliva also can be retracted through air/water syringes and handpieces. The overwhelming majority of these bacteria are classified as opportunistic pathogens and do not usually pose a high risk of disease for healthy persons. However, there are increasing numbers of patients with weakened immune systems who routinely seek dental treatment, and who can be periodically exposed to microbial opportunists via colonized water. Historical evidence of clinical infection in this type of patient has been reported following medical exposure to waterborne pathogens, such as *Pseudomonas, Klebsiella, Legionella*, and non-tuberculous *Mycobacterium* species. Despite the presence of bacteria in numbers greatly exceeding levels established for drinking and recreational waters, few cases of illness among patients or dental health-care workers have been documented. However, because most dental offices are located in outpatient settings, epidemiological links between an infection and recent exposure to contaminated dental water are difficult to establish. This situation changed dramatically in 2012 with publication of the first documented instance of dental patient infection (Legionnaires disease) from highly contaminated waterlines used during two treatment appointments. The same bacterial serogroup was isolated from the dental handpiece waterline and the patient's bronchial aspirate.

Waterline Infection Control Strategies

Although flushing water through dental waterlines can clear organisms suspended in the bulk fluid, the effects are transient. Bacterial counts can quickly rise to levels that equal or exceed pre-flush levels as biofilm grows or is dislodged by flowing water. The most recent CDC infection control guidelines for dental unit waterlines recommend that:

1. *Water of drinking quality must be used for routine dental care, and*

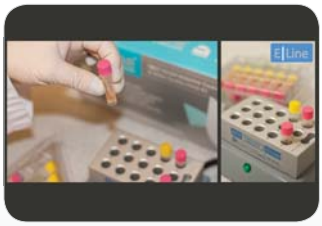
2. *Sterile water should be used for surgical procedures that involve exposure of bone, the vascular system, and tissue that is normally sterile.*

Properties of an Ideal Waterline Infection Control Agent

- Rapid "cidal" (i.e., lethal) antimicrobial action
- Exhibit broad-sprectrum antimicrobial activity against bacteria, fungi, protozoa
- Ability to disrupt/ disperse accumulated biofilms
- Exhibits "substantivity" to minimize or prevent microbial accumulation on treated surfaces
- Non-toxic to equipment or patients
- Non-pyrogenic
- Non-allergic
- Non-corrosive to metals
- No damaging effects on rubber or synthetic materials
- Does not interfere with performance of any dental restorative or therapeutic agents

Clinical monitoring of water quality can ensure that procedures are properly performed and that devices are working in accordance with the manufacturer's previously validated protocol. Monitoring dental unit water quality can assist in identifying problems in performance or compliance, and also provides documentation. There is no need to identify specific organisms unless investigating a waterborne illness or a unit that is refractory to treatment. Testing should accurately detect a wide concentration range and type of aerobic, mesophilic, heterotrophic, waterborne bacteria within a reasonable incubation time at room temperature. Generally, there are two options to monitor dental unit water quality: commercial self-contained test kits *(**Eline Water Quality Check**, Germiphene, Co.; **HPC Total Count Test Kit**, Millipore, Co.)* or commercial water-testing laboratories. Dentists should consult with the manufacturer of their dental unit or water delivery system to determine the best method for maintaining acceptable water quality (i.e., <500 CFU/ mL) and the recommended frequency of monitoring.

E|Line™ Water Quality Check Kit



Germiphene Corporation
Contact:
linda@germiphene.com
www.Germiphene.com

Product Description: Take charge of your office water today. With ***E|Line™***, you can rest assured that your efforts to clean/ disinfect your waterlines literally shows. *Biofilm and Bacteria Test Vials* indicate, via color change, water containing bacteria counts greater than 200 cfu/mL. Conveniently test on site. Easy to read, clear results in just 24 hours. Available: 37°C Dry Block Incubator, Single Test Vial Set (with Record Log), Triple Test Vial Set (with 3 Record Logs). Each Test Vial Set includes 12 vials: 6 Biofilm Test Vials + 6 Bacteria Test Vials.

Over the past few years, THE DENTAL ADVISOR has conducted numerous studies on dental waterline treatment systems. During our investigations, we have occasionally observed high microbial concentrations of up to 100,000-1,000,000 cfu/ml, despite the use of commercial treatments. In one sense dentistry is being asked to be proactive in its approach to reducing the "potential" of the dental unit waterline for cross-contamination and cross-infection. With the widespread application of effective, accepted infection control principles routinely exhibited in most dental facilities, exposing either patients or the waterline to water of poor microbiological quality is not acceptable.

Summary

The keys for accomplishing dental unit waterline asepsis remain the same as for other infection control goals - application of basic infection control principles and compliance with product instructions. Contaminated waterlines, like contaminated hands, instruments, and environmental surfaces, should be cleaned first to remove accumulated microbial and extracellular material before treatment. Compliance with a manufacturer's step-by-step procedures for accomplishing this removal is essential. Minimizing subsequent waterline colonization may require another series of protocols, some of which may be more time consuming than anticipated. Thus, the whole dental team needs to be aware of product costs, necessity for compliance, and the time required to reach recommended waterline microbial concentrations. Research developments in recent years have led to not only greater individual options for dental practitioners, but also the availability of combination system products, which contain separate waterline cleaning agents and maintenance chemicals (Table 3).

Table 3. Representative Dental Unit Waterline Treatment Products

Product	Manufacturer	Active Ingredients	TDA Testing
ICX Tablets	A-dec	Sodium percarbonate, silver nitrate, cationic surfactants	NT
BlueTab Waterline Maintenance Tablets	ProEdge	Silver dihydrogen citrate	NT
Team Vista Dental Waterline Cleaner	Hu-Friedy	Organic citrus botanicals (VistaClean), stabilized chlorine dioxide (VistaTab)	92% clinical evaluation
DentaPure DP365B & DP365M Cartridges	DentaPure	Elemental iodine	Laboratory
Monarch Lines	Air Techniques	Ethanol, chlorhexidine	Laboratory
Mint-A-Kleen	Anodia Systems	Glycerin, chlorhexidine	NT
MicroClear	Rowpar Pharmaceuticals	Chlorine dioxide	NT
Sterilex Ultra (liquid & powder forms)	Sterilex Corporation	Alkaline proxygen with phase transfer catalyst	NT
Sterisil Cartridge & Straw	Sterisil	Cartridge, silver; Straw, Ionized silver resin	NT
Citrisil Blue	Sterisil	Silver, citric acid	NT
VistaClear HP	Vista Research Group	Multi-stage biochemical filters	NT

NT = Not Tested

Clinical Tips

- Make sure to carefully read the instructions of your dental waterline treatment system. Proper maintenance of waterlines usually includes a monthly or quarterly shock treatment to remove accumulated microbial debris.
- If you are using a reverse osmosis treatment system to prepare water for filling dental unit bottles, the lines and tank associated with the treatment unit must also be shocked. This step is usually done at the same time as when the filters are changed; however, your treatment system's instruction manual should provide specific guidance.
- For most municipally fed dental waterline units, there are cylindrical filters located in the junction box that need to be replaced at least once a year. Contact your local service technician for help.
- Some dental units have a small water heater located in the junction. This is used to supply warmer water for the comfort of the patients. However, in reality the warmer water is creating a more optimal environment for bacterial growth. Therefore, have your local service technician turn-off the heater or make it so the waterlines bypass the heater completely.

Team Vista

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Hu-Friedy

(800) 483-7433

www.hu-friedy.com

Product Description: ***Team Vista*** provides continuous cleaning of dental waterlines associated with delivery units utilizing independent water bottles. ***VistaTab*** is a non-corrosive, antimicrobial tablet used for periodic cleaning and control of microbial contaminants in dental unit waterlines. ***VistaClean*** is a daily irrigant solution designed to protect waterlines and equipment from deposits and scale. ***Team Vista*** as environmentally friendly, non-toxic and odor-free. ***Team Vista*** was evaluated by 10 consultants in over 534 uses and received a 92% clinical rating.

Sterisil® Straw

Sterisil Inc.

(719) 622-7200

www.sterisil.com

Product Description: ***Sterisil® Straw and Antimicrobial Bottle*** are the solution to transitioning from daily tablets to a single yearly change out. The ***Sterisil® Straw*** works 365 days to continuously* disinfect and maintain dental unit waterlines. Easily installed by replacing the existing pick-up tube with the ***Sterisil® Straw***.

**EPA registered to produce less than or equal to 10 CFU per ml HPC Purity*

Citrisil™ Blue + Shock

Sterisil Inc.

(719) 622-7200

www.sterisil.com

Product Description: ***Citrisil™ Blue*** tablets continuously *disinfect and maintain dental waterlines. Start with one ***Citrisil Shock Tablet™*** and follow with one ***Citrisil™ Blue*** tablet per refill of each self-contained water bottle. ***Citrisil™ Blue*** conveniently provides the user with a light blue tint for visual compliance.

**EPA registered to produce less than or equal to 10 CFU per ml HPC Purity*