Water line contamination in the dental office

A Peer-Reviewed Publication
Written by Tija Hunter, CDA, EFDA, CDIA, MADAA

Abstract
Dental unit water lines have long been a source of discussion and much concern. Dental unit water systems (DUWS) harbor bacterial biofilms, which are known reservoirs for pathogens. In 1995, the ADA Council on Scientific Affairs responded to scientific evidence that suggested the microbiologic quality of water used in dental treatment needed improvement. They called for action to be taken on the design of dental equipment so that by the year 2000, water delivered to patients during nonsurgical dental procedures consistently contained no more than 200 colony-forming units per milliliter (CFU/mL) of aerobic mesophilic heterotrophic bacteria at any point in time in the unfiltered output of the dental unit. Since that time, technological advances have made this possible. The Centers for Disease Control and Prevention (CDC) now recommends that “coolant water used in nonsurgical dental procedures meet EPA regulatory standards for drinking water,” which is less than or equal to 500 CFU of heterotrophic bacteria per milliliter of water. This recommendation was published in the CDC’s Guidelines for Infection Control in Dental Health-Care Settings—2003. (Guidelines from the CDC differ about water used in oral surgical procedures.) Infections associated with microbial contamination of water lines appear to be rare. It has been shown that the level of microorganisms in untreated dental unit water lines is greater than 500 CFU/mL, which exceeds the drinking water standard. While colonization of microorganisms within the water lines may not be a concern to healthy individuals, it might place elderly or immunocompromised patients at unnecessary risk.

Educational Objectives
During this course the participant will:
1. Identify safe drinking water levels.
2. Discuss CDC and ADA recommendations.
3. Establish ways in which to test water lines.
4. Learn how to reduce the number of heterotrophic bacteria.

Author Profile
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Author Disclosure
Tija Hunter has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course.

This course was written for dentists, dental hygienists, and assistants.

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Educational Objectives
At the conclusion of this educational activity, participants will be able to:
1. Identify safe drinking water levels.
2. Discuss CDC and ADA recommendations.
3. Establish ways in which to test water lines.
4. Learn how to reduce the number of heterotrophic bacteria.

Abstract
Dental unit water systems (DUWS) harbor bacterial biofilms, which are known reservoirs for pathogens. In 1995, the ADA Council on Scientific Affairs responded to scientific evidence that suggested the microbiologic quality of water used in dental treatment required improvement. A call to action was taken on the design of dental equipment. By the year 2000, water used during nonsurgical dental procedures consistently contained no more than 200 colony-forming units per milliliter (CFU/mL) of aerobic mesophilic heterotrophic bacteria in the unfiltered output of the dental unit. A heterotroph is “an organism that cannot fix carbon from inorganic sources (such as carbon dioxide) but uses organic carbon for growth.”

Introduction
Bacteria that cause biofilm can build up in the self-contained water bottle, the lines to the high-speed handpiece, the three-way air/water syringe, and the ultrasonic/piezo tubing. How to properly flush these lines and keep the water at a safe drinking level is of concern to the American Dental Association (ADA). However, infections associated with microbial contamination of water lines appear to be rare. It has been shown that the level of microorganisms in untreated dental unit water lines can be greater than 500 CFU/mL, which exceeds the drinking water standard. While colonization of microorganisms within water lines may not be a concern to healthy individuals, it might place elderly or immunocompromised patients at unnecessary risk. Standards for safe drinking water quality are established by the Environmental Protection Agency (EPA), the American Public Health Association (APHA), and the American Water Works Association (AWWA). Together, these agencies have established a heterotrophic bacterial count below 500 CFU/mL as safe for consumption. Maintaining these levels regularly ensures optimal microbiologic equality.

Biofilm
Biofilm is a community of bacteria cells and other microbes that form a “slime” layer that lightly adheres to and forms a protective layer on surfaces. Found on all surfaces where moisture is present, biofilm can contain many types of bacteria as well as fungi, algae, protozoa, and nematodes. Polysaccharide slime produced by the many microbial inhabitants protects the cells from physical and chemical challenges, while water channels within the biofilm carry nutrients to the cells inside the film.

Over the years, researchers have investigated dental water line contamination and have concluded that plastic tubing is ideal for bacteria growth. Despite high levels of organisms found in the lines themselves, little evidence was presented to demonstrate that it was harmful. Bacterial biofilm is virtually universal in untreated dental unit water lines and can begin forming in a new dental unit within a few days. Unless procedures specifically designed to eliminate, trap, or kill biofilm are performed, there is little reason to believe that any dental unit can avoid being colonized by bacteria. In fact, bacterial counts numbering in the hundreds of thousands, even millions, per milliliter of dental unit water have been recovered from dental units across the country.

Since the ADA convened a special task force in the mid-1990s focusing on infection prevention, there have been a number of recommendations made to treat the water and reduce the number of bacteria.

Microorganisms
Research has identified numerous classes of organisms in dental water line samples ranging from nonpathogenic to pathogenic microbes. Types of microbes commonly found in dental water lines include: Bacterionema spp.; Corynebacterium spp.; gram negative bacilli and cocci; Klebsiella spp.; Neisseria; Pseudomonas spp. including P. aeruginosa, P. pyogenes, and Burkholderia cepacia; Staphylococcus epidermidis; Streptococcus mutans; Streptococcus salivarius; Streptococcus mitis; Actinomyces spp.; Enterococcus spp.; hemolytic streptococci; Staphylococcus aureus; B. subtilis; E. coli; Flavobacterium; nonhemolytic strep-tococci; Legionella pneumophila; Mycobacterium spp.; Aspergillus niger; Cladosporium; Actinomycetes; and Alcaligenes faecalis. Even small roundworms have been found in contaminated dental water lines.

Most of these microbes originate from the public water supply and are classified as opportunistic pathogens, meaning they do not usually pose a high risk of disease for healthy people. This fact has direct implications for dentistry because increasing numbers of patients with weakened immune systems routinely seek dental treatment. With elderly patients living longer and retaining permanent dentition, this exposure creates a heightened risk.

Legionnaires’ Disease Associated with Dental Water Lines
In February 2012, the first confirmed case of Legionnaires’ disease associated with dental water lines was reported. The patient, an 82-year-old woman in Rome, Italy, died just two days after she was diagnosed, despite heavy antibiotic treatment. In the
two to ten days prior to onset of illness, she had left her home only twice, both times for dental appointments. The *Legionella pneumophila* strain found in the dental water lines matched the microorganisms found to infect the patient.7

Dental water lines are conducive to *Legionella* growth. Biofilm grows well on most types of plastic tubing. The biofilm build-up rate is faster as well because microbes suspended in the water have a shorter distance to fall before contacting the tubing surface. Stagnation and low-flow rates also contribute to the problem. The water temperature in most dental lines exceeds 20°C (68°F), which is within the growth range for *Legionella*. For patient comfort, some offices heat dental water to around 37°C (98.6°F), which is ideal for the growth of *Legionella, Pseudomonas, Mycobacteria*, and many other human pathogens.10

**Health Implications**

According to the Organization for Safety, Asepsis and Prevention (OSAP), numerous studies conducted over the past 30-plus years have identified the presence of waterborne opportunistic pathogens in dental unit water, and these findings provide reason for concern.7

Many environmental organisms identified in dental treatment water have been associated with opportunistic infections in hospitalized or immunocompromised patients. For example, *Pseudomonas* species, nontuberculous mycobacteria, and *Legionella* species all have been isolated from dental unit water.7 *Legionella*, the causative agent of Legionnaires’ disease, may pose a particular concern, as it appears to be transmitted by inhaling aerosols or aspirating water contaminated with the bacteria.

OSAP further states that high-speed handpiece aerosols were associated with altered nasal flora in 14 of the 30 dentists studied.7 Nine of the dentists with altered nasal flora were positive for the same species of waterborne *Pseudomonas* isolated from the dental units. Several other studies have found higher titers of *Legionella* antibodies among dental personnel than in control populations, likely due to chronic exposure to *Legionella*-contaminated aerosols of dental unit water.7 Despite the higher antibody titers, however, no cases of *Legionella* pneumonia among the exposed workers have been documented.

A recent paper discussed the finding that high levels of the bacterial by-product known as endotoxin may be present in dental unit water.7 Exposure is known to exacerbate respiratory conditions such as asthma and may affect wound healing.

Some local news reports have suggested that bloodborne pathogens may be transmissible through dental treatment water.7 In properly functioning units, however, the volumes of biomaterial needed for disease transmission are unlikely to be retracted into water lines. Even if minute quantities of virus-contaminated material were to enter water lines, experts state there is no risk of colonization, as viruses require animal cells for replication, and they cannot survive long outside of a host organism. Although researchers have found evidence of oral flora in dental water systems, there is little evidence to suggest that these organisms form a significant part of the water line biofilm community.

**Chain of Infection**

The chain of infection is a way of gathering the information needed to interrupt or prevent an epidemic. Each of the links in the chain must be favorable to the organism for the epidemic to continue. Breaking any link in the chain can disrupt the epidemic.11

**Figure 1.**

**Organism**

**Reservoir**

**Vulnerable Hosts**

**Portal of Entry**

**Transmission**

**Portal of Exit**

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**Organism:** A form of life considered as an entity; an animal, plant, fungus, protistan, or moneran.

**Reservoir:** The place where microorganisms reside, thrive, and reproduce, e.g., food, water, toilet seat, elevator buttons, human feces, respiratory secretions.

**Portal of Exit:** The place where the organism leaves the reservoir, such as the respiratory tract (nose, mouth), intestinal tract (rectum), urinary tract, or blood and other body fluids.

**Mode of Transmission:** The means by which an organism transfers from one carrier to another by either direct transmission (direct contact between infectious host and susceptible host) or indirect transmission (which involves an intermediate carrier such as an environmental surface or piece of medical equipment).

**Portal of Entry:** The opening where an infectious disease enters the host’s body such as mucous membranes, open wounds, or tubes such as urinary catheters or feeding tubes inserted in body cavities.

**Susceptible Host:** A person who is at risk for developing an infection from the disease. Several factors make a person more susceptible to disease including age (young people and elderly people generally are more at risk), underlying chronic diseases such as diabetes or asthma, conditions that weaken the immune system such as HIV, certain types of medications, invasive devices such as feeding tubes, and malnutrition.
The Centers for Disease Control and Prevention (CDC)

According to the CDC 2003 Guidelines for Infection Control in Dentistry:

Dental Health Care Professionals (DHCP) should be trained regarding water quality, biofilm formation, water treatment methods, and appropriate maintenance protocols for water delivery systems. Water treatment and monitoring products require strict adherence to maintenance protocols, and noncompliance with treatment regimens has been associated with persistence of microbial contamination in treated systems. Clinical monitoring of water quality can ensure that procedures are correctly performed and that devices are being used in accordance with the manufacturer’s previously validated protocol.

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. Monitoring of dental water quality can be performed by using commercial self-contained test kits or commercial water-testing laboratories. Because methods used to treat dental water systems target the entire biofilm, no rationale exists for routine testing for such specific organisms as Legionella or Pseudomonas, except when investigating a suspected waterborne disease outbreak.

Evaluation of Water Lines

According to the American Dental Association Council on Scientific Affairs’ 1999 report to the profession on dental unit water lines, evaluating water quality before implementing a treatment protocol is controversial, because the scientific literature suggests that all units are highly contaminated, pretesting to confirm contamination is of questionable value. However, testing water quality after initiation of a treatment regimen ascertains whether a water line product or protocol achieves the desired outcome. Monitoring water quality according to an established routine can help identify problems in performance or compliance and provide documentation of water quality.

Source of Water for Dental Units

Municipal Water Supply

This source may provide limited access to the water line, but in such instances, there are options for controlling water quality:

1. Install a point-of-use filter between the dental instrument and the water line tubing.
2. Retrofit the dental unit so that the water is supplied by a self-contained water system for easy delivery of chemical treatments (contact the dental unit manufacturer about installing a self-contained water system).
3. Install a system that allows delivery of cleaning agents.

Self-Contained Reservoirs

Commercial devices and procedures designed to improve the quality of water used in dental treatment have been developed because, regardless of the source water used, untreated or unfiltered dental unit water lines are unlikely to meet drinking water standards. Additionally, many manufacturers recommend performing a start-up procedure or periodic “shock” treatment of the dental unit water lines to remove or reduce existing biofilm to improve their product’s performance. Common approaches to improve water quality include:

1. self-contained water systems combined with chemical treatment (e.g., periodic or continuous chemical treatment protocols);
2. systems designed for single chair or entire practice water lines that purify or treat incoming water to remove or inactivate microorganisms; and
3. combinations of these treatments.

Self-contained water systems or those with an independent water reservoir (e.g., bottle), when used with a chemical treatment protocol, have demonstrated safety and efficacy. This type of system isolates the unit from the municipal water supply and allows better control of the quality of source water (e.g., distilled) introduced into the system. These systems are available as original equipment on dental units or can be retrofitted to most dental units. However, use of an independent reservoir without use of a chemical treatment will have no effect on water line quality. Therefore, the primary advantage of self-contained water systems is that cleaning agents can be easily introduced into the system (either periodically or continuously). Generally distilled water is used in the water bottle system and agents (either tablets or a slow releasing straw) are added to help reduce microbes and keep orders away. And because distilled water is used, this type of system helps avoid interruptions in dental care when local health authorities issue a boil-water advisory. To avoid cross-contamination, careful handling and cleaning of the water bottle and pick-up tubing is necessary.

Centralized systems designed for single chair or entire practice water lines are becoming more popular. These systems can purify or treat incoming water to remove or inactivate microorganisms by using various methods such as nano-filtration, reverse osmosis, or ultraviolet light irradiation. It is common for these systems to use a combination of these methods as well as introduce a chemical agent to help control water quality.

Water Line Monitoring

The best method to verify the effectiveness of the dental unit water line cleaning regimen is to test the exiting water. Dental unit water testing products and services are used to monitor dental unit water quality. Testing commonly uses three samples of water taken from the same dental unit. Dental equipment (e.g., handpieces) should be removed before the samples are taken. It is important not to contaminate the water during sampling; therefore, gloves must be worn, and manufacturer’s directions followed.

Recommendations on Flushing

While flushing of dental unit water lines has been recognized as an important strategy for controlling microbial levels in dental water systems, recommendations regarding the efficacy of flushing have
changed in recent years. In 1993, the CDC recommended that dental water lines be flushed to reduce the microbial load in dental unit water. The most recently published CDC guidelines, however, suggest that other strategies beyond flushing are needed to improve water quality.

Mechanical flushing alone does little to control contamination in water lines. Although it can temporarily reduce the number of microbes in the water delivered to patients by clearing away many of the free-floating organisms in the water line, biofilm bacteria continually break free and contaminate dental unit water during the course of clinical treatment. Flushing for several minutes between patients, however, may be valuable in removing contaminants that can enter the water system during patient treatment.

The flushing of dental water lines has been shown to decrease the levels of planktonic bacteria in the water, but this practice has not been shown to affect the biofilm that accumulates in the water lines. To date, the effectiveness of flushing has been measured by comparing HPC levels present in initial and post-flushing samples.

General CDC Recommendations
1. Use water that meets EPA regulatory standards for drinking water (<500 CFU/mL of heterotrophic water bacteria) for routine dental treatment output water.
2. Consult with the dental unit manufacturer for appropriate methods and equipment to maintain the recommended quality of dental water.
3. Follow recommendations for monitoring water quality provided by the manufacturer of the unit or water line treatment product.
4. Discharge water and air for a minimum of 20 to 30 seconds after each patient from any device connected to the dental water system that enters the patient’s mouth (e.g., handpieces, ultrasonic scalers, and air/water syringes).
5. Consult with the dental unit manufacturer on the need for periodic maintenance of antiretraction mechanisms.

Special Considerations for Oral Surgical Procedures
Use sterile saline or sterile water as a coolant/irrigant when preforming oral surgical procedures. Use devices specifically designed for delivering sterile irrigating fluids (e.g., bulb syringe, single-use disposable products, and sterilized tubing).

According to OSAP, there are many steps oral health practitioners can take to improve the quality of dental unit water. However, practitioners should always consult with the manufacturers of their dental units before initiating any water line treatment protocol.

1. Follow current OSAP, ADA, and CDC recommendations to flush lines for several minutes each morning. Flush handpieces with air/water for 20 to 30 seconds between patient appointments. Installing sterilized handpieces and sterile or disposable syringe tips after flushing will reduce cross-contamination.

2. Always obtain and follow the dental unit manufacturer’s recommendations for treating dental unit water lines. Implementing protocols not recommended by the unit manufacturer could cause equipment damage and void warranties.
3. If recommended by the dental unit manufacturer, install and maintain antiretraction valves to prevent oral fluids from being drawn into dental water lines.
4. Avoid heating dental unit water. While it is common to heat water to increase patient comfort, doing so may amplify biofilm formation.
5. Consider using a separate water reservoir system to eliminate the inflow of municipal water into the dental unit. In addition to having better control over the quality of the source water used in patient care, it eliminates interruptions in dental care when boil-water notices are issued by local health authorities. Contact the manufacturer of the dental unit for a compatible system and treatment protocols before undertaking this step.
6. Use sterile solutions for all surgical irrigation. Additionally, ensure that only heat-sterilized/sterile disposable bulb syringes or sterile water delivery devices are employed to deliver the sterile water.
7. Educate and train oral health-care workers on effective treatment measures to ensure compliance and minimize risks to equipment and personnel.
8. Monitor scientific and technological developments in this area to identify improved technical approaches as they become available.
9. Cooperate with the oral health-care industry to develop and validate standard protocols for maintaining and monitoring dental unit water lines.
10. Because insufficient data currently exist to establish the effectiveness of all available methods used in the dental office, it is important to ensure that any sterile water system or device marketed to improve dental water quality has been cleared by the U.S. Food and Drug Administration (FDA).
11. Ensure dental office team compliance with whatever treatment approach is chosen by the practice. Their input as to the choice and maintenance is crucial for any success to be achieved.

Summary
Although research has shown dental water line contamination to have little if any effect on most patients’ health, patients with compromised immune systems are at a greater risk. It is up to each dental health-care worker to become educated and use proper infection-control techniques. Allowing stagnant water to remain in the lines without being flushed produces the greatest risk. Flushing of dental water lines in the morning and between each patient, plus the use of chemical additives, helps ensure the quality of the water used in the dental office.
Identify products that fit your needs and are compatible with your dental unit (contact the dental unit manufacturer). Some cleaning agents, such as bleach, can corrode parts of the dental unit. Develop a schedule for water line maintenance (based on manufacturer’s recommended treatment methods) and establish a protocol for monitoring the quality of dental unit water.

References

Questions
1. What does CFU stand for?
   - a. Colony forensic units
   - b. Colony forming units
   - c. Colonization from units
   - d. Colonization factor units

2. The ADA called for action required that water delivered to patients during nonsurgical dental procedures consistently contained no more than how many colony-forming units per milliliter (cfu/ml) of aerobic mesophilic heterotrophic bacteria?
   - a. 6
   - b. 60
   - c. 600
   - d. 6000

3. Biofilm is:
   - a. A slime layer
   - b. A strip used to test the level of contamination of the water
   - c. Used to clean dental water lines
   - d. Kept at the CDC to ensure proper compliance

4. Which type of microbe is NOT commonly found in dental water lines?
   - a. Streptococcus mutans
   - b. Legionella pneumophila
   - c. Aspergillus niger
   - d. Gernepsis mutans

5. Most opportunistic pathogens are from:
   - a. Contained water units
   - b. Purified water
   - c. Public water supply
   - d. Well water

6. The only way to know that a dental unit water line cleaning regimen is effective is to:
   - a. Test the water coming out of the unit
   - b. Purchase water from a reliable source
   - c. Use water purifying tablets
   - d. Use city tap water

7. Bacterial biofilm is virtually universal in untreated dental unit water lines. Over the years, researchers have investigated dental water line contamination citing that plastic tubing is ideal for bacteria growth.
   - a. Both statements are true
   - b. Both statements are false
   - c. The first statement is true; the second statement is false
   - d. The first statement is false; the second statement is true

8. Heterotrophic bacteria require what to grow?
   - a. Moisture
   - b. Heat
   - c. Carbon source
   - d. None of the above

9. Dental water lines are conducive to ___ growth.
   - a. Legionella
   - b. Gernepsis
   - c. Crosstex Mutens
   - d. None of the above

10. OSAP stands for:
    - a. Organization for Safety and Asepsis Procedures
    - b. Organization for Safety and Asepsis Prevention
    - c. Organization for Safety and Associated Procedures
    - d. None of the above

11. Self-contained water systems or those with an independent water reservoir (e.g., bottle), when used with a chemical treatment protocol, have demonstrated safety and efficacy. Centralized systems can purify or treat incoming water to remove or inactivate microorganisms by using various methods such as nano-filtration, reverse osmosis, or ultraviolet light irradiation.
    - a. Both statements are true
    - b. Both statements are false
    - c. The first statement is true; the second statement is false
    - d. The first statement is false; the second statement is true

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Questions

12. In 1993, the U.S. Centers for Disease Control and Prevention (CDC) recommended that dental water lines be:
   a. Flushed to prevent contamination
   b. Rinsed with a cleansing agent
   c. Flushed to reduce the microbial load in dental unit water
   d. Bought from a reliable source

13. Mechanical flushing alone does little to control contamination in water lines. Flushing of dental water lines has been shown to decrease the levels of planktonic bacteria in the water.
   a. Both statements are true
   b. Both statements are false
   c. The first statement is true; the second statement is false
   d. The first statement is false; the second statement is true

14. Which of the following is recommended for use or as a coolant/irrigant when performing oral surgical procedures?
   a. sterile saline
   b. sterile water
   c. a and b
   d. one of the above

15. Consider using a water reservoir tablet system to eliminate the inflow of municipal water into the dental unit. Always heat dental unit water.
   a. Both statements are true
   b. Both statements are false
   c. The first statement is true; the second statement is false
   d. The first statement is false; the second statement is true

16. The CDC now recommends that “coolant water used in nonsurgical dental procedures meet EPA regulatory standards for drinking water,” which is less than or equal to ____ of heterotrophic bacteria per milliliter of water.
   a. 5,000 colony forming units
   b. 500 colony forming units
   c. 2,500 colony forming units
   d. 700 colony forming units

17. By far, ____ in the dental office should take center stage.
   a. Water unit testing
   b. Infection control
   c. CDC guidelines
   d. None of the above

18. What is found on all surfaces where moisture is present
   a. slime mold
   b. biofilm
   c. treponema
d. a and c

19. Standards for safe drinking water quality are established by:
   a. Environmental Protection Agency (EPA)
   b. American Public Health Association (APHA)
   c. American Water Works Association (AWWA)
   d. All of the above

20. The chain of infection is a way of gathering the information needed to interrupt or prevent
   a. epidemic
   b. xenograph
   c. pandemia
d. a and c

21. Which of these does not belong in the chain of infection?
   a. Portal of exit
   b. Transfer host
   c. Reservoir
   d. Organism

22. The flushing of dental water lines has been shown to decrease the levels of:
   a. cryptosporidia
   b. krill
   c. planktonic bacteria
d. none of the above

23. Because insufficient data currently exist to establish the effectiveness of all available methods as used in the dental office, it is important to ensure that any sterile water system or device marketed to improve dental water quality has been cleared for market by the:
   a. FDA
   b. EPA
   c. Both the FDA and the EPA
   d. None of the above

24. Follow current OSAP, ADA, and CDC recommendations to flush lines for several minutes each morning. Flush handpieces with air/water for 20 to 30 seconds between patient appointments. Installing sterilized handpieces and sterile or disposable syringe tips after flushing will reduce cross-contamination. Always heat dental unit water for patient comfort.
   a. Both statements are true
   b. Both statements are false
   c. The first statement is true; the second statement is false
   d. The first statement is false; the second statement is true

25. In February 2012, the first confirmed case of Legionnaires’ disease associated with dental water lines was reported. What strain was found in both the dental unit water lines and in the patient?
   a. Streptoccocus Mutans
   b. Streptoccocus Miltis
   c. Nematode
   d. Legionella Pneumophila

26. Dental water lines are not conducive to Legionella growth. Biofilm grows well on most types of plastic tubing.
   a. Both statements are true
   b. Both statements are false
   c. The first statement is true; the second statement is false
   d. The first statement is false; the second statement is true

27. According to OSAP, which of these organisms has not been identified in dental unit water lines?
   a. Pseudomonas species
   b. Nontuberculous mycobacteria
   c. Legionella
   d. Flora contaminini

28. One study suggests that ____ produced by contaminated water from high-speed handpieces was/were associated with altered nasal flora in 14 of the 30 dentists studied.
   a. Splash
   b. Spatter
   c. Aerosol
   d. Droplets

29. Blood-borne pathogens may be transmissible through dental unit treatment water. Although researchers have found evidence of oral flora in dental water systems, there is little evidence to suggest that these organisms form a significant part of the water line biofilm community.
   a. Both statements are true
   b. Both statements are false
   c. The first statement is true; the second statement is false
   d. The first statement is false; the second statement is true

30. Mode of transportation refers to:
   a. Means by which an organism transfers from one carrier to the other
   b. Direct contact by the infectious host and susceptible host
   c. None of the above
   d. Both a and b
Water line contamination in the dental office

Educational Objectives

1. Identify safe drinking water levels.
2. Discuss CDC and ADA recommendations.
3. Establish ways in which to test water lines.
4. Learn how to reduce the number of heterotrophic bacteria.

Course Evaluation

1. Were the individual course objectives met?
   Objective #1: Yes  No  Objective #2: Yes  No

2. To what extent were the course objectives accomplished overall?  5 4 3 2 1 0
3. Please rate your personal mastery of the course objectives.  5 4 3 2 1 0
4. How would you rate the objectives and educational methods?  5 4 3 2 1 0
5. How do you rate the author's grasp of the topic?  5 4 3 2 1 0
6. Please rate the instructor's effectiveness.  5 4 3 2 1 0
7. Was the overall administration of the course effective?  5 4 3 2 1 0
8. Please rate the usefulness and clinical applicability of the course.  5 4 3 2 1 0
9. Please rate the usefulness of the supplemental webmaterial.  5 4 3 2 1 0
10. Do you feel that the references were adequate?  Yes  No
11. Would you participate in a similar program on a different topic?  Yes  No
12. To what extent were the course objectives accomplished overall?  5 4 3 2 1 0
13. What additional continuing dental education topics would you like to see?  ____________________________
14. How long did it take you to complete this course?  ____________________________
15. Was there any subject matter you found confusing? Please describe.  ____________________________
16. What additional continuing dental education topics would you like to see?  ____________________________
17. Would you participate in a similar program on a different topic?  Yes  No
18. Do you feel that the references were adequate?  Yes  No
19. How long did it take you to complete this course?  ____________________________
20. Please rate the usefulness and clinical applicability of the course.  5 4 3 2 1 0
21. Please rate the usefulness of the supplemental webmaterial.  5 4 3 2 1 0
22. Did you feel that the references were adequate?  Yes  No
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26. Would you participate in a similar program on a different topic?  Yes  No
27. Do you feel that the references were adequate?  Yes  No
28. How long did it take you to complete this course?  ____________________________
29. What additional continuing dental education topics would you like to see?  ____________________________
30. Would you participate in a similar program on a different topic?  Yes  No

For immediate results, go to www.DentalAcademyOfCE.com to take tests online.

INSTANT EXAM CODE 15147

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