2021 Course #2

Self-Study Course

Course Instructions:

- Read and review the course materials.
- Complete the **15 question test**. A total of **12 questions** must be answered correctly for credit.
- Submit your answers online at:

  http://dentistry.osu.edu/sms-continuing-education
- Check your email for your CE certification of completion (please check your junk/spam folder as well).

About SMS CE courses:

- **TWO CREDIT HOURS** are issued for successful completion of this self-study course for the OSDB 2019-2021 biennium totals.
- **CERTIFICATE of COMPLETION** is used to document your CE credit and is emailed to each course participant.
- **ALLOW 2 WEEKS** for processing of your certificate.

Frequently Asked Questions:

Q: Who can earn FREE CE credits?

A: EVERYONE - All dental professionals in your office may earn free CE credits. Each person must read the course materials and submit an online answer form independently.

Q: Where can I find my SMS number?

A: Your SMS number can be found in the upper right hand corner of your monthly reports, or, imprinted on the back of your test envelopes. The SMS number is the account number for your office only, and is the same for everyone in the office.

Q: How often are these courses available?

A: Four times per year (8 CE credits).

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This continuing education activity has been planned and implemented in accordance with the standards of the ADA Continuing Education Recognition Program (ADA CERP) through joint efforts between The Ohio State University College of Dentistry Office of Continuing Dental Education and the Sterilization Monitoring Service (SMS).

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Release Date:
April 26, 2021
8:30am EST

Last Day to Take Course Free of Charge:
May 28,2021
4:30pm EST

THE OHIO STATE UNIVERSITY
COLLEGE OF DENTISTRY

Dental Unit Waterlines

This is an OSDB Category B: Supervised self-instruction course

About the Author

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Neither I nor my immediate family have any financial interests that would create a conflict of interest or restrict my judgement with regard to the content of this course.

Objectives:

- Define dental unit waterline (DUWL).
- Recall the common types of microbial contamination in water and how they affect dental unit waterlines.
- Define biofilm and describe how to prevent biofilms from forming.
- List the methods available to test water for microbial quality and quantity.
- Discover and learn remediation techniques after a waterline contamination.

Introduction

What is a DUWL?

Modern dental chair units consist of a network of interconnected narrow-bore plastic tubes called dental unit waterlines (DUWLs). These tubes carry water to all parts of dental equipment such as the high-speed handpiece, the air/water syringe, and ultrasonic scalers (CDC, 2021).

Why is DUWL testing important?

To put it simply, contaminated DUWLs present health risks to patients and staff.

Dental unit waterlines provide an appropriate growth environment for microorganisms entering dental units from the municipal or self-contained water systems. The quality of dental unit water-lines (DUWL) is important because both patients and dental staff are regularly exposed to water and aerosols generated from dental units. Opportunistic pathogens like *Pseudomonas, Legionella, Candida*, and *Aspergillus* have all been detected in DUWLs. Bioaerosols from these pathogens can be dispersed in the air, resulting in effects on the quality of indoor air (Kadaifeiler & Cotuck, 2014).

Microbiology Overview

Microbiology is the study of all living organisms (microorganisms) that are too small to be visible to the naked eye. This includes bacteria, fungi, archaea, viruses, prions, protozoa, and algae. Many microorganisms are harmless, but some can cause illness or disease. Low levels of microorganisms are typically present throughout our environment and rarely cause disease or illness in healthy individuals. After chemical disinfection of public water sources began in the United States in the early 1900's illness from contaminated water sharply decreased.

Common opportunistic pathogens found in DUWL

Pseudomonas

Pseudomonas is an opportunistic pathogen that can be found in soil, water, and on plants. It needs minimal nutrients to survive. Pseudomonas is VERY good at forming biofilms. Its growth in drinking water can affect color, taste, odor, turbidity, and of course cause disease.

Legionella

Legionella has been shown to be a cause of drinking water contamination. When individuals become infected with strains of *Legionella*, it is often referred to as Legionnaires' disease. Breathing in a vapor or mist that contains the bacteria transmits the disease.
Legionnaires' disease is not passed from one person to another. Most people who are exposed to the bacteria do not become ill or show symptoms, however when symptoms are exhibited, they present like pneumonia. Treatment with antibiotics is typically successful but hospitalization is necessary in some cases.

Candida

Candida is a yeast (fungus) that can be found in drinking water. *Candida* is another opportunistic pathogen that can cause disease in immunocompromised patients when they are exposed to water contaminated with *Candida*. Little is known about the effect of bleach on *Candida* (Novak et al, 2017). *Mycobacterium, Staphylococcus, Bulkholderia , Acinetobacter,* and *Aeromonas* genus comprise the rest of the most common species found in DUWLs.

Colony-Forming Units (CFUs)

In the microbiology laboratory, counting and identifying bacteria or fungi is a several step process. The basic unit of measure for a bacterial or fungal species is a colony-forming unit (CFU). Colony-forming units give a good estimate of how many single cell-forming units of bacteria there are in a sample. Colony-forming units are a way for scientists to quantify the amount of bacteria without having to count every single cell. The typical size of a bacterial cell is about 2 microns, well below the threshold of the human eye. A single viable cell is capable of reproducing multiple times to the point where it can physically be visible to the naked eye in the form of a colony.

What is a biofilm?

Dental office personnel should be familiar with biofilms. One of the best examples of a biofilm is dental plaque that forms on the surfaces of teeth. Biofilms are a collective of one or more types of microorganisms that can grow on many different surfaces. Biofilms can consist of bacteria, fungi, and protists. Biofilms thrive upon continually moist or wet surfaces. Besides teeth, dental unit waterlines are a perfect environment for biofilm formation.

Biofilms form when free floating microorganism (let's stick with bacteria for this example) come in contact with an appropriate surface to put down "roots." The bacteria will begin producing an extracellular polymeric substance (EPS) that is made up of sugars, proteins, and nucleic acids. EPS is what allows the bacteria in a biofilm to "stick" together.

Environmental conditions help to determine to what extent a biofilm grows. Biofilms can be only a few layers of cells thick, or they can be very thick. For example, microorganisms that depend on large amounts of oxygen can be slow to grow if they don't have access. Environmental "shear stress" can also affect biofilm growth. For example, if there is a high flow of water across a biofilm, it will be thin, if the water is slow flowing like in a pond, the biofilm will be thicker. Portions of biofilms can "break away" and find a new home elsewhere in a technique known as "seeding dispersal."

Within a biofilm, bacteria are more resistant to antibiotics and major disinfectants. This makes them more dangerous to us as humans, especially to people who are immunocompromised.

Dental Unit Water Quality

Most microorganisms that are found in dental unit waterlines originate from the public water supply and do not usually present a substantial risk of infection for healthy dental patients (Dewhirst & Molinari, 2018). Assessing the water quality of your DUWL begins with determining the source of water for your dental unit. Dental units typically have two possible sources: municipal water and self-contained water systems.

Municipal water supplies typically provide little access to the waterline. There are means to control this type of system though. A point-of-use filter can be installed between the dental instruments and the waterline tubing. The dental unit can be retrofitted so that the water is supplied via a self-contained water system for easy delivery of chemical treatments. Alternatively, a system that allows delivery of cleaning agents at the junction box can be installed.

Municipal source water is held accountable to the same standards as drinking water, so it is a common question to ask, “Shouldn’t municipal water meet standards at all times?” The answer is not necessarily. While the water from municipal sources is treated to prevent microbial growth, it typically contains some concentration of mineral deposits. These mineral deposits can settle and attach to the tubing of a waterline and act as a perfect anchoring point for microbes and subsequent biofilm formation.

Self-contained water system

This source is a reservoir or bottle that attaches to the DUWL, which isolates it from the municipal water source. Tap water, distilled water, or sterile water must be manually added to the system. This system is convenient for adding cleaning agents easily and regularly.

Standards

Dental unit waterlines should meet the same quality standards as drinking water. The standard for drinking water is less than or equal to 500 CFU/mL. Furthermore, in 1995, the American Dental Association (ADA) asked dental equipment manufactures to provide equipment capable of delivering water quality at less than or equal to 200 CFU/mL.

CDC	ADA
≤500 CFU	≤200 CFU

Meeting Specifications for the Standards-Testing

Even treated waterlines fail up to one third of the time (Birschbach, 2019). There are several testing methods and types of testing kits available to assist you with determining your water quality levels.

In office

In office or “in house” testing has its advantages and disadvantages.

Advantages:

•Reduces the reliance on a 3rd party contractor (laboratory).
•Typically saves time on test results and data gathering.
•Great for offering a “baseline” status for the quality of the DUWL.
•Provides fast results for fast action.

Disadvantages:

•Must have an appropriate number of trained personnel who can perform the testing method.
•Must develop your own system to track, trend, and store test results and data.
•Less reliable than laboratory testing
•Only able to specify “Pass/Fail.”

Laboratory or 3rd Party Testing

Laboratory waterline testing also has its advantages and disadvantages (Birschbach, 2019).

Advantages:

•A “hands off” process that only requires paying for the service and obtaining a water sample.
•Does not require specialized or trained personnel.
•Provides independent reports than can assist an office.

Disadvantages:

•Cost or financial burden of testing.
•Trusted laboratory is required for reliable and accurate testing.

Laboratory testing comprises 3 main methods for heterotopic plate counts (formerly standard plate counts). Heterotopic bacteria are bacteria that use an enzyme that binds only to one substrate. R2A, Membrane Filtration, and SimPlate. R2A is the “gold standard” in testing. R2A and membrane filtration are superior to SimPlate testing because they both incubate the water samples at the same temperature that DUWLs would most likely be, and therefore, the conditions are present for likely microbial contaminants to grow (OSAP, 2000). With the R2A method, DUWL samples are plated on to gel bacterial counting plates and incubated for 7 days and the number of colonies are counted and calculated into corresponding CFUs.

How to collect samples for testing

Water samples should be collected at the “point of use” or the point where the waterline reaches the patient. Water samples should not be collected at a hand washing sink or a drinking fountain that does not involve the dental procedure. Dental equipment should be removed prior to collecting the sample. Good infection control practices should be followed during the time of collection, such as proper protective equipment (gloves, sterile technique). Instructions from the laboratory should be reviewed ahead of collection and specifications followed. For example, SMS (Sterilization Monitoring Service) requires a 2-minute flush of each line to be tested prior to collection.

Frequency

Currently, there are no **mandated** standards or regulations that require water quality testing on a determined frequency. It is currently at the discretion of each clinic or practice to determine their testing frequency and method.

OSAP recommends the following to ensure patient safety:
1. Test within one month of implementing a treatment protocol.
2. Test your waterlines every month to start.
3. Once you have all passing lines two months in a row; test quarterly.

Shock vs. Treatment

Shocking a waterline is using a disinfectant or chemical to clean the waterlines.
Treating a waterline is using a low level anti-microbial to maintain clean lines, for example a cleaning tablet.

Preventing contamination

The CDC recommends the following to help prevent buildup of free-floating microbial contaminants:
1.Run the waterline for several minutes at the beginning of each clinical day.
2.Run the waterline for a minimum of 20-30 seconds after each patient.
Flushing and purging procedures are important because of the potential for negative pressure created in the waterline after each use of the instrument. There is a chance that bodily fluids from a patient can be retracted out of the mouth and into the instrument. While flushing waterlines helps to clear out any free-floating microbial contamination in the waterlines, there is currently no evidence that it aids in the removal of biofilms.

Chemicals that Aid in the Removal of Biofilm

Research studies have shown that there are numerous chemicals that aid in the removal of biofilm layers. It is important to remember that removal of the surface layer of a biofilm does not mean that it is destroyed.
The following chemicals have been shown to aid in the removal of biofilm layers:
1.Chloramine
2.Sodium hypochlorite (bleach)
3.Sodium dodecyl sulfate (SDS)
4.Hydrogen peroxide
5.Chlorine dioxide
If using chemical means to clean and flush your waterlines, be sure to consult with the manufacturer's instructions for your specific unit. It is also a good idea to determine a frequency on which you will perform the cleaning and flushing and how you will document it.

What if a dental unit waterline test fails?

The top six reasons why dental unit waterlines fail are:
1.Not shocking ever or enough; using the wrong product for shocking and/or daily care
2.Not following product instructions for use
3.Poor source water
4.Relying on central systems (in office distillers, distilled water)
5.No reservoir on dental unit for shocking
6.Not following dental unit waterline testing shipping instructions; cross contamination of sample vials (Kelsh, 2019).

It is important to know your dental unit and how it operates including where the filters are located and how frequently to change them. It is also important to know the source of your water and if it has any known contaminants. This will offer clues into what the baseline testing will result in. If using a self-contained system, it is important to disinfect and dry the bottle when not in use to prevent biofilm formation. Take care to change the bottle properly. Keeping it sterile is important. When storing water, it is important to do so in the proper manner, as this can be an additional source of contamination (Kelsh, 2019).

Conclusion

Contacting the manufacturer for the dental unit waterline to request recommendations for treatment and maintenance is imperative for all units. DUWL management requires selecting products that are intended for dental water—line treatments rather than household products or disinfectants. Clean source water must be used. Routine maintenance and cleaning are integral to keeping biofilm formation at bay. Providing training to all personnel handling or using the dental unit on how to replenish, treat, test, or otherwise manage the system is one of the best ways to prevent waterline testing failures. Dental unit waterline maintenance is important for keeping patients and dental office staff safe and healthy.

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