CDC Infection Control in Dental Health-Care Settings: Looking Ahead to 2015

A Peer-Reviewed Publication
Written by Marie T. Fluent DDS and Catherine L. Pawloski, RDH, BSDH

Abstract
The Centers for Disease Control and Prevention (CDC) remains the prominent government agency for infection control guidelines within the United States. The existing document, Guidelines for Infection Control in Dental Health-Care Settings, was published in 2003 and is currently recognized by dental personnel in all dental healthcare settings. The CDC is currently updating and undertaking a limited revision to be released in 2015. Until recently, these proposed changes remained unknown to the dental community at large. At the 2013 Organization for Safety and Prevention (OSAP) Symposium, proposed modifications of CDC guidelines were introduced and discussed. These potential revisions are the basis of this course. Newly identified infection control risks, potential interventions, and infection control equipment updates will be addressed. Course participants are encouraged to review the CDC updated guidelines in its entirety upon release in 2015.

Educational Objectives:
At the conclusion of this educational activity participants will be able to:
1. Identify the importance of the CDC Guidelines as they pertain to the practice of dentistry
2. Describe the advantages of utilizing burs and endodontic files as single-use items
3. Distinguish between drug-susceptible versus drug-resistant microorganisms
4. Discuss the efficacy of double gloving as an exposure risk reduction strategy
5. Discuss optimal frequency for biological monitoring for sterilizers as recognized by current CDC guidelines

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Author Disclosures
Marie T. Fluent DDS and Catherine L. Pawloski, RDH, BSDH, have no potential conflicts of interest to disclose.
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Introduction
The current CDC document; Guidelines for Infection Control in Dental Health-Care Settings, was published in 2003 and was developed for dental healthcare personnel in all dental health settings. This document was updated and revised from previous guidelines and consolidated recommendations from other relevant CDC guidelines such as Hand Hygiene in Healthcare Settings, Guidelines for Infection Control in Healthcare Personnel, and Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Healthcare Facilities. While the current CDC infection control guidelines are over 10 years old, they generally remain consistent with other existing CDC Hospital guidelines. These documents were developed by CDC staff in collaboration with experts in the area of infection control. Where possible, these guidelines are based on scientific evidence regarding infection control issues as well as consensus and evidence-based recommendations.1 It is interesting to note that, although the Guidelines for Infection Control in Dental Health-Care Settings were developed specifically for dental healthcare personnel, many of the recommendations are derived from studies based in the medical profession.

The CDC has a new process for developing evidence-based guidelines. This new process will be implemented in the 2015 revisions. This process follows a rigorous methodology that includes conducting systematic reviews, identifying conflicts of interest and tying recommendations closely to the evidence. Groups or individuals whose activities could be affected by implementation of the new guidelines have legitimate reasons for providing input and have been consulted throughout the process and development. These stakeholders include: organized dentistry, academia and research groups, industry, non-governmental organizations and federal agencies.2

The selection of topics to be addressed for the 2015 guidelines were based on expert input, unresolved issues from the 2003 guidelines or issues in need of clarification. The new guidelines will also include emerging issues not included within the 2003 document. Scientific evidence concerning risk of transmission in dental settings will be addressed. Additional topics may be considered if they can be developed into a research question from which a systematic review can be conducted. Potential topics to be addressed fall into three general categories: risk of transmission, intervention, and equipment. Some specific transmission risks to be considered are: surgical smoke, burs and endodontic files, Methicillin-resistant Staphylococcus aureus (MRSA), prions and Creutzfeldt-Jakob disease, and Clostridium difficile. Interventions to be discussed include the issue of double gloving. Equipment considerations to be included are dental unit waterlines and sterilization monitoring. See Table #1.2

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At the 2013 Organization for Safety and Prevention (OSAP) Symposium, proposed modifications of CDC guidelines were introduced and discussed. These potential revisions are the basis of this course. Newly identified infection control risks, potential interventions, and infection control equipment updates will be addressed. Course participants are encouraged to review the CDC updated guidelines in its entirety upon release in 2015.

Glossary of terms:
Alcohol-based hand-rub. An alcohol containing preparation designed for application to the hands for reducing the number of viable microorganisms on the hands. In the United States, such preparations usually contain 60%–95% ethanol or isopropanol
Antimicrobial soap: Soap (i.e., detergent) containing an antiseptic agent
ANSI: American National Standards Institute
AAMI: Association for the Advancement of Medical Instrumentation
DHCP: Dental Healthcare Personnel
EPA: Environmental Protection Agency
FDA: Food and Drug Administration
OSAP: The Organization of Safety, Asepsis and Prevention. A recognized authority of and voice for ensuring safe, infection free access to oral healthcare
NIOSH: National Institute for Occupational Safety and Health. A U.S. federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness
PPE: Personal Protective Equipment
Prion: Protein particle lacking nucleic acid that has been implicated as the cause of certain neurodegenerative diseases (e.g., scrapie, Creutzfeldt-Jakob disease (CJD) and bovine spongiform encephalopathy (BSE)).


### Discussion:

**Surgical Smoke**

The use of lasers and electrosurgical devices in dental procedures creates the possibility of a new mode of transmission for disease to dental healthcare personnel. During laser and electrosurgical procedures, the process of tissue destruction results in the release of a smoky byproduct referred to as a “heated plume”. Heated plumes pose an occupational risk as they have the potential to carry hazardous particles and chemicals such as hydrogen cyanide, benzene and formaldehyde.\(^1\) Plumes may also contain tissue debris and viable infectious agents such as viruses and bacteria that can be released into the immediate surrounding atmosphere. Dental clinicians present in this environment are at potential risk for these plumes to reach the nasal or ocular mucosa.\(^1\) Specific viruses and bacteria such as HPV, HIV and coagulase-negative Staphylococ-

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**Table 1. Topics to be addressed for Guidelines for Infection Control in Dental Health-Care Settings, 2015**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Current Infection Prevention Problem or Concern</th>
<th>Discussed in 2003</th>
<th>Recommended in 2003</th>
<th>What is planned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Smoke</td>
<td>Risk of occupational infection from smoke created during laser or electrosurgical procedures</td>
<td>Some viruses and bacteria detected in laser plumes</td>
<td>No recommendation—unresolved issue</td>
<td>Literature review and update</td>
</tr>
<tr>
<td>Prions and Creutzfeldt-Jakob Disease</td>
<td>Risk of disease transmission due to: -Pulpal tissue -Contaminated instruments</td>
<td>Special Consideration: Resistant to standard sterilization procedures</td>
<td>No recommendation—unresolved issue</td>
<td>Review and update of literature</td>
</tr>
<tr>
<td>Burs and Endodontic Files</td>
<td>Overarching issue:  -Single vs. Repeated use  -Risk of disease transmission</td>
<td>Special Consideration: Difficult to clean</td>
<td>No recommendation</td>
<td>Continue discussions with FDA</td>
</tr>
<tr>
<td>Double Gloving (for oral surgical procedures)</td>
<td>Effectiveness in preventing disease transmission</td>
<td>-Perforation studies suggested additional protection from blood contact -Effectiveness in preventing disease transmission not demonstrated</td>
<td>No recommendation—unresolved issue</td>
<td>Review of literature</td>
</tr>
<tr>
<td>Dental Unit Water Lines</td>
<td>Frequency of monitoring</td>
<td>-Clinical monitoring of water quality can ensure that procedures are correctly performed and that devices are working in accordance with manufacturer’s previously validated protocol -Lack of information to determine optimal frequency for each type of water maintenance system</td>
<td>Consult with manufacturer to determine best method for maintaining acceptable water quality (≤500 CFU/mL) and recommended frequency of monitoring.</td>
<td>Review and update of literature Discussion with FDA and EPA</td>
</tr>
<tr>
<td>Sterilizers</td>
<td>Since 2003:  -Guidelines and standards made additional recommendations (i.e. daily monitoring when processing multiple loads)  -New classes of chemical indicators since 2003</td>
<td>Monitor at least weekly using biological indicators -Monitor each load with mechanical and chemical indicators</td>
<td>Review literature Review 2008 CDC guidelines Review ANSI/AAMI standards Consult with FDA</td>
<td></td>
</tr>
</tbody>
</table>

Reference: 2
cus, Corynebacterium species, and Neisseria species, have been detected in laser plumes. Although studies have found intact HPV DNA in laser vapor from warts treated with a carbon dioxide laser, there have been no reports of laser plume-induced diseases in humans.1

Several studies regarding the presence of infectious papillomavirus in surgical procedures that generate smoke showed that:

- Greater amounts of papillomavirus DNA were recovered in laser vapor than in electrocautery vapor4
- To avoid airborne transmission of plume containing laryngeal papilloma viral infected cells and infectious viral particles, the carbon dioxide laser parameters should be in a continuous mode with the power density equal to, or more than, 1667 W/cm².7
- Potential HPV diseases among healthcare personnel from inhaled HPV virus particles. Some HPV types pose “low risks” and others pose “high risks”8
- Risk for HPV transmission to healthcare personnel during smoke generating procedures seems low but needs further study.8

According to the CDC 2003 Guidelines, no current evidence has indicated that HIV or HBV have been transmitted via aerosolization or inhalation of laser and electrosurgical plumes and no recommendations were given. The CDC stated that this was an unresolved issue and the guidelines stressed the need for continued studies. The National Institute for Occupational Safety and Health (NIOSH) however, established infection control protocol developed by the Association of periOperative Registered Nurses (AORN). These practices include:

- Standard precautions (e.g. high-barrier masks and full face shield)
- Central room suction units with inline filters to collect particulate matter from minimal plumes
- Dedicated mechanical smoke exhaust systems with high-efficiency filter to removed substantial amounts of laser plume particles5
- AORN also recommends that “respiratory protection that is at least as protective as a fit-tested surgical N-95 filtering facepiece respirator should be considered for use in conjunction with LEV (local exhaust ventilation systems) in disease transmissible cases (e.g., human papillomavirus)”9

These recommendations suggest that standard PPE such as surgical masks may not provide adequate protection for laser or electrosurgical procedures. Potentially infectious cellular material may be aerosolized clinically that are beyond the filtration capabilities of typical surgical masks.

Research and infection control recommendations involving laser plumes and electrosurgical smoke has been focused on hospital settings and large, non-dental related surgeries. Studies regarding heated plumes and occupational risks in outpatient dental settings are minimal. Thus, questions remain regarding the necessity for additional infection control precautions for laser and electrosurgical procedures. It is anticipated that the CDC will continue to review literature and make appropriate recommendations with regard to infection control precautions and evacuation methods to suction plumes from surgical smoke in the updated 2015 guidelines.

**Creutzfeldt-Jakob Disease and Other Prion Diseases**

Prion diseases are a family of rare progressive neurodegenerative disorders that affect both humans and animals. They are usually rapidly progressive and always fatal. Prions are proteinaceous infectious particles that are the agents in diseases which involve neural tissues and the brain. Among humans, Creutzfeldt-Jakob disease (CJD) is the most common human prion disease or transmissible spongiform encephalopathies (TSEs), although variant Creutzfeldt-Jakob Disease (vCJD) and other prion diseases exist.

CJD and vCJD are transmissible from exposure to infected central nervous tissue. According to the CDC, no cases of prion diseases linked to the use of contaminated medical equipment have been confirmed in the United States since 1976, before routine implementation of sterilization procedures were used in healthcare settings. In dentistry, potential risk for prion diseases exists in procedures involving the exposure of dental pulp (e.g. nervous tissue). This may pose a risk for infection and cross-contamination of patients infected with prion disease because prions exhibit unusual resistance to conventional chemical and physical decontamination procedures. Prion disease remains controversial in dental healthcare settings because of this resistance and fatality of the disease.

Current studies regarding prion disease demonstrate:

- Lack of evidence of human-to-human transmission of CJD or vCJD in healthcare settings.
- The theoretical risk of transmission of prion disease through dental treatment is unknown, but is thought to be very low, and emphasizes the need to maintain standard infection control and sterilization procedures for all infectious agents.10
- Endodontic files, the instruments that come in direct contact with the pulp, are particularly difficult to clean and are regularly found to be contaminated with residual tissue after reprocessing.11
- Prions are resistant to infection control protocol in dentistry and treating endodontic files as single-use devices could eliminate this potential risk.12

As the CDC published the 2003 guidelines, there was minimal evidence to provide infection control recommendations for prion disease. Thus, special considerations for prion disease infection control were provided:

- Use single-use disposable items and equipment whenever possible.
- Consider items difficult to clean (e.g., endodontic files, broaches, carbide and diamond burs) as single-use disposables and discard after one use.
- To minimize drying of tissues and body fluids on a device, keep the instrument moist until cleaned and decontaminated.
- Clean instruments thoroughly and steam-autoclave at 134°C for 18 minutes. This is the least stringent of sterilization methods offered by the World Health Organization.13
• Do not use flash sterilization (do not sterilize instruments unwrapped) for processing instruments or devices that may be contaminated with prion diseases

### Single-Use Burs/Endodontic Files

Single-use disposable devices are items that are to be used once and are not to be reprocessed (e.g., cleaned, disinfected, or sterilized) after use on a single patient. These items are typically difficult to clean and sterilize and most often are not heat-tolerant. Examples include syringe needles, prophylaxis angles and cups, plastic orthodontic brackets, saliva ejectors, high-volume evacuator tips and air/water syringe tips. These products have been manufactured in a disposable form and must be discarded after each use. The reuse of these devices can affect their safety, performance and effectiveness, exposing patients and staff to unnecessary risk.14 The universal symbol for single use items is:

![universal symbol for single use items](image)

This symbol may be found on packaging on single-use medical or dental items.

Burs and endodontic files are considered single-use items primarily due to the risk of prion diseases, which make these instruments resistant to current infection control procedures. Burs and files can become contaminated with blood, saliva, pulpal and necrotic tissue and pathogens during routine clinical use. Thus, sterilization of these instruments is mandatory. Due to the intricate detail and structure of cutting components of burs and files, the need for pre-cleaning prior to sterilization may be prudent, yet may also prove difficult. Repeated processing cycles can deteriorate the cutting surfaces of files and carbide and diamond burs, leading to ineffective instrumentation of tooth structure and may lead to instrument weakness, breakage and separation incidents during dental procedures. Thus, many burs and files are currently being manufactured and sold as single-use items.

Recent studies regarding sterilization of dental burs and endodontic files show:

- Sterilization methods are less than 100% effective on previously used burs and files.
- Three different sterilization methods were evaluated (steam pressure/autoclave, dry heat, chemical vapor). Bacterial contamination was found and testing following re-sterilization.12
- Single-use burs and endodontic files reduce the risk of transmission between patients.12
- It is more cost effective to re-use burs and files however, there is risk of cross-contamination with sterilization not being 100% effective, despite pre-cleaning.15
- Surface deposits and micro-cracks were found on endo files after cleaning and sterilization.14

These instruments were ultrasonically cleaned and steam autoclaved. They were examined via scanning electron microscopy.

- The most common failure of endodontic files is due to fatigue.14

In consideration of these research findings and cost concerns for burs and endodontic files, the concept of using these items as single-use disposable devices is controversial. The Guidelines for Infection Control in Dental Health-Care Settings—2003, give no recommendations regarding the use of endodontic files and burs as single-use devices. Continued discussions with the FDA and literature reviews are planned in anticipation of the 2015 revised Guidelines.

### Double Gloving

Hands are the livelihood for all healthcare professionals. The importance of protecting hands from cuts, abrasions and percutaneous injuries cannot be overstressed. With regard to double gloving, the CDC Guidelines for Infection Control in Dental Health-Care Settings—2003 states, “Although the effectiveness of wearing two pairs of gloves in preventing disease transmission has not been demonstrated, the majority of studies among HCP and DHCP have demonstrated a lower frequency of inner glove perforation and visible blood on the surgeon’s hands when double gloves are worn.” It is also strongly recommending that sterile surgeon’s gloves be worn when performing oral surgical procedures since these gloves are more rigorously regulated by the FDA for sterility assurance and are less likely than patient examination gloves to harbor pathogens. Also, they may provide an increased level of protection for dental personnel if exposure to blood is likely. (16) The 2003 CDC Guidelines made no recommendations regarding the effectiveness of wearing two pairs of gloves to prevent disease transmission during oral surgical procedures.

In surgical operating rooms, many professional organizations now recommend the use of double gloves to create a safer working environment. These include: The Centers for Disease Control and Prevention (CDC),17 The Association of periOperative Registered Nurses (AORN),18 The American Academy of Orthopedic Surgeons (AAOS),19 and the American College of Surgeons (ACS).20

With regard to double gloving, recent studies have shown:

- **Perforation rates are high.** One study showed perforation rates as high as 61 percent for thoracic surgeons and 40 percent for scrub personnel. Double gloving decreases the risk of exposure to patient blood by as much as 87 percent when the outer glove is punctured.21
- **Cuts or needlesticks are common.** They may occur in as many as 15 percent of operations.22, 23
- **Suture needles are the most frequent source of injury.** They are involved in as many as 77 percent of total injuries. Most injuries are self-inflicted, but a notable number, perhaps as much as 24 percent, are inflicted by a co-worker.24
- **Double gloving reduces the risk of exposure to patient blood.** One study showed exposure to blood is reduced by as much...
as 87 percent when the outer glove is punctured. Volume of blood on a solid suture needle is reduced by as much as 95 percent when passing through two glove layers, thereby reducing viral load in the event of a contaminated percutaneous injury.25

• Double-colored gloves make the intraoperative detection of perforations easier.

One study noted that perforations in single-gloves are often not detected during operations. This factor may increase the risk of transmission of bloodborne infections, particularly because the time of exposure may be long. Double-colored gloves make the intraoperative detection of perforations easier. Additionally, double gloving is known to significantly reduce the perforation risk. Therefore, the use of double colored gloves is recommended in all categories of surgery.26

• Minimal decreases in tactile sensitivity are noted by wearing double gloves.

One study reported an 88 percent acceptance rate in the group that wore double gloves. Of those, 88 percent did not perceive any decrease in tactile sensitivity.25

• There are protective benefits to double gloving for all surgical procedures

Double gloving effectively prevented cutaneous blood exposure and this should become a routine for the thoracic surgeon to prevent transmission of infectious diseases from the patient to the surgeon.27

Perioperative personnel’s risk decreased by 70 percent when double gloving in comparison to wearing a single pair of gloves.28

When considering whether or not to wear double gloves, standard precautions must be followed. Standard precautions apply to all patient care, regardless of the suspected or confirmed infection status of the patient. For example, the selection of double gloves with regard to the medical history of certain patients does not comply with standard precautions. However, a clinician may choose to wear double gloves for each surgical procedure performed due to increased risk during these procedures. Thus, the practice of double gloving should be considered “procedure specific” not “patient specific”.

A review of the literature regarding double gloving for oral surgical procedures is planned for the 2015 CDC Guidelines. While the issue of double gloving was considered unresolved in 2003, evidence seems to suggest that double gloving provides a safer working environment for both the surgical team and patient.

**Dental Unit Waterlines**

The CDC Guidelines for Infection Control in the Dental Setting—2003 state that studies have demonstrated that dental unit waterlines (i.e., narrow-bore plastic tubing that carries water to the high-speed hand piece, air/water syringe and ultrasonic scaler) can become colonized with microorganisms, including bacteria, fungi, and protozoa. The Guidelines also state that although oral flora and human pathogens have been isolated from dental water systems, the majority of organisms recovered from dental waterlines are common heterotrophic water bacteria and that these exhibit limited pathogenic potential for immunocompetent persons.1

There was one reported and documented case of disease transmission and death due to *Legionella bacteria* from a contaminated dental unit waterline in 2012.29 As noted in the Lancet case report, “aerosolized water from high-speed turbine instruments was most likely the source of the [Legionella] infection.” Dental unit waterlines have long been recognized as a potential risk for exposure to *Legionella*, most likely due to breathing aerosols or mists generated by water sources in the dental offices, such as high-speed handpieces. This was a landmark case as this is the first documented incident of infection transmission from dental unit waterlines.

To maintain and monitor dental unit water, the 2003 CDC Guidelines recommend that DHCP 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. 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 working in accordance with the manufacturer’s previously validated protocol.

The 2003 Guidelines recommends that dentists 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. However, the CDC provides no specific recommendations regarding the optimal frequency of monitoring for each type of maintenance system nor is maintenance or record keeping suggested. The CDC will consider a review and update of literature and discussions with the FDA and EPA prior to issuing the revised 2015 Guidelines for Infection Control in the Dental Setting.

**Methicillin-resistant Staphylococcus aureus (MRSA)**

The microorganism *Staphylococcus aureus*, is a highly adaptable bacteria that is frequently found in the normal flora of the human respiratory tract, GI and GU systems and skin. *S. aureus* does not always cause infection or disease. It is estimated that 33% of the population may be colonized with *S. aureus* in the anterior nares of the nasal passages.30

Methicillin-resistant *Staphylococcus aureus* (MRSA) is any strain of *Staphylococcus aureus* that has adapted and developed resistance to beta-lactam antibiotics which include the penicillins (methicillin, dicloxacillin, nafcillin, etc) and cephalosporins. Strains of *S. aureus* that are susceptible to these antibiotics are
MRSA (Methicillin-sensitive Staphylococcus aureus). MRSA organisms are not considered more virulent than MSSA, however, their antibiotic resistance makes MRSA infections more difficult to treat with standard types of antibiotics, and thus more dangerous. It is estimated that 2% of the population may be colonized with MRSA.30

There are two types of MRSA infections: Community associated and healthcare associated. Most community associated MRSA infections are localized to skin and soft tissues. The initial appearance of a community acquired MRSA infection is folliculitis or a cluster of abscesses or the presence of “spider bites”. Other clinical manifestations of MRSA may include: furuncles (involving multiple hair follicles), carbuncles (boils) or bullous impetigo. These lesions may be red, swollen, and painful, warm to the touch, purulent, and may be accompanied by a fever.31 MRSA infections are highly contagious and occur most frequently on tissue areas of friction and chronic irritations, and areas of the body that are covered by hair. Healthcare associated MRSA infections however, may cause life-threatening bloodstream infections, pneumonia and surgical site infections.31 Some differences between Community Associated and Healthcare Associated MRSA are listed in table #2.

Although MRSA is still a major patient threat, a CDC study showed that invasive (life-threatening) MRSA infections in healthcare settings are declining. Invasive MRSA infections that began in hospitals declined 54% between 2005 and 2011, with 30,800 fewer severe MRSA infections. The study also showed 9,000 fewer deaths in hospital patients in 2011 versus 2005.30

The potential transmission of MRSA in dental healthcare facilities was not addressed in the 2003 CDC Guidelines. Literature is reviewed and specific guidelines will be recommended in 2015. However, dental healthcare personnel may consider the following MRSA facts and general infection control protocol as recommended by the CDC.

- MRSA is highly contagious and may be spread by direct or indirect contact.
- MRSA can survive on surfaces and fabrics for hours to months depending upon temperature, humidity, amount of pathogens present and type of surface.
- EPA registered intermediate level hospital disinfectants that are routinely used to clean and disinfect clinical contact surfaces in dental operatories are effective at killing MRSA. Use products according to manufacturer’s instructions.
- Hand hygiene is the most effective means of preventing infection transmission.
- Both hand washing and alcohol-based hand sanitizers are effective in preventing MRSA infection transmission.
- Consider all used PPE as contaminated and follow proper infection control protocol
- MRSA skin infections can develop into more serious infections. Encourage patients with suspicious lesions to follow up with healthcare provider for proper care and treatment.32

### Clostridium difficile

Clostridium difficile is a gram-positive spore-forming bacterium that is associated with serious healthcare-associated infections. Most healthcare-associated infections are declining, and C. diff infections levels are declining as well. One study showed C. diff infections have been reduced by 20% over 21 months at 71 hospitals. There are currently about 250,000 hospitalizations per year and 14,000 deaths in the USA related to C. difficile infections.1 Older adults (over age 65T) are particularly at risk, especially those who are immunosuppressed, take antibiotics and are receiving medical care in an in-patient setting. The CDC has published guidelines for the healthcare community for the prevention of C. diff infections. However, C. diff. was not addressed in the CDC Guidelines for Infection Control in Dental Health-Care Settings—2003.

Early clinical manifestations of Clostridium difficile infection include: watery diarrhea, fever, loss of appetite, nausea and abdominal pain and tenderness. Severe cases of C. diff infection include pseudomembranous colitis, toxic megacolon, sepsis and death (rarely).

Clostridium difficile is transmitted via fecal oral route. Any surfaces, devices or materials that become contaminated with feces may serve as a reservoir for C. diff spores. Spores are transmitted to other patients via hands of healthcare personnel who have touched a contaminated surface or item.

The CDC recommendations for C. diff are directed toward long term care and inpatient facilities. While dentistry is typically performed in an outpatient clinical setting, infection control recommendations may not appear to apply directly to dentistry. First,

<table>
<thead>
<tr>
<th>Community Associated MRSA</th>
<th>Healthcare Associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most are localized to skin and soft tissues</td>
<td>Affiliated with surgical wounds and blood infections and may lead to pneumonia or life-threatening bloodstream infections</td>
</tr>
<tr>
<td>Occurs in otherwise healthy people in community</td>
<td>Most frequently occur in in-patient facilities</td>
</tr>
<tr>
<td>Typically spread through direct contact or by sharing personal items</td>
<td>Typically spread via contaminated hands of healthcare providers (direct and indirect contact)31</td>
</tr>
<tr>
<td>Risk factors: compromised skin</td>
<td>Common reservoirs: nursing homes, hospitals, chronic care facilities</td>
</tr>
<tr>
<td>Shared personal items</td>
<td>Antimicrobial use (quinolones)</td>
</tr>
<tr>
<td>Antimicrobial use (quinolones)</td>
<td>Other risk factors include crowded conditions: College dormitories, daycare centers, military recruits in barracks</td>
</tr>
<tr>
<td>More easily treated</td>
<td>More difficult to treat</td>
</tr>
</tbody>
</table>
it is unlikely that patients with C. diff would present for dental procedures while symptomatic. However, C. diff infected patients continue to shed organisms for a number of days following cessation of diarrhea.\textsuperscript{33} As evidence suggests, infective patients may thus present for treatment in dental health facilities.

Several areas of accepted infection control protocol in the dental setting may be ineffective with regard to C. diff. First, the products used for environmental surface disinfection in the dental setting (EPA-registered intermediate level hospital disinfectants) are not effective against Clostridium difficile spores. Hospital settings and long term care facilities may use hypochlorite-based disinfectants or EPA registered disinfectants with a sporicidal claim. Second, alcohol based hand rubs are also ineffective against C. diff spores. Thus, when a patient has been diagnosed with C. diff, healthcare provider hands must be washed with plain or antimicrobial soap, and alcohol hand sanitizers may not be used. Other infection control protocol such as PPE, use of gloves, and instrument sterilization procedures remain effective against C. diff.

Since C. diff is a public health concern, reduction of this infection is a public health priority. Antimicrobial stewardship targeted to C. difficile reduction shows promise, because increased rates of C. diff are associated with inappropriate antibiotic use.\textsuperscript{34}

A Stewardship program is aimed at reducing overuse and inappropriate selection of antibiotics to achieve optimal outcomes for patients in cost-effective ways.

The potential transmission of C. difficile in dental healthcare facilities was not addressed in the 2003 CDC Guidelines. Literature will be reviewed and specific guidelines for C. diff will be addressed in the 2015 revisions. Dental healthcare personnel may consider the following C. diff infection control recommendations for in-patient settings as protocol is developed for dental healthcare settings.

- Recommended infection control practices in long term care and home health settings are similar to those practices taken in traditional healthcare settings.
- Wearing of gloves and PPE when treating patients with C. diff.
- Minimize frequency and duration of antimicrobial therapy\textsuperscript{35}
- Implementation of an Antimicrobial Stewardship program
- Restrict the use of cephalosporin and clindamycin (except for antibiotic prophylaxis)\textsuperscript{35}
- Identify and isolate C. difficile patients early (for in-patient healthcare settings)
- Emphasize compliance with hand hygiene before glove donning and after glove removal
- Perform hand hygiene with soap (plain or antimicrobial) and water, as alcohol does not kill C. difficile spores.\textsuperscript{35}
- Cleaning and disinfection of environmental surfaces as recommended by CDC
- Sterilization of critical and semi-critical instruments as recommended by CDC
- Avoid use of antiperistaltic agents or Loperamide (Imodium\textsuperscript{39}) as they may worsen C. diff symptoms

- Early C. diff control for mild disease: discontinue antibiotic and oral rehydration
- Moderate or advanced infection: refer to healthcare provider for appropriate antibiotic treatment

### Types of chemical indicators and integrators used for monitoring and optimal frequency for biological monitoring of sterilizers

Sterilization procedures are routinely monitored using a combination of mechanical, chemical and biological indicators. These indicators evaluate the sterilizing conditions and the procedure’s effectiveness.\textsuperscript{16} Mechanical indicators evaluate cycle time, temperature and pressure by observing the gauges or displays on the sterilizer and noting these parameters for each load. Chemical indicators are used both internally (within pouches or cassettes) and externally such as autoclave tape, (on outside of pouches/cassettes) to assess the physical conditions during the sterilization process. Since chemical indicators do not contain microbial spores, they do not prove that sterilization has been attained. They do however, allow detection of certain equipment malfunctions and may help to quickly identify errors in the sterilization process. The 2003 CDC Guidelines recommend the following with regard to chemical indicators and frequency for biological monitoring of sterilizers:

- Use an internal chemical indicator within each package. If the internal indicator cannot be seen from outside the package, also use an external indicator.
- Use mechanical, chemical and biological monitors according to the manufacturer’s instructions to ensure the effectiveness of the sterilization process.
- Monitor each load with mechanical (e.g., time, temperature and pressure) and chemical indicators.
- Place a chemical indicator on the inside of each package. If the internal indicator is not visible from the outside, also place an exterior chemical indicator on the package.
- Do not use instrument packs if mechanical or chemical indicators indicate inadequate processing.
- Monitor sterilizers at least weekly using a biological indicator with a matching control (i.e., biological indicator and control from same lot number).
- Use a biological indicator for every sterilizer load that contains an implantable device. Verify results before using the implantable device, whenever possible.
- Maintain sterilization records (i.e., mechanical, chemical, and biological) in compliance with state and local regulations.

The CDC also recommends biological monitoring in additional circumstances:

- Whenever a new type of packaging material or tray is used.
- After training new sterilization personnel.
- After a sterilizer has been repaired.
- After any change in the sterilizer loading procedures.

Since chemical indicators provide sterility assurance for devices used for care of humans, they are classified in the United States as a Class I medical device for conditions where substantial harm could result from a device failure. This class includes all human implanted devices (e.g., pacemakers) and some devices that are not implanted (e.g., catheters, sutures, and surgical drapes). Biological indicators are used in addition to chemical indicators in monitoring processes for these devices. By comparison, chemical indicators provide assurance of sterility performance of the sterilization process, but do not provide information about the biological or environmental conditions at the time of sterilization. Thus, the use of chemical indicators alone is not appropriate for monitoring the sterilization process for implantable devices.
States as “medical devices”. Thus, professional guidance and governmental safeguards have been developed to assure their safety, quality, and proper use. These standards have evolved as the medical device industry developed new monitoring technologies. The professional associations that provide standards and recommended practices include the Association for the Advancement of Medical Instrumentation (AAMI), Centers for Disease Control and Prevention (CDC), and the Association of periOperative Registered Nurses (AORN). AAMI offers extensive published documents that represent current industry recommendations based on hospital practices and medical products available in the U.S. Today, ANSI/AAMI recognizes six classes of chemical indicators:

- **Class 1 (process indicator):** indicate that the package has been directly exposed to the sterilization process.
- **Class 2:** For use in specific tests such as detection of adequate air removal in pre-vacuum type sterilizers.
- **Class 3:** Single variable indicators. React to one of the critical variables and is intended to indicate exposure to sterilization process at a state value.
- **Class 4:** Multi-variable indicators. Reacts to two or more of the critical variables.
- **Class 5:** Integrating indicators react to all critical variables.
- **Class 6:** Emulating indicators react to all critical variables for specified sterilization cycles. This classification of chemical indicators was standardized in 2005 and is approved for surgical instruments in medical operating rooms. The classes do not have a hierarchical significance and each class has its own characteristics and intended use. These six classes of chemical indicators were not available when the 2003 CDC Guidelines were published.

As the CDC revises the Guidelines for Infection Control for dental settings, it is anticipated that a thorough review of literature and 2008 CDC guidelines will be performed, as well as a review of the ANSI/AAMI standards and consultation with the FDA. It is anticipated that the optimal frequency for biological monitoring of heat-based, tabletop sterilizers will be addressed as well as the specific types of chemical indicators and integrators to be used for sterilization monitoring.

**Conclusion:**

In the prospective revised Guidelines for Infection Control in Dental Health-Care Settings—2015, it is anticipated that the CDC will address emerging infectious diseases, unresolved issues and areas of infection control that were not addressed in previous guidelines. Evidence suggests microorganisms will continue to evolve and adapt in order to survive and thrive and will continue to cause disease transmission. All healthcare settings, including dentistry, are affected by the emergence and transmission of antimicrobial-resistant microbes. Dental healthcare personnel must remain updated and constantly aware of impending infectious disease threats which may challenge current infection control precautions. Standard infection control precautions of yesterday may be inadequate or ineffective tomorrow. As microbes continue to adapt and change, so must we to ensure a safe clinical environment for our patients and ourselves.

**References:**

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35. Infection control and hospital epidemiology may 2010, vol. 31, no. 5 shea-idsa guideline Clinical Practice Guidelines for Clostridium difficile Infection in Adults: 2010 Update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) Stuart H. Cohen, MD; Dale N. Gerding, MD; Stuart Johnson, MD; Giaran P. Kelly, MD; Vivian G. Loo, MD; L. Griford McDonald, MD; Jacques Pepin, MD; Mark H. Wilcox, MD
36. Class 6 sterility assurance technologies: New applications, real-world science and current guidance by Lorrie Calabrese and Mary Beth Nooney, Nov. 2011

Additional Resources:
• ADA Council on Scientific Affair’s Statement on Dental Unit Waterlines.
• CDC MRSA Treatment Guideline, 2012
• CDC Infection Control Guidelines for MRSA
• CDC Preventing C. difficile infections in healthcare settings
• Evaluation and Research on Antimicrobial Stewardship’s Effect on Clostridium difficile Project, Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services
• CDC Guideline for Disinfection and Sterilization in Health-care Facilities, 2008
• From Policy to Practice: OSAP’s Guide to the Guidelines

Author Profiles
Marie T. Fluent DDS, is a graduate of the University of Michigan, School of Dentistry and has enjoyed 25 years of private practice. Marie provides lectures on infection prevention and has written numerous articles on infection control in the dental office. Marie is a member of OSAP, serves on the editorial board for The Dental Advisor and is an infection control consultant for the Ann Arbor VA hospital. She can be reached at mtfluent@yahoo.com.

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Author Disclosures
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Questions

1. The CDC Guidelines for Infection Control in the Dental Setting 2003:
   a. Are entirely evidence-based
   b. Consolidates recommendations from other relevant
      CDC guidelines
   c. Include specific infection control recommendations
      regarding drug-resistant organisms.
   d. Were developed for general dental procedures only and
      did not address specialty areas of dentistry

2. The general categories of potential topics to be addressed in the 2015 Guidelines are:
   a. Risk of transmission, intervention, and Equipment
   b. MRSA, MSSA, and Clostridium difficile
   c. Surgical smoke, prion disease and Creutzfeldt-Jakob
      Disease
   d. Burs and endo files, dental unit waterlines, and sterilization
      monitoring

3. Drug-resistant microorganisms:
   a. Are more virulent than drug-susceptible microorganims
   b. Are transmitted only during clinical procedures
   c. Were discussed thoroughly in the 2003 Guidelines
   d. May be found in the normal flora of healthy persons

4. Infection prevention of MRSA may include:
   a. Hand washing only, as alcohol based hand rubs are
      ineffective against MRSA
   b. The use of sodium hypochlorite (household bleach) on
      clinical contact surfaces
   c. The use of EPA registered intermediate level hospital
      disinfectants for use on clinical contact surfaces
   d. Use of double gloves

5. Community associated MRSA:
   a. Is not highly contagious
   b. May be life threatening
   c. Is common in chronic care facilities
   d. Is common in crowded living conditions

6. Healthcare associated MRSA:
   a. Rates are increasing rapidly in healthcare settings.
   b. May cause life-threatening bloodstream infections
   c. Commonly originate from contact sports
   d. Are easily eradicated once introduced

7. Clostridium difficile:
   a. Is a public health problem that has increased in both
      incidence and severity
   b. Is a common pathogen in dental health care settings
   c. Is easily acquired by young, healthy persons
   d. Is transmitted by inhaling airborne spores

8. Antimicrobial stewardship programs:
   a. Encourage the widespread use of broad-spectrum
      antibiotics to eradicate infections
   b. Do not show much promise since antibiotics are
      necessary for the treatment of C.diff
   c. Are aimed at reducing over-use and inappropriate
      selection of antibiotics
   d. Encourage the use of antibiotics that are the least
      expensive

9. Treatment of C.diff infections may include:
   a. Loperamide (Imodium)
   b. Antibiotics such as cephalosporins and clindamycin
   c. Discontinuation of antibiotics and oral rehydration
   d. Anti-peristaltic agents

10. The 2003 Guidelines for Infection Control in the Dental Health Setting made the following recommendations regarding double gloving:
    a. No recommendations were given, double gloving
       remained an unresolved issue
    b. Double gloving was recommended for patients known
       to be infected with bloodborne pathogens
    c. Double gloving was recommended for all oral surgical
       procedures
    d. Double gloving was recommended for all general dental
       and hygiene procedures

11. Which of the following are true for double gloving?
    a. Double gloving has no impact on the risk of exposure to
       patient blood
    b. Tactile sensitivity is greatly impacted by wearing double
       gloves
    c. Manual dexterity is greatly impacted by the use of
       double gloves
    d. Double gloving is recommended by the American
       Academy of Orthopedic Surgeons (AAOS) and the
       American College of Surgeons (ACS)

12. Among surgical personnel:
    a. Glove perforation rates are rare
    b. Suture needles are the most frequent source of injury
    c. Needle stick injuries and cuts are statistically
       insignificant
    d. It has been proven that double gloving prevents disease
       transmission

13. Dental unit waterlines:
    a. Are most commonly colonized with microorganisms
       from oral flora and human pathogens
    b. Have never caused disease transmission
    c. Become colonized with microorganisms including
       bacteria, fungi and protozoa
    d. Commonly cause disease in immunocompromised
       patients

14. In the 2003 Guidelines, the CDC recommended:
    a. Monthly monitoring of dental unit waterlines
    b. Optional testing of dental unit waterlines and record
       maintenance of results
    c. Routine testing for specific organisms such as
       Legionella or Pseudomonas
    d. Consultation with manufacturer of water delivery
       system for recommended frequency of monitoring.

15. Heated plumes as a result of laser and electrosurgical devices:
    a. Do not pose an occupational risk to dental professionals
    b. Are only a concern in hospital surgical settings
    c. Have the potential to hold specific bacteria and viruses
       such as HPV, HBV and HIV
    d. Have specific recommendations given by the CDC for
       infection control standards

16. Studies regarding the presence of infectious HPV in procedures that generate surgical
    smoke showed that:
    a. If inhaled, pose a “high risk” to health care personnel
       among health care personnel
    b. The potential risk of transmission is low, but still needs
       further study
    c. The carbon dioxide laser parameters does not need to be
       in a specific mode or specific power density to to avoid
       airborne transmission
    d. Greater amounts of HPV DNA were recovered in
       electrocauterization vapor than laser vapor

17. Research and infection control recommendations regarding laser plumes and
    electrosurgical smoke:
    a. Has been focused mainly in dental-related outpatient
       settings
    b. Are abundant and will result in future recommendations
       in the updated 2015 CDC guidelines
    c. Is still limited regarding dental settings at this time and
       no current recommendation is given
    d. Suggests that standard PPE such as surgical masks may
       provide adequate protection for laser or electrosurgical
       procedures

18. Prion diseases:
    a. Affect humans only
    b. Slowly progress and are treatable
    c. Involve neural tissues in the brain
    d. Are transmittable by aerosols

19. Creutzfeldt-Jakob disease:
    a. Is the most common human prion disease
    b. Is non-transmissible through exposure to nervous
       tissue
    c. Is transmitted via human- to-human contact
    d. Is the only existing transmissible spongiform
       encephalopathy

20. The risk of prion disease transmission in the dental field:
    a. Is still unknown, but is thought to be high
    b. Applies directly to periodontal instruments, which have
       direct contact with the gingival tissue
    c. Lies in contaminated dental instruments, as current
       sterilization procedures are ineffective at killing prions
    d. Result in the consideration for multi-use items in dental
       procedures involving pulpal tissue

21. Special considerations for prion disease infection control provided by the 2003 CDC
    guidelines include:
    a. Using flash sterilization for instruments or devices that
       may be contaminated with prion disease
    b. Allow instruments to dry with tissues and body
       fluids on them before starting the sterilization
       process
    c. Clean and sterilize following standard precautions for
       all dental instruments
    d. Use single-use disposable items and equipment when
       possible
22. Single-use disposable items:
   a. Are to be used once and are not to be reprocessed after single use on patient
   b. Are typically easy to clean and heat tolerant
   c. Are manufactured to be used more than once, if needed
   d. May be reused if there is no visual body fluid or debris

23. Sterilization of endodontic files and dental burs:
   a. Does not indicate pre-cleaning due to the intricate detail and structure of cutting components
   b. Is effective on prion disease
   c. May lead to instrument fatigue and breakage if processed repeatedly
   d. Is not necessary despite the potential to be contaminated with blood, saliva, pulpal and necrotic tissue and pathology

24. The single use of endodontic files and dental burs may be recommended because:
   a. Sterilization methods (steam pressure, dry heat, chemical vapor) are 100% effective on previously used burs and files
   b. It is more cost-effective
   c. Single-use burs and endodontic files increase the risk of transmission between patients
   d. Surface deposits and micro cracks have been found on files after ultrasonic cleaning and autoclave sterilizing process

25. The revised Guidelines for Infection Control in Dental-Health Care Settings—2015 will be:
   a. Entirely evidence-based
   b. Developed with input from organized dentistry, academia, and research groups and industry
   c. Based primarily upon the needs of the private clinician
   d. Will focus exclusively upon emerging infectious diseases

26. The CDC recommends which of the following regarding chemical indicators?
   a. An internal indicator should be placed within each package
   b. An external indicator must be placed outside of every package
   c. Chemical indicators are so sensitive that they now replace the need for biological monitoring
   d. Chemical indicators guarantee that sterilization has occurred

27. Which of the following are true regarding the classes of chemical indicators?
   a. A class 5 indicator is better than a class 4 indicator and should be used whenever possible
   b. Each class has its own characteristics and intended use
   c. These 6 classes of indicators were developed exclusively for dentistry
   d. The CDC researched and developed the classification of chemical indicators

28. Current CDC recommendations for biological monitoring include:
   a. Each day a sterilizer is used
   b. Monthly monitoring of each autoclave
   c. Monitoring only after training new personnel and after sterilizer repairs
   d. Monitoring every load that contains an implantable device

29. Sterilization procedures are routinely monitored:
   a. By observing gauges or displays on the sterilizer
   b. By using a combination of mechanical, chemical and biological indicators
   c. By evaluating cycle time, temperature and pressure
   d. By assessing the physical conditions during the sterilization process

30. Which of the following is true?
   a. Microorganisms will continue to evolve and adapt in order to survive and thrive
   b. Infection protocol of today will be entirely adequate in 5 years
   c. Infection control protocol must be updated every 10 years
   d. Standard precautions protect dental personnel from transmission of all diseases
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Educational Objectives
1. Identify the importance of the CDC Guidelines as they pertain to the practice of dentistry
2. Describe the advantages of utilizing bun and endodontic files as single-use items
3. Distinguish between drug-susceptible versus drug-resistant microorganisms
4. Discuss the efficacy of double gloving as an exposure risk reduction strategy
5. Discuss optimal frequency for biological monitoring for sterilizers as recognized by current CDC guidelines

Course Evaluation
1. Were the individual course objectives met? Yes No Objective #1: Yes No Objective #4: Yes No Objective #2: Yes No Objective #5: Yes No Objective #3: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.
2. To what extent were the course objectives accomplished overall? S 4 3 2 1 0
3. Please rate your personal mastery of the course objectives. S 4 3 2 1 0
4. How would you rate the objectives and educational methods? S 4 3 2 1 0
5. How do you rate the author’s grasp of the topic? S 4 3 2 1 0
6. Please rate the instructor’s effectiveness. S 4 3 2 1 0
7. Was the overall administration of the course effective? S 4 3 2 1 0
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