

Review Article

Infection Control in Dentistry: A Review

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Abstract: Cross-infection can occur during clinical practice with transmission of infectious agents between patients and health workers in a clinical environment. Transmission of dental infection can occur through infected air droplets, blood, saliva, and instruments contaminated with secretions etc. In this article we will discuss various dental infections and their control in dental practice.

Keywords: Infection control, Occupational hazard, Safety training, Needle stick injury, Dental exposure, Infection control, Injury, DHCP.

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INTRODUCTION

Transmission of infectious agents among patients and dental health care personnel (DHCP) in dental settings is not that common. However, from 2003 to 2015, transmissions in dental settings, including patient to-patient transmissions, patient to dentist and vice-versa have been documented ((Redd, J. T. *et al.*, 2007; Radcliffe, R. A *et al.*, 2013; Bradley, K. K. *et al.*, 2013; Klevens, R. M *et al.*, 2013). Cross-infection can be transmitted through infected air droplets, blood, saliva, and instruments contaminated with secretions (Kohn, W. G. *et al.*, 2013). Persons who seek dental care could be in the prodromal phase or being carriers of certain infectious diseases, without knowing about their physical conditions. Our oral cavity and respiratory tract harbor various bacteria and viruses like Cytomegalovirus (CMV), Hepatitis C Virus (HCV), and Hepatitis B Virus (HBV), Herpes simplex virus (HSV types 1 and 2), HIV/AIDS, Staphylococci, Streptococci, Mycobacterium and thousands of unknown microbes as well. Furthermore, nowadays we are living in an era of eco-epidemiology, with global emergence and re-emergence of many communicable diseases. Emerging agents as Ebola, Middle East Respiratory Syndrome-Corona Virus (MERS-CoV), H1N1 and H5N1 and others can be also transmitted during dental practice (Bayry, J. 2013). Blood borne infections are main threat for the transmission of infections in dental practice.

Exposure to blood and body fluids need great concerns from both dental care providers and the patients (N. Yamalik, W. & Van Dijk.2013).

SAFETY CONTROL MEASURES

The recognition of dentists' potential to cause cross-infection in early 1980s, stimulated Centre for Disease Control (CDC), American Dental Association, and other Health care professional agencies to escalate their call for dental practitioners to make adoption of the Universal precautions as their highest professional priority. Dental professionals have a legal duty of care to protect the health and safety of their patients (Khanghahi, B. M.*et al.*, 2013).

Standard Precautions are the basic infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where health care is provided. These practices are designed to protect both DHCP and prevent DHCP from spreading infections among patients (McCarthy, G. M., & Britton, J. E. 2009).

Standard Precautions include—1. Hand hygiene. 2. Use of personal protective equipments (e.g., gloves, masks, eyewear). 3. Respiratory hygiene/cough etiquettes. 4. Sharps safety (engineering and work practice controls). 5. Safe injection practices (i.e.,

aseptic technique for parenteral medications). 6. Sterile instruments and devices. 7. Clean and disinfected environmental surfaces. Each element of Standard Precautions is described in the following sections (Baseer, M. A. *et al.*, 2013).

Hand hygiene is the most important measure to prevent the spread of infections among patients and DHCP. Education and training programs should thoroughly address indications and techniques for hand hygiene practices before performing routine and oral surgical procedures. For routine dental examinations and nonsurgical procedures, use water and plain soap (hand washing) or antimicrobial soap (hand antisepsis) specific for health care settings or use an alcohol-based hand rub (70%). Although alcohol-based hand rubs are effective for hand hygiene in health care settings, soap and water should be used when hands are visibly soiled (e.g., dirt, blood, body fluids). For surgical procedures, always perform a surgical hand scrub before putting on sterile surgeon's gloves (Tada, A. K. I. O. *et al.*, 2014). For all types of hand hygiene products, follow the product manufacturer's label for instructions.

Complete guidance on how and when hand hygiene should be performed, including recommendations regarding surgical hand antisepsis and artificial nails can be found in the Guideline for Hand Hygiene in Health-Care.

Key Recommendations for Hand Hygiene in Dental Settings

Perform hand hygiene—

- When hands are visibly soiled.
- After barehanded touching of instruments, equipment, materials, and other objects contaminated by blood, saliva, or respiratory secretions.
- Before and after treating each patient.
- Before putting on gloves and again immediately after removing gloves.

Use soap and water when hands are visibly soiled (e.g., blood, body fluids); otherwise, an alcohol-based hand rub may be used (J. Bayry, 2013; R. Bueno-Mari, A.P *et al.*, 2015).

Personal Protective Equipment Personal protective equipment (PPE) refers to wearable equipment that is designed to protect DHCP from exposure to or contact with infectious agents. PPE that is appropriate for various types of patient interactions and effectively covers personal clothing and skin likely to be soiled with blood, saliva, or other potentially infectious materials (OPIM) should be available (N.K. Ibrahim. 2014). These include gloves, face masks, protective eye wear, face shields, and protective clothing (e.g., reusable or disposable gown, jacket, laboratory coat). Examples of appropriate use of PPE

for adherence to Standard Precautions include— ■ Use of gloves in situations involving possible contact with blood or body fluids, mucous membranes, non-intact skin (e.g., exposed skin that is chapped, abraded, or with dermatitis) or OPIM. ■ Use of protective clothing to protect skin and clothing during procedures or activities where Definition from 2003 CDC Dental Guidelines — Oral surgical procedures involve the incision, excision, or reflection of tissue that exposes the normally sterile areas of the oral cavity. Examples include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth (e.g., removal of erupted or nonerupted tooth requiring elevation of mucoperiosteal flap, removal of bone or section of tooth, and suturing if needed) or contact with blood or body fluids is anticipated (N.Y. Ashri, & R.S. Al Sulimani, 2007). ■ Use of mouth, nose, and eye protection during procedures those are likely to generate splashes or sprays of blood or other body fluids. DHCP should be trained to select and put on appropriate PPE and remove PPE so that the chance for skin or clothing contamination is reduced. Hand hygiene is always the final step after removing and disposing of PPE. Training should also stress preventing further spread of contamination while wearing PPE by: ■ keeping hands away from face. ■ Limiting surfaces touched. ■ Removing PPE when leaving work areas. ■ Performing hand hygiene.

Respiratory Hygiene/Cough Etiquette in Dental Settings 1. Implement measures to contain respiratory secretions in patients and accompanying individuals who have signs and symptoms of a respiratory infection (A. Mohebbati *et al.*, 2010), beginning at point of entry to the facility and continuing throughout the visit. a. Post signs at entrances with instructions to patients with symptoms of respiratory infection to—

- Cover their mouths/noses when coughing or sneezing.
- Use and disposal of tissues.
- Perform hand hygiene after hands have been in contact with respiratory secretions. b. Provide tissues and no-touch receptacles for disposal of tissues. c. Provide resources for performing hand hygiene in or near waiting areas. d. Offer masks to coughing patients and other symptomatic persons when they enter the dental setting. e. Provide space and encourage persons with symptoms of respiratory infections to sit as far away from others as possible. If available, facilities may wish to place these patients in a separate area while waiting for care. 2. Educate DHCP on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens when examining and caring for patients with signs and symptoms of a respiratory infection (Edris. A, *et al.*, 2014 ; Harte, J. A. 2010).

Sharps Safety Most percutaneous injuries (e.g., needle-stick, cut with a sharp object) among DHCP involve burs, needles, and other sharp instruments. Implementation of the OSHA Blood-borne Pathogens Standard has helped to protect DHCP from blood exposure and sharps injuries. However, sharps injuries continue to occur and pose the risk of blood-borne pathogen transmission to DHCP and patients (Al-Maweri, S. A *et al.*, 2015). Most exposures in dentistry are preventable; therefore, each dental practice should have policies and procedures available addressing sharps safety. DHCP should be aware of the risk of injury whenever sharps are exposed. When using or working around sharp devices, DHCP should take precautions while using sharps, during cleanup, and during disposal. Engineering and work-practice controls are the primary methods to reduce exposures to blood and OPIM from sharp instruments and needles. Whenever possible, engineering controls should be used as the primary method to reduce exposures to blood borne pathogens. Engineering controls remove or isolate a hazard in the workplace and are frequently technology-based (e.g., self-sheathing anesthetic needles, safety scalpels, and needleless IV ports). Employers should involve those DHCP who are directly responsible for patient care (e.g., dentists, hygienists, dental assistants) in identifying, evaluating and selecting devices with engineered safety features at least annually and as they become available (Wang, W. E. I., 2012; Ibrahim, N. K. *et al.*, 2015).

Key Recommendations for Sterilization and Disinfection of Patient-Care Devices for Dental Settings

1. Clean and reprocess (disinfect or sterilize) reusable dental equipment appropriately before use on another patient.
2. Clean and reprocess reusable dental equipment according to manufacturer instructions. If the manufacturer does not provide such instructions, the device may not be suitable for multi-patient use. a. Have manufacturer instructions for reprocessing reusable dental instruments/equipment readily available, ideally in or near the reprocessing area.
3. Assign responsibilities for reprocessing of dental equipment to DHCP with appropriate training.
4. Wear appropriate PPE when handling and reprocessing contaminated patient equipment.
5. Use mechanical, chemical, and biological monitors according to manufacturer instructions to ensure the effectiveness of the sterilization process.

Environmental Infection Prevention and Control Policies and procedures for routine cleaning and disinfection of environmental surfaces should be included as part of the infection prevention plan. 1. Establish policies and procedures for routine cleaning

and disinfection of environmental surfaces in dental health care settings. a. Use surface barriers to protect clinical contact surfaces, particularly those that are difficult to clean (e.g., switches on dental chairs, computer equipment) and change surface barriers between patients. b. Clean and disinfect clinical contact surfaces that are not barrier-protected with an EPA-registered hospital disinfectant after each patient. Use an intermediate-level disinfectant (i.e., tuberculocidal claim) if visibly contaminated with blood. 2. Select EPA-registered disinfectants (Setia, S. *et al.*, 2013) or detergents/disinfectants with label claims for use in health care settings. 3. Follow manufacturer instructions for use of cleaners and EPA-registered disinfectants (e.g., amount, dilution, contact time, safe use, disposal). Dental Unit Water Quality Dental unit waterlines (i.e., plastic tubing that carries water to the high-speed handpiece, air/water syringe, and ultrasonic scaler) promote bacterial growth and development of biofilm due to the presence of long narrow-bore tubing, inconsistent flow rates, and the potential for retraction of oral fluids. Dental health care personnel and patients could be placed at risk of adverse health effects if water is not appropriately treated (Nasir, E. F. *et al.*, 2009; Barlean, L. *et al.*, 2014). All dental units should use systems that treat water to meet drinking water standards (i.e., ≤ 500 CFU/ mL of heterotrophic water bacteria). Independent reservoirs—or water-bottle systems—alone are not sufficient. Commercial products and devices are available that can improve the quality of water used in dental treatment. Education and training are critical elements of Standard Precautions, because they help DHCP make appropriate decisions and comply with recommended practices. When Standard Precautions alone cannot prevent transmission, they are supplemented with Transmission-Based Precautions. This second tier of infection prevention is used when patients have diseases that can spread through contact, droplet or airborne routes (e.g., skin contact, sneezing, coughing) and are always used in addition to Standard Precautions (Mousa, A. A. *et al.*, 1997). Dental settings are not typically designed to carry out all of the Transmission-Based Precautions (e.g., Airborne Precautions for patients with suspected tuberculosis, measles, or chickenpox) that are recommended for hospital and other ambulatory care settings. Patients, however, do not usually seek routine dental outpatient care when acutely ill with diseases requiring Transmission-Based Precautions (Porter, S. R. *et al.*, 1993).

Nonetheless, DHCP should develop and carry out systems for early detection and management of 7 potentially infectious patients at initial points of entry to the dental setting. To the extent possible, this includes rescheduling non-urgent dental care until the patient is no longer infectious or referral to a dental setting with appropriate infection prevention precautions when

urgent dental treatment is needed (Yoder, K. S. 1985; Otuyemi, O. D. *et al.*, 2001).

DISCUSSION

Patient safety is an important dental discipline which aims at improving quality of patient care, minimizing treatment mistakes and improving safety. Safety measures discussed above are needed for protecting both patients and staff members. Despite of these guidelines and recommendations issued by medical and dental societies as well as governmental organizations, studies illustrated that infection is not well controlled in some dental practices and hospitals.

Implementation of Standard practices, use of proper precautions, pre-exposure immunization and post-exposure prophylaxis are also vital for preventing transmission of blood borne infections and other dentally acquired cross- infections.

Hands are considered as a major source of infection in dentistry and wearing of gloves by dental personnel had been an essential element of cross-infection control (Burke, F. J. *et al.*, 1991). Gloves may be non-sterile examination gloves or single-use-disposable sterile surgical gloves that can be used in a patient's mouth. A study was conducted on dental practitioners in various states of India reported that more than 90% of dentists use gloves routinely (Grace, E. G. *et al.*, 1991). Hand hygiene substantially reduces potential pathogens and is considered a critical factor in reducing the risk of transmitting microorganisms between dentists and patients. Scrubbing hands all the way up to the elbow for about 2–6 min using a hand sanitizer removes the dead cells along with the bacteria resident on the skin of the hands. Bacteria beneath the gloves multiplies very fast due to the humid and warm environment as opposed to a dry and cool area (Bowden, J. R. *et al.*, 1989). If soap has residual properties (staying on the skin on repeated washing with the antimicrobial soap), it tends to slow the multiplication of microbes (Sofola, O. O. *et al.*, 2005).

A pre-procedural rinse with good antiseptic like chlorhexidine gluconate, essential oils, povidone iodine) had been known to reduce the level of oral microorganisms generated in aerosols or spatter during routine dental procedures with rotary instruments (Samaranayake, L. P., & McDonald, K. C., 1990).

According to Al-Omari and Al-Dwairi, Steam sterilization has been the method of choice since ages for instrument sterilization. When autoclaved, all bacteria, viruses, fungi, and spores are inactivated. Autoclaves are of particular importance in poorer countries due to the much greater amount of equipment that is re-used. Providing stove-top or solar autoclaves to rural medical centers has been the subject of several proposed medical aid missions.

Use of boiling water as a method of sterilization is no longer recommended in dentistry. Simply boiling for 30 min or more can kill virtually all vegetative cells present, but cannot kill spores, which can re-germinate shortly and resume growth. Therefore, boiling is an insufficient method to achieve sterilization. A study conducted in Khartoum, Sudan, an African Country believed to be under-developed, revealed that only 2% of the respondents were using boiling water for sterilization. The reported usage of boiling water for sterilization was 2.6% and 8% in New Zealand and Caribbean general dentists, respectively (Alhazzazi, T. Y., 2016).

Dentists and clinical dental staff being at a high risk for hepatitis B infection must be vaccinated for it. A study done in Riyadh, KSA, showed that 3.2% of female patients attended the dental clinics of King Saud University had seropositive HBV and HCV. Meanwhile, they were unaware about their infection and had no clinical manifestations. The study concluded that taking medical history without screening for HBV and HCV might lead to treating infected patients as non-infected and this can increase the risk of cross infection unless strict adherence to standard precautions is applied.

Another study conducted by reviewing literature done on occupational risks of viral infections in the operating room over the last 5 decades. Results revealed that the risks of viral infections remained the same as a decade ago. Furthermore, a house-hold survey done in Damietta, Egypt, 2014, found that 1.1% of the participants were infected with HBV, 9.3% with HCV, and both infections co-existed in 0.4%. One of the main risk factors for both infections was exposure to dental procedure. In addition, the continuous increase in the number of patients seeking dental clinics should give alarming signs to dentists and Dental Health Care Programs (DHCPs) for better infection control measures in future.

CONCLUSION

An educational program on infection control, isolation, and precautions for all healthcare workers to allow compliance with infection control policies are necessary to reduce infectious hazards among not only DHCPs but also their patients. Apart from this, careful monitoring of infection control practices should also be done by the government authorities to increase the percentage of DHCPs practicing adequate infection control measures.

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