# Rationale for Infection Control and Its Applicability in Dental Clinics - An Overview

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**Abstract:** Infection control measures and procedures play a primary role in controlling the spread of the infectious diseases in a health care setting. Therefore, the aim and objective of this article is to throw light on the importance of Infection control and various steps taken which help in the process of infection control. Dentistry is a field wherein there is high risks of exposure to saliva/blood and other potentially infectious materials, and therefore, mandates a high standard of infection control and safety in suppressing cross-contamination and occupational exposures to blood- and saliva-borne diseases. Dental care professionals are at a higher risk of cross infections while treating patients so it is the duty of the clinician to keep himself updated and educate and vaccinate the personnel working under him.

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**Key Words:** Disinfection, infection control, sterilization

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**Introduction:** The purpose of infection control is to minimize the spread of infections in between the patients and reduce the exposure of health care providers to blood and other potentially infectious material. It cuts down the potential risk of disease transmission. Infection prevention and control (IPC) is a scientific approach designed to prevent harm caused by infection to patients and health workers. The knowledge of IPC is basic for treating infectious diseases. There are many routes of disease transmission like airborne, blood borne, fecal-oral, vectorborne and vertical transmission (Table1) . The major concern of transmitting the disease in dental setup is through bloodborne route and via aerosol.

**Table 1: Routes Of Disease Transmission**

| | Routes Of Transmission | Pathogens Transmitted |
|---|---|---|
| 1 | Aerosol | Mycobacterium |
| 2 | Blood Borne | HIV, Hepatitis |
| 3 | Fecal-Oral | Cholera, Hepatitis A, Polio, Rotavirus, Salmonella, And Parasites |
| 4 | Vector Borne | Malarial Parasite |
| 5 | Vertical Transmission | HIV |
| 6 | Sexual | HIV |

**Aerosol:** The infectious agent transmitted through airborne routs has significant implications for how healthcare workers (HCWs) need to manage patients infected with such agents. Clinicians are advised to wear appropriate Personal protective equipment (PPE) while working on infected patients. Such PPE mandates a tight seal around the airways for bioaerosols. Available data, has shown the potential for aerosol transmission for Middle-East Respiratory Syndrome-associated coronavirus (MERS-CoV)[1,2] and Ebola virus[3,4]. There have been few publications classifying droplets using particle sizes over the years[5–10]. Generally: i) small particles of < 5–10 µm aerodynamic diameter that follow airflow streamlines are capable of short and long range transmission; particles of < 5 µm quickly penetrates the airways all the way down to the alveolar space, and particles of < 10 µm penetrates below the glottis[7] ii) large droplets of diameters > 20 µm in diameter follow a ballistic trajectory and fall mostly under the influence of gravity.

For these particle sizes surgical masks would be effective, as they will act as a direct physical barrier to droplets of this size that are too large to be inhaled into the respiratory tract around the sides of the mask; iii) 'intermediate particles' of diameters 10–20 µm, will have some properties of both small and large droplets, to some extent, but settle more quickly than particles < 10 µm and potentially carry a smaller infectious dose than large (> 20 µm) droplets.

'Aerosols' would also include 'droplet nuclei' which are small particles with an aerodynamic diameter of 10 µm or less, typically produced through the process of rapid desiccation of exhaled respiratory droplets[5,6]. A dental aerosol is generated from dental instruments like ultrasonic scalers, dental hand pieces, three-way syringes and other high-speed instruments.

These aerosols are air suspended in the clinical setup. These aerosols can pose risks to the clinician, staff and other patients as well.

The heavier particles (>50 µm ) of the aerosols suspend in the air for short period and settles down quickly, but the lighter particles tend to remain suspended for longer periods and are capable to enter and get deposited in the lungs when they are inhaled and possess the capacity of transmitting diseases.

The water used in the dental units can be contaminated with Legionella. The aerosols from the hand-pieces of such dental units may cause spread of infection by Legionella in the environment of the dental setting[11].

The dental unit water lines (DUWLs) may also have other bacteria like Mycobacterium species and Pseudomonas aeruginosa. Transmission of tuberculosis also occurs from the cough producing procedures on the patients with tuberculosis that involve production of aerosols[12]. Mycobacterium tuberculosis is transmitted in the form of droplet nuclei usually smaller than 5 µm which stay suspended in the environment for longer duration.

The virus that caused the COVID-19 pandemic is named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses (ICTV) on 11 February 2020[13].

SARS-CoV-2 remains stable in aerosols for hours in aerosols and for few days on surfaces, hence the transmission of SARS-CoV-2 is possible through aerosols and also shows fomite transmission.

Dentists are at increased risk of exposure to SARS-CoV-2. As they have to work in close proximity of the dental health care workers to the patients, dental procedures involving aerosol production is not advisable in patients who tested positive for COVID-19 (figure1).

On 16 March 2020, the American Dental Association (ADA) has advised dentists to postpone all elective procedures. ADA also developed gui-dance specific to address dental services during the 2019–20 coronavirus pandemic[14,15] .

**Figure 1: SARS-CoV-2**

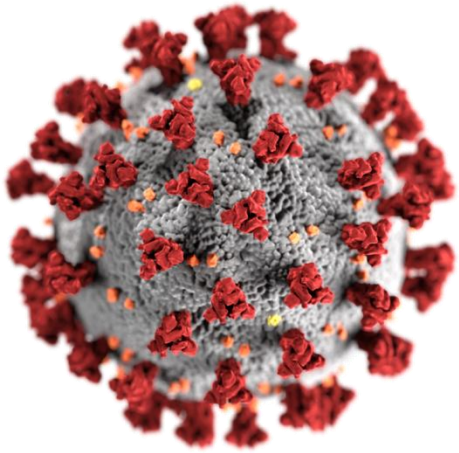


Figure 1: This illustration, created at the Centers for Disease Control and Prevention (CDC), shows ultra structural morphology exhibited by corona-viruses. The picture is in in public domain for more information visit CDC/ Alissa Eckert, MS; Dan Higgins, MAM - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #23312[29]

**Percutaneous (Bloodborne)**: Dental surgeons are exposed to numerous disease-causing microorganisms that may be transmitted in dental settings through several routes. This may include 1) Intact or non-intact skin in direct contact with blood, saliva, or other potentially infectious substances, 2) Indirect contact with a contaminated instruments, operatory equipment, or environmental surfaces, 3) Contact of mucous membranes of the eyes, nose, or mouth with droplets. The average risk of HIV infection after a single percutaneous exposure to HIV- infected blood is 0.3% (range: 0.2%–0.5%) and after an exposure of mucous membranes in the eye, nose, or mouth, the risk is approximately 0.1%[16].

A deep cut with an instrument that was visibly contaminated with the patient's blood, or a procedure that involved a needle placed in a vein or artery of patient increases risk for HIV infection[17]. The risk of transmission is high if the exposure to blood from patients with terminal illnesses is present. Nearly 2% of new cases of HIV occur due to unsafe injection use[18]. Invasive dental procedures are greatly associated with HIV virus transmission. Transmission can also occur from patient to patient via contaminated instruments. Universal precautions should be followed, assuming each patient as potentially infectious. This will reduce the risk of HIV transmission from patients to dentists. Hepatitis

Virus of utmost concern to dentists are the blood borne hepatitis B virus (HBV) hepatitis C virus (HCV) and hepatitis D virus (HDV). HBV is transmitted by percutaneous or mucosal exposure to blood or body fluids of a person with HBV infection.

Persons infected with HBV can transmit the virus for as long as they are HBsAg-positive. HDV occurs only as a co-infection with HBV and HBV immunization confers immunity to both HBV and HDV[19-21]. HBV and HCV are present in saliva hence can be transmitted by saliva contamination of instruments or surfaces.

Moreover HBV survive in dried blood at room temperature on environmental surfaces for some time and hence proper disinfection and sterilization should be followed. Transmission of microbes through direct contact of infected fluids in the form of splash or splatter on the non intact skin and exposure to infected lesions and surfaces can also occur[22].

**Decontamination And Spaulding's Classification:** Earle H. Spaulding classified the instruments of patient care items into critical, Semi critical and non critical on the basis of risk of infection involved in the use of these items. This approach was designed 30 years ago and is still being followed due to its approach towards disinfection and sterilization of patient care items[23].

Critical items confer a high risk for infection if they are contaminated with microorganism. These instruments penetrate sterile tissues and mucous membranes.eg surgical instruments like scalpel, blades, forceps, bone chisel, periodontal scalers, dental burs etc.

Semi critical items are those items which contact mucous membranes and non intact skin but do not penetrate them. This includes air water syringe tip, suction tips, dental headpieces.

Others include air water syringe handles, suction hose ends, lamp handle and switches, amalgam condensers, impression trays .Semi critical items should not only be disinfected but should be covered, cleaned, sterilized or discarded.

Non critical items – they are those that come in contact with intact skin but not mucous membranes. Two types of non critical items – 1: clinical contact surfaces which are touched by gloved hands. 2: housekeeping surfaces. Eg. Chairs, benches, floors walls, length of hoses etc. Disinfection of patient care items according to spauldings classification Critical items can be sterilized by autoclave chemiclave, dry heat, immersion in full strength glutaraldehyde (8 hours for sterilization and rinsed with sterile water) or sterile single use disposables.

Semicritical items also can be sterilized by autoclave chemiclave, dry heat, immersion in full strength glutaraldehyde (8 hours for sterilization and rinsed with sterile water) or sterile single use disposables. Non critical items can be disinfected by intermediate level disinfectant which includes hydrogen per oxide based, phenols, iodophores, quaternary ammonia compounds or disposable barriers.

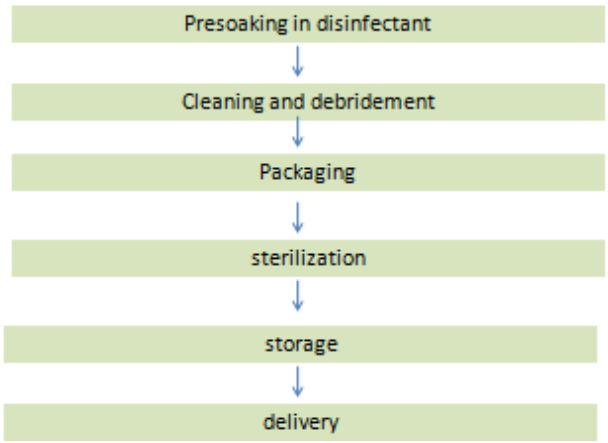
Environmental surfaces can be disinfected by intermediate to low level disinfectants which includes phenols, iodophores, and quaternary ammonia compounds. Sanitization can be done by scrub wash with soap and water.

**Personnel Health Elements of an Infection Control Program**: Personnel health elements becomes an integral part of the infection control program as it provides a protective environment to the dental health care personnel. The objective of this program is to educate the dental health care personnel regarding[22] Identification of work related infection risks, Institute preventive measures Ensure prompt exposure management and medical follow up.

**Sterilization:** In any dental setup the proper management of the sterilisation and pre sterilization phases plays a fundamental role in good management of instruments and personnel. It not only improves efficiency but it also saves clinical time. Presently instrument sterilizers are increasingly efficient in achieving results, both in terms of time and size.

In the present scenario management of dental procedures requires more skilled dentists, in terms of both knowledge and competence. The speed of execution of a given intervention depends on the ability of the team to deal with critical situations, in managerial terms. In these situations, it is essential not to compromise both the correct daily dental practice methodology and the instruments sterilisation and disinfection procedures (figure 2).

**Figure 2: Steps In Sterilization**




Sterilisation is a procedure that destroys any living organism in a vegetative form or spore present on the surface of the material to be sterilised[24]. An item or product that is devoid of living microorganisms is defined as sterile[25]. Sterilisation must be performed with a repeatable, verifiable, and documentable method. Chemical sterilisation is mainly used for the decontamination of thermo sensitive instruments, which cannot withstand cycles of autoclaving[26]. Autoclave sterilisation should be considered the elected procedure for most of the instruments which can tolerate wet heat.

Over the years, the most common forms of physical heat sterilisations in dental practices have been saturated steam, chemical steam, and dry heat. The latter 2 methods are considered unreliable and of limited use. The autoclave is the instrument used for the sterilisation of dental instruments.

At the start of the sterilisation cycle in, a pump aspirates the air present in the sterilisation chamber. This is essential, because the air in the chamber acts as an insulating barrier which prevents uniform penetration and diffusion of the steam. A fractional vacuum phase distinguishes the latest generation autoclaves from the older generation.

After the air inside the chamber has been expelled, the steam is introduced. After evacuation and substitution with steam, the pressure inside the chamber is higher than the atmospheric one, which leads to an increase in the boiling point of the water[27, 28].

**Conclusion:** All people have significant potential of carrying infectious microorganisms and transmit disease to other people. Therefore, it must be assumed that all blood and body fluids/substances are potentially contagious. Universal precaution should be followed to reduce the risk of transmission of pathogens. Clinician must ensure proper disinfection and sterilization of operatory and instrument to reduce cross transmission.

**References:**

1. CIDRAP (Center for Infectious Disease Research and Policy). Commentary: Protecting health workers from airborne MERS-CoV—learning from SARS https://www.cdc.gov /coronavirus/mers/infection-prevention-control.html. Accessed 9 August 2017.
2. Kim SH, Chang SY, Sung M, et al. Extensive viable Middle East respiratory syndrome (MERS) coronavirus contamination in air and surrounding environment in MERS isolation wards. Clin Infect Dis. 2016; 63:363–9.
3. CIDRAP (Center for Infectious Disease Research and Policy). Commentary: Health workers need optimal respiratory protection for Ebola https://www.cdc.gov/vhf/ebola /healthcare-us/ppe/guidance.html. Accessed 9 August 2017.
4. Osterholm MT, Moore KA, Kelley NS, Brosseau LM, Wong G, Murphy FA, et al. Transmission of Ebola viruses: what we know and what we do not know. MBio. 2015; 6:e00137.
5. Cole EC, Cook CE. Characterization of infectious aerosols in health care facilities: an aid to effective engineering controls and preventive strategies. Am J Infect Control. 1998; 26:453–64.
6. Hinds WC. Aerosol technology. 2nd ed. New York: John Wiley & Sons; 1999.
7. Infectious Diseases Society of America (ISDA). Preventing Transmission of Pandemic Influenza and Other Viral Respiratory Diseases: Personal Protective Equipment for Healthcare Personnel: Update 2010. Chapter: 2 Understanding the Risk to Healthcare Personnel. 2010. https://www.nap.edu/ read/13027/chapter/4#30
8. Yan J, Grantham M, Pantelic J, Bueno de Mesqita PJ, Albert B, Liu F, et al. Infectious virus in exhaled breath of symptomatic seasonal influenza cases from a college community. Proc Natl Acad Sci U S A. 2018; 115:1081–86.
9. Herfst S, Schrauwen EJ, Linster M, Chutinimitkul S, de Wit E, Munster VJ, et al. Airborne transmission of influenza a/H5N1

virus between ferrets. Science. 2012; 336:1534–41.
10. Centers for Disease Control and prevention (CDC). Approaches to Better Understand Human Influenza Transmission. 2010. https://www.cdc.gov/ influenzatransmissionworkshop2010/
11. Petti S, Vitali M. Occupational risk for Legionella infection among dental healthcare workers: meta-analysis in occupational epidemiology. BMJ Open. 2017;7(7):e015374. Published 2017 Jul 13. doi:10.1136/bmjopen-2016-015374
12. Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings,2005". www.cdc.gov. Retrieved 2020-03-16
13. "Naming the coronavirus disease (COVID-19) and the virus that causes it". www.who.int. Retrieved 2020-03-19.
14. "COVID-19 Resources for Dentists". American Dental Association. Retrieved 23 March 2020.
15. Wang Chen, Horby Peter W, Hayden Frederick G, Gao George F. A novel coronavirus outbreak of global health concern. The Lancet. 2020;395(10223):470–473.doi:10.10 16/S0140-6736(20)30185-9
16. Guidelines for Infection Control in Dental Health-Care Settings, MMWR December 19 (RR-17), 2003, 52.
17. Cardo DM, Culver DH, Ciesielski CA. Centers for Disease Control and Prevention Needlestick Surveillance Group. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. N Engl J Med. 1997; 337:1485-90.
18. Amritraj A, Rajan PS, Shenoy N, Poojary D, Shetty S. Awareness among young dentists about transmission of H.I.V. and preventive Measures. International Journal of Bioassays. 2013; 02(04):701-704.
19. McCarthy GM. Risk of Transmission of Viruses in theDental Office. J Can Dent Assoc. 2000; 66:554-557.
20. Bond WW, Favero MS, Petersen NJ, Gravelle CR, Ebert JW, Maynard JE. Survival of hepatitis B virus after drying and storage for one week. Lancet 1981; 1:550-1.
21. Heir J, Zicchardi VB. Transmission of Infectious Disease in the Dental Setting. The Mount Sinai Journal of Medicine. 1998; 65:378-382.
22. Guidelines for Infection Control in Dental Health-Care Settings---2003 Recommenda-tions and Reports December 19, 2003/ 52(RR17);1-61
23. Spaulding E. The role of chemical disinfection in the prevention of nosocomial infections. In: Proceedings of the International Conference on Nosocomial Infections, 1970. Chicago, IL: American Hospital Association; 1971. p. 247-54.
24. Sheth N., Rathod Y., Shenoi P., Shori D., Khode R., Khadse A. Evaluation of new technique of sterilization using biological indicator. Journal of Conservative Dentistry. 2017;20(5):346–350. doi: 10.4103/jcd.jcd_253_16.[PMC free article] [PubMed] [CrossRef] [Google Scholar]
25. Rutala W. A., Weber D. J. Disinfection and sterilization in health care facilities: what clinicians need to know. Clinical Infectious Diseases. 2004;39(5):702–709. doi: 10.1086/ 423182. [PubMed] [CrossRef] [Google Scholar]
26. Lacerda V. A., Pereira L. O., Hirata R., Jr, Perez C. R. Evaluation of two disinfection/ sterilization methods on silicon rubber-based composite finishing instru-ments. American Journal of Dentistry. 2015; 28(6):337–341.
27. Edwardsson S., Svensäter G., Birkhed D. Steam sterilization of air turbine dental handpieces. Acta Odontologica Scandinavica. 2009;41 (6):321–326. doi: 10.3109/000163583091623 42.
28. Andersen H.-K., Fiehn N.-E., Larsen T. Effect of steam sterilization inside the turbine chambers of dental turbines. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 1999; 87(2):184–188. doi: 10.1016/s1079-2104(99)70271-4.
29. CDC/ Alissa Eckert, MS; Dan Higgins, MAM - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #23312

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