Surface Disinfection

Khrystyna Vyprynyuk, RDH, B.S., M.H.S.
New York City College of Technology

Introduction

With the focus of most infection control procedures centered around mitigating the spread of the COVID-19 virus since early 2020, it is important to review and discuss the importance of infection control procedures in the dental setting for the post-COVID era. A pre-and-post-pandemic survey of infection control practices among dentists collected and analyzed data showing increased knowledge and higher adherence to infection control guidelines[1].

In addition to the COVID-19 virus, other, highly infectious, and potentially life-threatening diseases could spread in a dental setting. Some of the most prominent infectious diseases found in a dental office are viruses (Herpes simplex virus types 1 and 2, Norovirus, Coxsackievirus, Hepatitis viruses (HBV, HCV, HDV), Human immunodeficiency virus (HIV), Cytomegalovirus, Measles, Mumps, Rubella, and Respiratory viruses), and bacteria (S. aureus, E. coli, N. gonorrhea, T. pallidum, S. pyogenes, M. tuberculosis, Legionella pneumophila, and P. aeruginosa) [2]. Multiple routes of disease transmission exist in a dental setting. Direct or indirect contact with contaminated fluids, such as blood and/or saliva, can occur during dental procedures. Additionally, infectious agents can be spread by aerosols [3]. Transmission of infectious agents through indirect contact occurs by cross-contamination of environmental surfaces or objects.

Methods & Materials

This presentation is designed to aid dental professionals in improving their understanding of cross-contamination and disease transmission and avoid breaking the chain of infection transmission by incorporating proper surface disinfection into their routine.

- A review of available literature will answer questions on which diseases are most commonly spread in the dental setting.
- A review of the disease transmission process through cross-contamination of environmental surfaces will offer recommendations for best practices of surface disinfection and inform of the environmental hazards of disinfecting products.

Most common infections in a dental setting and modes of transmission

Any microorganism that colonizes the oral cavity or the bloodstream can spread in a dental environment. Among the most commonly found microorganisms are herpes viruses (HSV 1 and HSV 2), HIV, hepatitis B and C, Staphylococci, and Streptococci [3]. These pathogens could be transmitted from bodily fluids such as the blood or saliva of an infected individual to a potentially susceptible host (dental health care provider or another patient). A 2015 study of environmental surfaces in a dental setting showed contamination in 38% of the cases, most commonly Klebsiella, P. aeruginosa, E. coli, and Enterobacter [2].

Many of these microorganisms can survive outside of the host. Environmental surfaces serve as a reservoir for pathogens, which can remain pathogenic for prolonged periods of time. Depending on the nature of the pathogen, such as the type of the virus, pathogenicity, and weight of the particles, the time of persistence on environmental surfaces ranges from hours to days, weeks, and even months [3,5].

Multiple modes of transmission are possible in a dental setting: direct contact (bodily fluids), indirect contact (contaminated objects or surfaces), contact with mucous membranes, and inhalation of contaminated particles [3]. Cross-transmission of micro-organisms frequently occurs within the dental office. Based on the current research, this does not frequently result in infections in the patient or the dental healthcare providers (DHCP), keeping the actual risk for cross-infection low [2]. Preventing the spread of potentially harmful microorganisms in the dental setting is possible by breaking the chain of transmission [2]. To successfully break the chain of indirect disease transmission, surface disinfection protocols must be followed to the highest standard [6]. According to a recent survey, 89 % of dental hygienists believe they can reduce the spread of disease by following Infection Control Guidelines [7].

Types of Surfaces

In the dental setting, surfaces that are not in direct contact with the patient are called environmental surfaces [3] Those surfaces are further divided based on the degree of contamination into housekeeping surfaces and clinical contact In the dental setting, surfaces that are not in direct contact with the patient are called environmental surfaces [3] Those surfaces are further divided based on the degree of contamination into housekeeping surfaces and clinical contact surfaces [3] (Fig. 2). Clinical contact surfaces are frequently touched during patient care and pose a high risk of disease transmission through cross-contamination from gloved hands, aerosols, and contact with instruments [3,8]. These are surfaces such as computer mice, keyboards, pens, telephones, light switches, dental unit control switches, bracket trays, x-ray switches, sensors, and many more [3,8]. Housekeeping surfaces are those that are not frequently touched during patient care, such as floors and countertops, sinks, and walls [8].

This risk of infection from environmental surfaces is high, due to insufficient cleaning and disinfection practices [6]. The actual level of viral contamination on surfaces is not well-researched. However, various detection methods are used to determine how many pathogens are present on surfaces, which surfaces are most susceptible to contamination, and what types of pathogens are of most concern for transmission. One well-known detection method is the use of a special reagent - luminol - to detect the presence of blood particles on surfaces following dental procedures. A study revealed 86.7-100% contamination of surfaces such as flooring below the patient's headrest, instrument tray, operating light, dental chair armrests, cuspidor, and suction unit with blood detected using luminol [9].

Figures 1 and 2

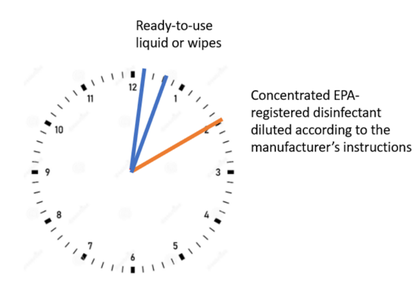
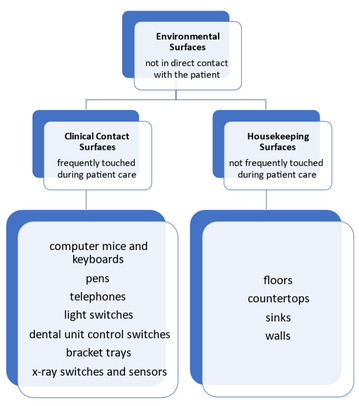


Figure 1. Recommended kill time for most bacteria, viruses, and yeast



Best ways to maintain asepsis and reduce cross-contamination

Prevention of disease transmission is achieved by reducing the number of microorganisms on surfaces [3]. To slow the spread of potentially pathogenic microorganisms on surfaces in the dental operatory, it is important to break the chain of infection [2]. According to the Centers for Disease Control (CDC) guidelines, this could be achieved through hand hygiene, the use of personal protective equipment (PPE), the use of engineering controls, and surface disinfection [8]. The proper way to maintain surfaces in a dental operatory is by cleaning, disinfecting, and use of surface barriers [3]. A combination of those approaches may be used [10].

The first approach is to clean and disinfect contaminated surfaces. The CDC recommends the use of an EPA-registered intermediate-level disinfectant to treat contaminated surfaces at the beginning of the day, after each patient, and at the end of the day [8]. Soiled surfaces and surfaces with visible contamination of blood or saliva must be cleaned prior to disinfecting [11]. A 2-step cleaning and disinfecting approach is recommended, using the Environmental Protection Agency (EPA)-registered disinfectant. EPA- registered disinfectants are available in multiple formulations. They could be found as ready-to-use or concentrated liquids [12]. An ideal disinfectant is characterized by a short kill time - a contact time between the disinfectant and the surface needed to inactivate a given pathogen. A specific time required to deactivate each pathogen is listed on the label [6]. Some EPA-registered disinfectants claim a 10-minute kill time. However, the effectiveness of these disinfectants against vegetative bacteria, yeasts, mycobacteria, and viruses is reported at exposure times of 30-60 seconds [13]. Reduced contact time will provide assurance that more pathogens are inactivated in a shorter period of time and increase compliance among providers.

Studies showed that ready-to-use disinfectants require a much shorter contact time [12]. Widely available, ready-to-use pre-wetted towelettes (wipes) are very common because of the ease of use of those products. Kill time for each brand and formulation of pre-wetted towelettes varies between 1 and 3 minutes (Fig. 1 and 3).

A second approach to minimizing disease transmission through cross-contamination of environmental surfaces is barrier protection [10]. This approach includes the placement of water-resistant impervious barriers on frequently touched surfaces prior to contamination (Fig. 4). Those surfaces include but are not limited to computer mice and keyboards, pens, hoses, handles, and switches. Barriers are either pre-cut pieces of thick film with mild adhesive to assure it remains on the surface, or plastic covers designed to fit specific equipment, cut to size, and secured by elastic. Removal and replacement of contaminated barriers after each patient encounter combined with disinfecting surfaces with proper disinfectant, assures compliance with infection control procedures. Additionally, thorough general cleaning and disinfection of clinical contact surfaces are performed regardless of barrier protection at the end of each workday [8].

The bundle approach refers to bundling multiple evidence-based practices for improving patient outcomes. The five most common practices have been identified as creating policies and procedures; appropriate selection of cleaning and disinfecting products; educating staff to include environmental services (ES) and patient equipment; monitoring compliance (i.e. thoroughness of cleaning, product use) with feedback; and implement a "no touch" room decontamination technology6. It is recommended to follow two to three of the listed recommendations simultaneously for the best outcomes.

Figures 3 and 4

Imprint on the environment

Despite the proven decrease in infections associated with contamination of environmental surfaces in a dental operatory due to the consistent use of disinfectants and surface barriers, multiple concerns remain regarding the safety of dental healthcare professionals and its impact on the environment. The use of surface disinfectants in dental operatories has a significant impact on the environment. Research shows that surface disinfection is one of the categories of infection control procedures that negatively impact the environment through human toxicity (cancerous and non-cancerous), marine, air, and freshwater eutrophication, acidification, and land use [15]. Various skin reactions can be a result of direct contact with disinfectants, such as alcohol and hypochlorite. Skin reactions may include peeling, bleeding, cracking, and stinging [16]. Inhalation of disinfectant sprays, contact with skin, and use of alcohol (propanol) contribute to human toxicity [15]. Therefore, the use of personal protective equipment (PPE), such as utility gloves, masks, shields, eyewear, and overgrown is recommended during surface disinfection [8].

Additionally, proper waste management, and categorizing many different types of waste into appropriate packaging is essential [16]. Studies have been carried out to calculate how impactful a single dental visit with all related infection control procedures can be on the environment. A single dental exam is not that harmful, but studies must be conducted to learn about the potential impact on the environment if multiplied by the number of dental visits annually nationwide and globally [15]. Plastic containers from disinfecting wipes, the use of disposable plastic barriers, etc. increase waste and negatively impact land use, and marine, and freshwater pollution, resulting in climate change. The effectiveness of disinfecting products in breaking the chain of disease transmission is a priority. As dental professionals, we can contribute to minimizing the negative impact of surface disinfection by studying the effectiveness of more environmentally friendly substitutes, using products packaged with minimal effects on the environment in mind, and reducing waste.

Conclusion

Based on this review it is safe to conclude that despite the level of disease transmission in a dental setting being relatively low, necessary steps should be taken to minimize the spread of infectious diseases. Surface disinfection is one of the many measures a dental care professional could take to break the chain of disease transmission. Various surface disinfection protocols are being implemented depending on the type of surface, material, and type of disinfectant used. It is important to remember the potentially negative impact of the use of infection control procedures on the environment and attempt to minimize waste and use environmentally friendly products without compromising the quality of infection control.

References

1. Cheng HC, Chang YJ, Liao SR, Siewchaisakul P, Chen SLS. The impact of COVID-19 on knowledge, attitude, and infection control behaviors among dentists. BMC Oral Health. 2021;21(1):584. doi:10.1186/s12903-021-01946-w
2. Volgenant CMC, de Soet JJ. Cross-transmission in the dental office: does this make you ill? Curr Oral Health Rep. 2018;5(4):221-228. doi:10.1007/s40496-018-0201-3
3. Schneiderman MT, Cartee DL. Surface disinfection. In: DePaola LG, Grant LE, eds. Infection Control in the Dental Office. Springer International Publishing; 2020:169-191. doi:10.1007/978-3-030-30085-2_12
4. Umar D, Basheer B, Husain A, Baroudi K, Ahamed F, Kumar A. Evaluation of bacterial contamination in a clinical environment. J Int Oral Health. 2015;7(1):53-55. Accessed December 6, 2022. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4336662/
5. Dhadse P, Oza R, Bhombe K. Disinfectants for Dental Setting in Coronavirus Disease 2019 Era. J Datta Meghe Inst Med. 2022;17(1):83-87. doi:10.4103/jdmimsu.jdmimsu_438_21
6. Rutala WA, Weber DJ. Best practices for disinfection of noncritical environmental surfaces and equipment in health care facilities: A bundle approach. Am J Infect Control. 2019;47S:A96-A105. doi:10.1016/j.ajic.2019.01.014
7. Garland KV. A Survey of United States Dental Hygienists' Knowledge, Attitudes, and Practices with Infection Control Guidelines. The Journal of Dental Hygiene. 2013;87(3):140-151.
8. Guidelines and recommendations | infection prevention & control in dental settings | division of oral health | cdc. Published May 23, 2019. Accessed December 6, 2022. https://www.cdc.gov/oralhealth/infectioncontrol/guidelines/index.htm
9. Al-Eid RA, Ramalingam S, Sundar C, Aldawsari M, Nooh N. Detection of visually imperceptible blood contamination in the oral surgical clinic using forensic luminol blood detection agent. J Int Soc Prev Community Dent. 2018;8(4):327-332. doi:10.4103/jispcd.JISPCD_10_18
10. Upendran A, Gupta R, Geiger Z. Dental infection control. In: StatPearls. StatPearls Publishing; 2022. Accessed December 6, 2022. http://www.ncbi.nlm.nih.gov/books/NBK470356/
11. Standard precautions. Published November 30, 2022. Accessed December 6, 2022. https://www.cdc.gov/oralhealth/infectioncontrol/summary-infection-prevention-practices/standard-precautions.html
12. Rutala WA, Weber DJ. Surface disinfection: treatment time (Wipes and sprays) versus contact time (Liquids). Infection Control & Hospital Epidemiology. 2018;39(3):329-331. doi:10.1017/ice.2017.288
13. Rutala WA, Weber DJ. Disinfection, sterilization, and antisepsis: An overview. American Journal of Infection Control. 2019;47:A3-A9. doi:10.1016/j.ajic.2019.01.018
14. West AM, Nkemngong CA, Voorn MG, et al. Surface area wiped, product type, and target strain impact bactericidal efficacy of ready-to-use disinfectant Towelettes. Antimicrob Resist Infect Control. 2018;7(1):122. doi:10.1186/s13756-018-0416-z
15. Borglin L, Pekarski S, Saget S, Duane B. The life cycle analysis of a dental examination: Quantifying the environmental burden of an examination in a hypothetical dental practice. Community Dent Oral Epidemiol. 2021;49(6):581-593. doi:10.1111/cdoe.12630
16. Cabrera-Tasayco F del P, Rivera-Carhuavilca JM, Atoche-Socola KJ, Peña-Soto C, Arriola-Guillén LE. Biosafety measures at the dental office after the appearance of covid-19: a systematic review. Disaster Medicine and Public Health Preparedness. 2021;15(6):e34-e38. doi:10.1017/dmp.2020.269

Presented at the 99th Annual Session of the Greater New York Dental Meeting in 2023.