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Original Research

A review on management of droplet infection and aerosol in dental practice among practitioners during covid 19

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ABSTRACT:
The transmission of infectious disease is very common among dental practioners as there is frequent direct contact with patients. It has become a life threatening area during the covid 19 pandemic. The aim of our study is to review/refurnished or brief on knowledge among dental practioners about the spread of infectious disease and droplet infection during dental practice so as to alert ways of management to prevent from further spread of infections. **Method**: Data were collected through pubmed and google scholar where previous published articles based on infectious disease and its control were mentioned using MESH terms. **Result**: Till the date 24 articles were found, out of which 7 satisfied our inclusion criteria.The following articles were analysed and Data were collected from the month of April 2020 till September 2020. Most of the studies reported that mode of transmission is frequent through direct contact /fomites and aerosols as stated by previous authors. **Conclusion:** The management of such situation is by adhering to strict protocols as mentioned in CDC guidelines and imparting further knowledge among practitioners about several infectious diseases and remaining updated as situation arises.

Keywords: infectious diseases, infection control, covid 19, aerosols, droplet infections

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INTRODUCTION

The transmission of infection and infectious disease has been affecting a lot of dental practice and practioners since decades. Such mode of transmission is very common among patient to practitioner, practioner to patient and vice versa([1]). The very common mode of transmission being highlighted in earlier times were mostly through aerosols and droplet infections . Nowadays covid 19 is the life threatening pandemic where the route of transmission is mostly face during dental treatment as there is a direct contact between patient and practitioner. The operating field is always flooded with saliva, blood and other fluids and the environment is filled with aerosolized droplets which lingers in the atmosphere for hours which is obviously attributed as a risk in the mode of disease transmission during dental practice([6,7]). However dental care can be provided with a high degree of safety for the patient and therapist, provided that the protocols of modern infection control are adhered to which is available from the Centers for Disease Control and Prevention [[2]].

Thomas etal have stated that Transmission of bloodborne pathogens can normally be prevented through the use of standard precautions. The Centers for Disease Control (CDC) defines standard precautions as ‘‘any standard of care designed to protect health care personnel and patients from pathogens that can be spread by blood or any other bodily fluid, excretion, or secretion.’’([2]). The term ‘‘standard precautions’’ replaces the term ‘‘universal precautions.’’ Standard precautions apply to contact with blood, bodily fluids (except sweat), intact mucous membranes, and non-intact skin. These precautions are normally sufficient to prevent the transmission of infectious agents in the dental setting.([2])

METHODS

MAINTENANCE AND RESOURCES/TRAINING OF OPERATORS

Information of the therapist as well patient must be recorded in secure files for documentation regarding immunisation, occupational exposures to bloodborne pathogens (BBP), injuries, and medical work restrictions ([3]).

Thomas etal has reported that operators must be trained and educated about infection control(IC) protocol. They should have training in the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and IC. Sometimes individuals may be infected or injured during their observational experience. If such individuals are present in the practice, an appropriate policy should be developed regarding mandatory training, hepatitis B immunization, and postexposure protocol should an injury occur. Appropriate legal counsel should be sought in developing these guidelines as reported by Thomas etal.

Thomas et al have also stated that Appropriate Training must be received at the time of initial assignment. Training should be conducted annually thereafter. Training sessions should be held during working hours. It may be convenient to review IC issues at monthly staff meetings on an ongoing basis. If this is done, a formal record of the training should be kept for all attendees. At a minimum, training should cover: the Occupational Safety and Health Administration (OSHA) Standard; bloodborne diseases (especially hepatitis B [including information on immunization], hepatitis C, and HIV/AIDS); the office-specific exposure control plan; the use and care of personal protective equipment (PPE); postexposure protocol; and hazard communication (eg, biohazard symbols).([4])

General information on infection control is available from a number of sources. Chief among these are the latest guidelines from the Centers for Disease Control and Prevention (ie, Guidelines for Infection Control in Dental Healthcare Settings – 2003) [[2]]. The Regulatory Compliance Manual is available from the ADA and is a good source of general information ([5]).

RESULTS

ANALYSIS OF RESULTS ON ROUTE OF TRANSMISSION AND MANAGEMENT

Results obtained from the articles on handling situation during covid 19, As all the seven studies were proposed in a general consensus, any elective non-emergency dental care for patients with suspected or known COVID-19 should be postponed for at least 2 weeks during the COVID-19 pandemic. Only urgent treatment of dental diseases can be performed during the COVID-19 outbreak taking into consideration pharmacological management as the first line and contagion-reduced minimally invasive emergency treatment as the secondary and final management as stated byBanakar et al.([8])

A review by Zi-yu GE etal([9])on Possible aerosol transmission of COVID-19 and special precautions in dentistry have stated that aerosols from highly virulent pathogens like severe acute respiratory syndrome-coronavirus (SARSCoV) can travel more than six feet similarly stated by Kutter et al ([10]) . Contaminated surfaces have been found to be a route of transmission of several nosocomial pathogens. Although human coronaviruses including SARS-CoV and Middle East respiratory syndrome-coronavirus (MERS-CoV) have limited capacity to survive on a dry surface, several studies have reported that they can persist on a surface for a few days, particularly when suspended in human secretion, and undergo onward transmission (Kramer et al., 2006; Otter et al., 2013) ([11]). Hand contact with contaminated surfaces may lead to pathogen acquisition and transfer to the eyes, nose, or mouth, resulting in a new case of infection.

A review conducted by Zemouri et al. ([12]) showed that 38 types of microorganisms could be found in the air of the dental clinic, including Legionella pneumophila, the causative agent of severe pneumonia. There have been reports of patients acquiring pneumonia after being treated at a dental clinic. Another group in the UK reported an outbreak of tuberculosis among dental patients who acquired the infection at their local dentist ,Smith et al([13]). In terms of coronavirus, a study conducted by Wang et al. ([14]) examined the oral cavity of SARS patients and found large amount of SARS-CoV RNA in their saliva ((7.08×103) to (6.38×108) copies/mL), suggesting the possibility of coronavirus transmission through oral droplets. Past evidence showed that the majority of SARS-CoV and MERS-CoV cases were associated with nosocomial transmission in hospitals, resulting, partly, from the use of aerosol-generating procedures performed on patients with respiratory disease (Chowell et al. ([15]). Based on the current epidemiological data, 2019-nCoV has higher transmissibility than SARS-CoV and MERS-CoV (Chen et al)([16]). Therefore, modification of standard precaution and infection control regimen targeted toward 2019- nCoV is essential during this outbreak.

Fig. 1 Different routes of transmission in dental setting: aerosol, droplet, and fomite(courtesy Zi-yu GE etal)

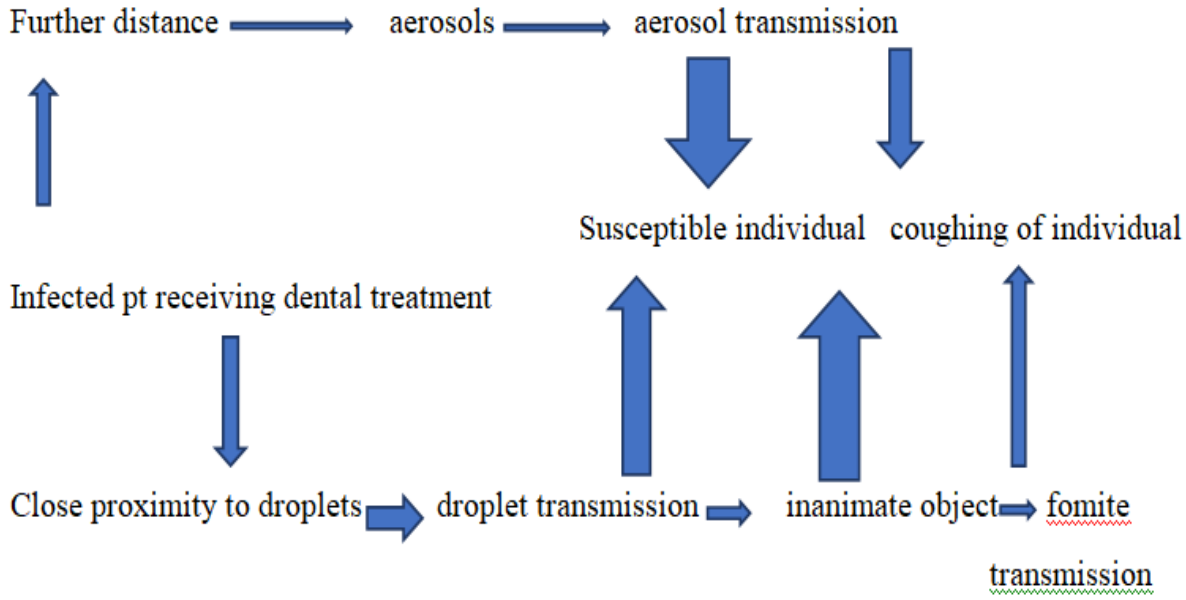

Table 1 An overview of the guidelines provided for Coronavirus 2019 in dentistry by articles

I.D. Author (Year)	Guidelines offered	Procedural considerations	Authors' comments on the literature gap
Alharbi et al. (2020)	i.) Emergency Tx (fracture and infection compromising patient's airway, uncontrolled bleeding) for all patients ii.) Minimally invasive urgent care without aerosol generation for asymptomatic suspect, stable active and recovered patients III.) Invasive urgent care with aerosol generation for asymptomatic suspect	.i) Restrict Intraoral imaging Ii.) Preprocedural use of 0.23% povidone-iodine mouth-wash at least 15 s iii) II.) Single-use devices iv)Use a rubber dam v) Avoid aerosol-generating procedures vI.) Avoid administering Ibuprofen	Lack of a guideline for patients who need dental Tx before an imminent transplant -Lack of a guide on proper saliva ejectors or surgical aspiration
2) Harrel et al 2004	suggested layering infection control steps to reduce the potential danger from contaminated dental aerosols	1. barrier protection – mask, gloves and eye protection; 2. preprocedural rinse with antiseptic mouthwash; 3. high-volume evacuator; 4. high-efficiency particulate air room filters and ultraviolet (UV) treatment of ventilation system. Many other techniques and devices have been introduced since the early 2000s	A limitation of the studies testing effectiveness of aerosol-reducing interventions is the use of bacterial colony-forming units (CFU) as a surrogate measurement tool to check for reduction in contaminated aerosol. Hence, in patients where the preprocedural rinses are used, the true efficacy ofthe otherinterventions may be obscured as the bacterial counting the saliva itself is controlled
3) Yadav 2015	UV has germicidal properties and short wavelength UV-C (250 nm to 265 nm wavelength) is used for disinfection purposes	Ozonisation: ozone, an allotrope of oxygen, owes its antimicrobial activity to its high oxidative potential.	

		Temperature measurement is recommended when the patient enters the dental office; if the body temperature exceeds 37.3 ◦C, it is suggested the treatment be postponed . In patients with a cured COVID-19 infection, the American Dental Association (ADA) guidelines propose to reschedule dental treatment at least 72 h after the resolution of the symptoms, or 7 days after the appearance of initial symptoms, such as fever controlled without antipyretics and spontaneous improvement of breathing	perform an accurate telephone triage, a subsequent triage in dental clinics, and a complementary questionnaire to collect as much information as possible about the patient and his or her family members, specifically regarding symptoms and movements in the previous 14 days
4) Ma et al.	Pilot study on avian influenza	3 types of mask- N95, surgical mask, homemade 4 layered mask	No significant differences on efficiency
5) Lee et al.	focused on particles between 0.093 and 1.61 μm, and demonstrated that the FFP respirators provided better protection than the surgical masks, suggesting that such surgical masks are not a good substitute for FFP respirators in the case of airborne transmission of bacterial and viral pathogens	Filtration efficiency ranges from 80 %,94%,99%	The principal limitation of surgical masks is due to the poor face fit and the consequential possibility of aerosol aspiration.
6) Rabenau et al.and Kampf et al.	illustrated that various groups of disinfectants, such as propanol, sodium hypochlorite, and ethanol, in percentages ranging from 80 to 95% (as a hand rub) or 62 to 71% (as a surface disinfectant	can reduce SARS-CoV-2 load to below recording levels in a variable lapse of time.	Pertinent papers on this topic are limited.
7) ziyu et al	i) Post a cough etiquette instruction at the entrance of the waiting room. Ensure that all patients cover their nose and mouth with a tissue or their elbow when coughing or sneezing; instruct them to dispose used tissues into a waste bin immediately after use and ensure hand hygiene ii) Hand hygiene There is a growing awareness of the importance of handwashing in the prevention of acute	Use of personal protective equipment Preprocedural mouth rinses Rubber dam isolation Removal of filter or contaminated air	Dentist are at high risk for exposure to infectious disease. . A better understanding of aerosol transmission and its implication in dentistry can help identify and rectify negligence in daily dental practice. In addition to the standard precautions, implementation of special precautions could prevent disease transmission from asymptomatic carriers.

	respiratory infections. During the outburst of SARS, several epidemiological studies suggested that handwashing with soap and 70%–90% alcohol-based hand rubs (ABHRs) was effective in curbing SARS transmission (Rabenau et al., 2005; Fung and Cairncross, 2006).		

DISCUSSION

PROTOCOLS FOLLOWED AS A MEANS OF INFECTION CONTROL DURING COVID 19

Banaker etal have reported Pre-dental treatment before entering a dental office Patient triage, identification of possible suspects, delay of non-urgent dental care, management of dental appointments, and active screening of dental staff are among the protective protocols that should be considered prior to the patient entering the dental office.

At the dental office Active screening of patients, management of social distancing in the dental office, offering sanitation measures to the patients, use of facemasks by everyone entering the dental office, patient education, use of PPE by the dental team, and management of dental operatory room are among the procedures required to be carried out in dental offices.

During dental treatment Maintaining hand hygiene, offering a preoperative antimicrobial mouth rinse to patients, using rubber dams, high-volume saliva ejectors, and extraoral dental radiographs, using 4-handed dentistry, avoiding aerosolgenerating procedures, one-visit treatment, and environmental cleaning and disinfection procedures should be implemented during dental procedures

Post dental treatment Cleaning and disinfecting reusable facial protective equipment, as well as management of laundry and medical waste following routine procedures should be considered after dental treatment.

A Review of surface disinfection protocols in dentistry: a 2019 update by Mel Mapparappu etal([17]) have reported article exploring the history as well as the current practice of disinfection in the dental profession and further explores the variations in the use of surface disinfection based on the published literature. In this study current practice guidelines as recommended by agencies like Centers for Disease Control (CDC) were studied and summarized for the review. The authors have discussed that in the pre-19th century era, natural elements like acids, sulfur, mercury, and various alkaline metals were valued for their ability to obliterate pathogens. However More recently aerosols, sprays, and disinfectant wipes with more powerful chemicals including quaternary ammonium compounds and aldehydes have become popular.

SEVERAL PRECAUTIONS TAKEN DURING DENTAL PROCEDURES

1. Patient screening: As is the routine, dentists should take a thorough medical history from each patient and confirm the health status at each recall visit. During outbreak, targeted screening questions for COVID-19 must be asked. These questions should include personal, travel, and epidemiological history. Temperature and lower respiratory tract symptoms should be closely monitored. Note that symptoms of fever and fatigue could be caused by acute dental infection; therefore, the etiology should be confirmed.
2. For patients whose infections are dental in origin, emergency treatments could be performed following standard dental emergency regimen.
3. For suspected/confirmed cases of COVID-19 that are medically stable, laboratory tests and multidisciplinary team consultations should be performed. To ensure the safety of patients and HCWs, the patient should be rescheduled after the outbreak if required.
4. For suspected/confirmed cases of COVID-19 requiring urgent dental treatment, highest level of personal protection should be implemented. To facilitate natural ventilation, WHO (2020a) recommends the use of a negative pressure room with a minimum of 12 air changes per hour or at least 160 L/s per patient. Mechanical ventilation should commence before treating the next patient
5. Waiting area Post a cough etiquette instruction at the entrance of the waiting room. Ensure that all patients cover their nose and mouth with a tissue or their elbow when coughing or sneezing; instruct them to dispose used tissues into a waste bin immediately after use and ensure hand hygiene. Patients should be placed in an adequately ventilated waiting area. For rooms with natural ventilation, 60 L/s per patient is considered adequate ventilation (Atkinson et al., 2009). Equipment such as blood pressure cuffs and thermometers should be cleaned and disinfected with 70% ethyl alcohol after each use, as recommended by the WHO (2016).

6. The WHO (2020) stated that hand hygiene includes either cleansing hands with an ABHR or with soap and water; both methods are equally effective. ABHRs70%–90% alcohol-based hand rubs (ABHRs) are preferred if the hands are not visibly soiled; if the hands are visibly soiled, water and soap should be used.

During dental practices, the spread of oral microorganisms mostly radiates toward the dentist's face, particularly in the inner part of the eyes and around the nose, which are important areas for infection transmission (Bentley et al., 1994; Nejatidanesh et al., 2013) ([18]). Personal protective equipment (PPE) can form an effective barrier against most hazards of aerosols generated from the operative site.

1. Protective eyewear and face shields: To protect the eyes from aerosols and debris created during dental procedure, protective eyewear or face shield should be worn throughout the treatment and disinfected between patients.
2. Face masks: When performing emergency dental treatment with suspected COVID-19 cases, a higher level of respiratory protection should be considered, such as EU FFP3 respirators conforming to European Standard 149 (EN149)
3. Preprocedural mouth rinse: A meta-analysis showed that the use of preprocedural mouth rinse, including chlorhexidine (CHX), essential oils, and cetylpyridinium chloride (CPC), resulted in a mean reduction of 68.4% colony-forming units in dental aerosol (Marui et al., 2019). Although the effect of preprocedural mouth rinse against coronavirus is still unknown, it has been proven that CHX is effective against several infectious viruses, including herpes simple virus (HSV), human immunodeficiency virus (HIV), and hepatitis B virus (HBV) (Wood and Payne, 1998) About 0.12% CHX was used as a preprocedural mouth rinse. For patients who develop mucosal irritation or other side effects such as tongue stain, 0.05% CPC could be a good alternative (Feres et al., 2010).
4. Rubber dam isolation: Application of rubber dam during cavity preparation showed a significant reduction in the spread of microorganisms by 90% (Cochran et al., 1989)
5. Removal/filter of contaminated air: the two most commonly used devices include the inexpensive highvolume evacuator (HVE) and the expensive high efficiency particulate arrestor (HEPA) filters

INTERVENTIONS BEING DONE TO REDUCE INFECTIONS

Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases a review paper by Kumbargere Nagraj S et al ([19])have stated that Many dental procedures produce aerosols (droplets, droplet nuclei and splatter) that harbour various pathogenic micro-organisms and may pose a risk forthe spread of infections between dentist and patient. The COVID-19 pandemic has led to greater concern about this risk. The objective was to assess the effectiveness of methods used during dental treatment procedures to minimize aerosol production and reduce or neutralize contamination in aerosols. Inclusion critera were randomized controlled trials (RCTs) and controlled clinical trials (CCTs) on aerosol-generating procedures (AGPs) performed by dental healthcare providers that evaluated methods to reduce contaminated aerosols in dental clinics (excluding preprocedural mouthrinses). The primary outcomes were incidence of infection in dental staff or patients, and reduction in volume and level of contaminated aerosols in the operative environment. The secondary outcomes were cost, accessibility and feasibility.

Enrica Laneve et al([20]) have reported that 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 factors that are related to the procedure underway, and the ability of the team to deal with critical situations, in managerial terms (late patients, overlaps in services, more consultants in the practice, and more investigative interventions) . In these situations, it is essential not to undermine both the correct daily dental practice methodology and the instruments sterilisation and disinfection procedures; hence, because of this, the capacity to be able to use sterile and well-stocked instruments in a reasonable time is priceless. To have a lot of sterile material in stock ready to use, it is essential to manage instruments properly and have the most efficient instruments and sterilizers .The main infections that can be contracted in a dental setting are caused by bacteria such as Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pyogenes, Streptococcus pneumoniae, Clostridium tetani (tetanus), Legionella, mycobacteria such as Mycobacterium tuberculosis (TB), fungi like Candida albicans, and viruses such as HIV (AIDS) and Hepatitis.The aerosol effect of some dental instruments favours the spread of these microorganisms, as phonation, sneezing, and coughing do. Disinfection and decontamination have to be put into practice not only to clean the instruments used in dental procedures but also to clean surfaces that may have come into contact with the patient's biological fluids or been contaminated by aerosols, like the surfaces of the dental chair and dental carts . Most commonly used disinfectants: formaldehyde; glutaraldehyde, peracetic acid, potassium peroxy-monosulphate complexes, phenols, alcohols, iodine compounds, chlorate compounds, quaternary ammonium salts, and chlorhexidine. The disinfection procedures following the decontamination phase, meaning the physicochemical removal of infecting agents from instruments in order to lower the infection burden, are not enough to ensure all of the microorganisms responsible for cross

infections are destroyed; in fact spores are resistant to the majority of disinfectants. We necessarily therefore have to resort to sterilisation procedures.

Sabino-Silva et al ([21]) starting with the assumption that COVID-19 may be present in saliva through major salivary gland infection or through the crevicular fluid, suggest more accurate studies in order to evaluate the possibility of early and non-invasive virus diagnosis using saliva samples. The possibility of the role of salivary gland cells in the initial progress of the infection and as a source of the virus should be considered and validated. Dentistry remains one of the most exposed professions to SARS-Cov-2; each individual clinical situation must be adequately controlled and pondered by the healthcare professional; defaults in protocols cannot be tolerated. However, there are indications in the literature on how to deal with emergencies reported by Federico Alcide Villani et al.([22])

A study was conducted by BL gordon etal ([23])to determine the knowledge and attitudes of dental health care workers (DHCWs) towards infection control procedures, to examine DHCWs' practising behaviour in respect of infection control, and to determine whether a relationship exists between knowledge, attitudes and behaviour. Study Data indicated that over the period of the review there have been substantial improvements with compliance in some areas of infection control in dentistry, for example glove wearing. However, other aspects, such as the effective management of needlestick injuries, remain problematic. They concluded that More rigorously designed studies are required to assess accurately dental team members' adherence to infection control guidelines.

CONCLUSION

The management of such infection and infectious disease is by adhering to strict protocols as mentioned in CDC guidelines and imparting further knowledge among practitioners about several infectious diseases and remaining updated as situation arises.

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CONFLICT OF INTEREST

None declared

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