



Improvement of Infection Control Measures during Dental Manipulations

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

When performing dental manipulations, infection control plays a special role, since its violation will negate all the efforts of the dentist, as well as allow various infectious and bacterial complications to develop in the body, as a result of which the patient's health will be significantly harmed.

Infection control in dentistry is especially important at the present stage, when the spread of coronavirus infection has not yet been stopped, and the world is already experiencing the third wave of COVID-19. So, today it is very important to evaluate the existing infection control measures taken in dental health organizations, both private and public, and to investigate the measures proposed in the literature to reduce the transmission of both the new coronavirus and other infectious diseases to patients.

Infection control measures in dentistry are aimed at minimizing the cross-transmission of mainly blood-borne pathogens. However, the high degree of contagion of the new coronavirus, as well as

the possibility of the appearance of such viruses in the future, makes specialists already think about the need to improve infection control measures in order to preserve the health of patients and make dental manipulations as safe as possible for them. This is especially important for elderly patients, in whom complications from coronavirus-like infectious diseases can be fatal.

In dental practice, many people are at risk, such as the practitioner, assistants, patients, administrative staff, cleaners, and possibly accompanying people. Standard precautions are usually not sufficient during the active spread of infections, so it is important to use proper PPE and follow hand hygiene. The sequence of consultations and scheduling of appointments with patients, as well as making changes to the waiting area, are also important. To minimize aerosol contamination, mouthwash should be performed before treatment. It should be taken into account that fans with NERA filters can significantly reduce the number of aerosols and, accordingly, reduce the level of pathogenicity of viruses.

The aim of the work is to consider the measures proposed in the publications aimed at improving the measures of infection control during dental manipulations.

Keywords: Infection control; dental manipulations; patient health; measures to counteract the spread of infection.

1. INTRODUCTION

The role of infection control has always been leading in the work of dentists of any profile. Ensuring the safety of dental procedures has always been an important factor contributing to the quality of dental services [1].

However, for a year, a highly contagious infectious disease has been actively spreading in the world, which forces all medical specialists in general and dentists in particular to pay the closest attention to such a component of the services provided as ensuring the safety of patients and blocking the transmission of coronavirus to healthy visitors of dental organizations [2].

The virus is hard enough to destroy. It is known that under favorable conditions, the SARS-CoV-2 virus can survive on surfaces such as plastic and stainless steel (7 days), treated wood and fabric (2 days), cardboard (24 hours), and the outer layer of surgical masks for up to 7 days. For this reason, these surfaces are a potential source of virus transmission through contact and emphasize the importance of hand hygiene [3].

The situation is complicated by the fact that, of course, for the first time the world is faced with a fairly serious virus that spreads rapidly and is quite difficult to detect and reduce its pathogenicity in time, but, unfortunately, all progressive humanity is aware that such a virus is far from the last, so it is extremely important to develop such a system of patient protection in dentistry and other branches of medicine, so that

patients can visit the doctor without fear, without fear of infection.

The aim of the work is to consider the measures proposed in the literature aimed at improving the measures of infection control during dental manipulations.

2. METHODS AND MATERIALS OF THE STUDY

Through the use of the analytical method, a significant amount of literature, both recent and previous periods, was studied concerning measures for organizing infection control during dental manipulations.

3. RESULTS

For the organization of infection control when performing dental manipulations, it is very important to analyze the ways and methods of penetration of various infections into the patient's body and the speed of their spread.

Saliva is an important source of transmission due to the release of its microparticles into the air, resulting from natural activities such as breathing, sneezing and coughing, which poses a potential danger to healthy uninfected people, as well as health care workers in medical institutions. However, dental personnel working in the immediate vicinity of the oral cavity are at greater risk, due to the extensive aerosols generated during dental treatment, especially when using high-speed drills, ultrasonic tools for removing tartar, and air/water syringes [4,5].

Studies show that quite often different viruses occur in more than half of patients, especially during the flu epidemic. However, the level of SARS-CoV-2 virus was significantly higher: it was detected in saliva samples of 87-100% of clinical dental patients [6].

The virus can enter the saliva in three ways: direct exchange of secretions from the upper and lower respiratory tract and the oral cavity. The last path is the first and most important. The gingival cleft fluid is rich in blood components and can also add viruses to saliva. Finally, the primary and secondary salivary glands may be the source of this virus, because the epithelial cells of the salivary gland ducts are found to be an early target for infections via angiotensin converting enzyme 2 (ACE2) receptors.

Following the principles and measures of infection control is a moral duty of all medical professionals. Dentistry is no exception. Infection control is important in dentistry, as the patient's saliva can be contaminated with oral commensals and opportunistic microorganisms. In addition, it may contain certain pathogens during infection, as well as in the state of its carrier. Due to the nature of dental procedures, contact with blood and saliva aerosols is unavoidable [7].

Direct contact with liquid-contaminated environmental surfaces, tools, and equipment is also a potential source of pathogen transmission. In dental practice, the dentist, dental assistant, staff handling and administering instruments, and patients are at risk of transmitting infections. Dental laboratory staff are also at risk due to cross-contamination between the clinic and the laboratory. In addition, it can be extended to their families if infection control measures are not taken correctly. Thus, in order to comply with infection control measures, most dentists in the world are guided by individual guidelines. These infection control measures were designed with the chain of infection and cross-infection in mind.

However, with the occurrence of a new coronavirus infection, infection control in dental organizations has changed. A particular difficulty in this regard is the possible contact of the dentist with carriers of the virus, which sometimes carry the disease asymptotically. A number of authors indicate that the release of the virus can begin 5-6 days before the appearance of the first symptoms. Presymptomatic carriers are difficult to identify,

although the viral load is maximum at the time of onset of symptoms. Consequently, anyone who needs dental care can be a potential source of transmission [8].

The infection control regime can be changed for the current pandemic, and then for the long-term endemic era. Many countries have banned or restricted dental procedures, allowing only minimal emergency care. However, this is an uneconomical and not a long-term solution to the problem. Therefore, if dental offices are allowed to operate, strong infection control measures are required to prevent the transmission of various types of infections. On this basis, standard precautions may be applied during the endemic period.

4. DISCUSSION

Usually, the patient's medical history is collected immediately before the examination. During the current pandemic, the urgency of dental treatment must be determined before the patient is scheduled for an appointment. Before the appointment, it is necessary to collect a general medical history by phone, e-mail or using other Internet systems. You must complete a COVID-19 screening questionnaire, including symptoms, contacts, and travel history. If this indicates the presence or possible presence of SARS-CoV-2 and the patient requires urgent treatment, additional infection control measures should be taken. If the level of infection in the population increases, non-emergency procedures should be postponed. If an appointment is scheduled, the patient should be asked to come alone and wear a mask. If it is necessary to have a person accompanying the patient in the dental clinic, such a person must necessarily use personal protective equipment and fill out an information questionnaire for screening COVID-19 [9].

In the waiting area of the dental clinic, you must leave only the most necessary items and furniture. Toys and magazines should be removed. The seating arrangements must be individual and placed at a safe distance from each other.

Hand sanitizers containing $\geq 70\%$ alcohol or other permitted substance should be available to the patient and accompanying person. An additional 30 minutes should be allocated for each patient, so that step-by-step precautions can be taken and the number of waiting people and patients can be minimized.

The staff of the clinic should include administrative staff, who should use personal protective equipment when working with patients, and avoid transferring medical records and related administrative materials from the treatment area to the administration area. In addition to the screening questionnaire, all people admitted to the clinic should have their temperature measured using a non-contact laser thermometer.

Mouth rinses containing antimicrobial compounds are commonly used for general oral hygiene and treatment. Among these antimicrobial compounds, the most commonly used are chlorhexidine, fluoride, triclosan, cetylpyridinium chloride, essential oils, and iodine. Using a therapeutic antimicrobial mouthwash before dental treatment can reduce aerosol contamination. The authors note that cetylpyridinium chloride with or without domiphen bromide can reduce bacterial load by 57%. Although chlorhexidine with antibacterial and antifungal properties is effectively used in dentistry, according to the Guidelines for the Diagnosis and Treatment of Coronavirus-related Pneumonia of the National Health Commission of the Republic of China, it may not be significantly effective against SARS-CoV-2.

Based on the study of disinfectants against viruses, the use of 0.5% hydrogen peroxide and 1% povidone-iodine is recommended for mouthwash. Povidone-iodine is commonly used to maintain oral health, as well as to prevent and treat oral infections, because its use is safe.

Hydrogen peroxide is recommended to be used with caution, since it has carcinogenic properties, but at low concentrations, the beneficial properties of this drug in the fight against viruses are still quite high. In particular, in a study of patients admitted to the intensive care unit, mouthwash with 3% hydrogen peroxide reduced the incidence of pneumonia associated with the use of artificial lung ventilation. Some authors suggested using beta-cyclodextrin together with Citrox flavone to reduce the pathogenicity of viruses. However, further research is required to determine the effectiveness of this recommendation [10].

Since no data are currently available, the use of any antimicrobial mouthwash can reduce the number of microorganisms, including SARS-CoV-2. During a pandemic, patients should be advised to brush their teeth and use antimicrobial mouthwashes before seeking dental care. The

practitioner may also rinse the mouth before treatment.

Since 62-71% ethanol showed its effectiveness against the new coronavirus (within 1 minute, the viruses died), it is possible that an oral gel containing ethanol can be developed and applied in the oral cavity before dental treatment.

Barriers and personal protective equipment are even more important in dental practice because of the nature of the treatment. The use of high-speed tips and the use of water and air create an aerosol contaminated with saliva and blood (particles <50 microns in size) or spray (particles > 50 microns in size).

This spray affects an area up to 8 feet away from the patient's mouth. Based on the simulation model, some authors have shown that during the ultrasonic removal of tartar, aerosols can spread to a distance of more than 1 meter from the back of the dental chair. They also showed that the head, chest, hands, and mask of the operator and assistant were heavily soiled. Even the inside of the masks was dirty. Therefore, it is necessary to use appropriate gloves, a mask, protective robes, and a cover for eyes and hair [11].

The correct placement of the mask on the dentist's face and other factors all affect the filtration of bacteria. It is preferable to use face shields that cover the forehead, eyes and mask. The hair should be short and covered with a disposable medical cap. Men should shave their beards.

Hand hygiene should be observed before and after contact with the patient, before putting on and after removing personal protective equipment (PPE), including gloves. Hand hygiene after removing the PPE is especially important. Dressing gowns should be high-collared, long-sleeved and cover street clothes. Over the robe, one can use a disposable protective plastic apron with long sleeves and a high collar. It is also necessary to use closed shoes [12].

Do not underestimate the danger of the microbial environment of aerosols after performing dental procedures. The aerosol slowly settles, contaminating surfaces and floors. Studies have shown that a cloud of aerosol remains around the dental chair for more than 30 minutes after the removal of tartar, so one should not remove

the protective barriers immediately after the procedure.

Only basic items and tools should be opened in the processing area. The dental chair should be covered with a thick plastic that can be disinfected before and after the patient's treatment. Spray and wipe techniques should be used to disinfect all exposed areas, including chairs, surfaces, lights, and handles. Dental prosthesis, patterns and other prosthetic materials must be disinfected before receiving and sending them to the dental laboratory.

Within the framework of infection control, patient care items (dental instruments, devices and equipment) are divided into critical, semi-critical and non-critical. Semi-critical and critical items should be sterilized, as most items are heat-resistant. Heat-sensitive items should be treated with a high-level disinfectant or sterilizer.

Chlorine-based disinfectants are known to act as high-level disinfectants and sterilizers. Chlorine-based disinfectants have proven effective against the coronavirus. They can be used on non-metallic surfaces and floors, but care should be taken because of their corrosive activity. The effective concentration is 2000 mg / L, which allows one to wipe high-frequency contact surfaces. In addition, chlorinated solutions are unstable and therefore need to be prepared fresh for use, which takes time and expense. A chlorinated compound, such as sodium dichlorisocyanurate, is also useful because it is stable and has an antiviral effect.

One can also use ethyl alcohol (70%), which is relatively inert and quickly evaporates, leaving the surfaces dry. Benzalkonium chloride with or without isopropyl alcohol also exhibits antibacterial and antiviral properties. Chlorine dioxide based on a slow-release solution, which has a multi-purpose application in dentistry, requires further study. It can be used as a surface sanitizer and for disinfection of impression material. It can also be used in the water supply of a dental unit (DUWL) and as a mouthwash [13].

Some chlorine dioxide tablets contain anti-corrosion compounds, which can be additional benefits, especially in dentistry, where many instruments are made of metal. Floors should be cleaned with a disinfectant twice a day.

DUWLs are potential sources of microorganisms due to the development of microbial biofilms and the periodic release of microorganisms into wastewater. Many DUWLs have a non-return valve that prevents the back-suction effect when contaminated water is sucked out of the patient's mouth, contaminating the DUWL system. Therefore, practicing dentists should evaluate the check valve or install it.

All DUWLs must contain a disinfectant, so dental chairs that do not have tanks and are connected to the city's water supply should be immediately converted to tanks in which drinking disinfectants can be placed. Chlorinated disinfectants such as chlorine dioxide and hypochlorous acid, which have been shown to be effective in DUWL disinfection, should be considered. In addition, several studies recommend weekly DUWL shock treatment using a high-level disinfectant.

Sterilizers should be tested and their effectiveness determined using conventional biological, chemical, and mechanical indicators.

The success of an effective infection control program depends on the correct design of the dental clinic premises. The floor plan, traffic flow, fixtures, dental chair, instrument handling, and recycling area should be considered [14].

High-performance particulate air filters (NERA) and UV chambers in the ventilation system can reduce aerosol-related pollution. A UV camera with NERA filters is ideal because it does not require regular disinfection of the filters. If possible, these filters should be installed directly above the dentist's chair with the air flow as such, so that the polluted air can be filtered [15].

In dental practice, the air flow should be directed from the waiting area and reception area to the room with the dental chair. Contaminated air from the area of the dental chair should not spread or circulate in the area that is not subject to treatment. It is also recommended to use portable NERA filters during the treatment of patients, which can be placed near the patient's chair to reduce the level of aerosol infection [16].

In addition to ventilation and air circulation, the use of bactericidal UV radiation should be considered. The exhaust fans for the bathrooms must be operated continuously during the consultation. Medical waste must be disposed of in accordance with accepted regulations. Staff

should be trained in all the principles and methods of infection control.

5. CONCLUSION

Infection control has always been important in dentistry, but during epidemics and pandemics of air-borne infections, additional precautions are required. Usually, in medical institutions, patients can transmit pathogens only through coughing, sneezing and direct contact, whereas in dentistry, with the formation of saliva aerosols, pathogens are literally released from the nasopharynx and oral cavity and spread through the air and surfaces.

In dental practice, many people are at risk, such as the practitioner, assistant, patients, administrative staff, cleaning lady, and possibly accompanying persons. Standard precautions are usually not sufficient during the active spread of infections, so it is important to use proper PPE and follow hand hygiene.

The sequence of consultations and scheduling of appointments with patients, as well as making changes to the waiting area, are also important. To minimize aerosol contamination, mouthwash should be performed before treatment. It should be taken into account that fans with NERA filters can significantly reduce the number of aerosols and, accordingly, reduce the level of pathogenicity of viruses.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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