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Knowledge, Challenges, and Adaptation Strategies for the New Normal Era after the COVID-19 Pandemic in Dentistry

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Abstract

1 SARS-CoV-2, the cause of the Covid-19 pandemic, is an international emergency problem that received special attention from WHO. Disease transmission can occur both directly and through contact with symptomatic or asymptomatic patients. Dentists have a high risk of contracting this virus during dental care through many kinds of virus transmission routes, so prevention is very important to fight Covid-19. Dentists can be potential carriers and transmit the infection to other patients, work teams, and their families, so it is necessary to use personal protective equipment strictly and minimize aerosol-generating treatments so that cross-infection can be prevented. Several associations issued protocols and guidelines in dental care since the start of the pandemic to reduce the risk of transmission during dental treatment, with the key elements of using personal protective equipment (PPE), physical barriers, and good sterilization principles. Ideally, a dental office is recommended to have good ventilation, **3** purifiers, and negative pressure. Adaptation to new habits in the new normal era is necessary to reduce the spread of Covid-19.

Keywords: Covid-19, Dentistry, New Normal, Pandemic

Introduction

1 The Covid-19 pandemic was first discovered in December 2019 in Wuhan, Hubei Province, China. This disease is an international emergency problem that received special attention from WHO and was declared a pandemic on January 30, 2020.^{1,2} Initially, this virus was known as 2019-nCoV, which was later referred to as SARS-CoV-2.³ Covid-19 caused a pandemic because it spread quickly to 215 countries worldwide.^{3,4}

As of 2021, **1** the World Health Organization (WHO) states that more than **9** three million confirmed cases and 100,000 deaths have been reported in Italy.⁵ On January 10, 2022, WHO also reported that 5,493,846 deaths had occurred globally.⁶ Several studies have shown that disease transmission can occur directly (through sneezing, coughing, and droplet inhalation) or

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in contact with patients (through the mouth, eyes, and mucous membranes) who are symptomatic or asymptomatic.^{2,7} Clinical symptoms of this infection include dry cough, fever, shortness of breath, muscle aches, and fatigue. Other symptoms that can also occur are increased phlegm, headaches, and diarrhea.^{2,8}

Dentists are professionals with a high risk of contracting this virus due to exposure to aerosols/droplets, saliva, and blood during dental care.³ In dentistry, there will be close contact between the patient and the doctor, so the infection will be very easily transmitted. When performed using a high-pressure handpiece or ultrasonic scaler, microorganisms can spread and survive for a long time in the air. Inhalation, dental instruments, contact with fluids in the oral cavity, and blood can transmit these microorganisms.²

Covid-19 has brought the world into a health crisis due to the many obstacles that have arisen in the fields of health services, education, and research. However, on the other hand, these conditions have allowed us to face these challenges with various good adjustments.⁹ This has caused a paradigm shift in dentistry over the past few years, so modifying service delivery has created new challenges for all dentists worldwide.^{5,10} Therefore prevention in dentistry is very important to fight Covid-19. This can be done by washing hands regularly, using personal protective equipment (PPE), providing rooms with good ventilation, and implementing strict protocols during treatment.²

Literature Review

The Covid -19 Virus

The highly contagious viral disease COVID-19 is confounding the whole world. At first, the coronavirus was referred to as the Wuhan coronavirus (CoV). However, over time and based on the symptoms that arise, this disease is currently designated as a severe acute respiratory syndrome (SARS-CoV-2).^{11,12} Due to these conditions, on January 30, 2020, this disease was declared an International Public Health Emergency by WHO because the death rate of infection with this virus was increasing.^{12,13} Currently, Indonesia faces the threat of the third wave of Covid with various variants, such as Omicron, with a higher transmission speed than the Delta variant.^{14,15}

SARS-CoV-2 is the seventh member of the coronavirus family with the order Nidovirales with large single-stranded RNA that infects humans, is zoonotic and is known as the Coronaviridae. This virus has a diameter ranging from 60–160 nm, is elliptical or spherical with a crown-like appearance when viewed under an electron microscope (in Latin terms, the corona is a crown), and has positive polarity.^{11,13,16,17} There are four types of CoV viruses, namely: alpha-, beta-, gamma-, and delta-coronaviruses; those that infect humans are known as human coronaviruses (HCoV), which in humans will attack the respiratory system.¹⁷ Based on several studies that have been conducted, it is known that SARS-CoV RNA is present in the saliva of SARS-positive patients, so that the transmission can occur via oral droplets. This virus is also adaptable so that it can infect new hosts.^{4,18}

Transmission of the Covid-19 Virus

Initially, the main transmission mechanism of the Covid-19 virus was thought to be from animals to humans. However, now it is known that the main source of transmission of infection is from humans, such as from infected patients who are symptomatic or asymptomatic.¹⁹ Transmission between humans can occur through droplet spread and direct or indirect contact routes.^{13,20} Several studies show that SARS-CoV-2 will bind to the angiotensin-converting enzyme (ACE-2) receptor in the mucosa of the respiratory tract and salivary glands.
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This is what causes transmission through aerosols; besides that, saliva is the main reservoir for droplet transmission.^{11,21} Upon entry, SARS-CoV-2 releases the viral genome into the cytoplasm, accelerating the viral replication mechanism.²²

Some current evidence indicates that there are three types of virus transmission routes in dentistry, namely:²³⁻²⁵

Direct transmission is due to inhaling droplets containing viruses from sneezing, coughing, and speaking loudly.²⁶

The first transmission is through inhalation of droplets carrying SARS-CoV-2 which are formed when someone coughs, sneezes, breathes, or speaks loudly and spreads through the air.^{4,13,27} When coughing, three thousand droplets are produced, and sneezing can produce forty thousand droplets containing the virus. This virus can be stable in the droplets that spread.^{4,13,21,27}

The resulting droplets can survive and spread with distances of up to 1 meter if the particle size is $>5\mu\text{m}$ and spread more than 1 meter if they have a diameter of $<5\mu\text{m}$.^{17,27} Therefore, large droplets have the potential to transmit the virus to nearby people, while smaller droplets are needed to be able to transmit to people at greater distances.^{17,21,28}

Transmission through the mucous membranes of the nose, mouth, and eyes

Furthermore, direct or indirect contact by touching a contaminated surface and then accidentally transferring it to the mouth, mucous membranes, nose, and eyes can also cause transmission of the virus.^{13,17,27}

Transmission via contaminated surfaces

Virus transmission in dentistry can be caused by the spread of aerosols (saliva and blood) generated from dental procedures when using high-speed handpieces, water and air syringes (3-way syringes), or ultrasonic instruments when treating patient teeth. The aerosol formed can come from the saliva and blood of infected patients.^{13,17,28,29} The size of the aerosol particles produced due to dental treatment is very small, so these particles can survive in the air for a long time before entering the breath or settling on the surface of an object, which can last several hours to days.^{17,21,28} These very small aerosol particles have the greatest potential for infection transmission because they can penetrate the pulmonary tract.^{17,28}

Pathogenesis

When the SARS-CoV-2 virus¹ attaches to surface receptors on the oral mucous membranes, eyes, or ears, the protein **angiotensin-converting enzyme 2 (ACE 2)** will mediate the internalization of SARS-CoV2. Then there will be protein activation which will eventually attach to the ACE 2 receptor, where the binding affinity of SARS-CoV-2 to the ACE 2 receptor is ten times higher than that of SARS-CoV to enter host cells. This virus also has the additional ability to divide, so the infection will be more effective and cause more severe long-term complications.³⁰⁻³² ACE 2/angiotensin plays a role in signaling and inflammation through the degradation of angiotensin II and the production of angiotensin. If there is a decrease, it will cause clinical symptoms of Covid-19, such as respiratory problems, vasoconstriction, and hypokalemia.³¹

Virus invasions into cells, such as myocytes, lungs, and endothelial cells, will cause inflammation, degeneration, edema, and tissue necrosis. These changes will contribute to

changes in the body's immune response, hypoxemia, lung injury, hypoxia, myocardial cell damage, and digestive tract disorders.³³

Age and gender greatly determine the expression of ACE 2; several studies also show that ACE 2 is weaker in women than in men. This proves that the number of Covid-19 cases is higher in men.^{34,35} Patients with Covid-19 with severe conditions will experience a significant decrease in the number of lymphocytic T cells and NK cells. The severity of the disease is also correlated with levels of interleukin, interferon, monocytes, and tumor necrosis factor-alpha (TNF- α).^{36,37}

Diagnosis, Laboratory Overview, and Complications of Covid-19 Sufferers

Based on the existing theory, it is stated that the diagnosis of Covid-19 can be made from a saliva sample and even some strains of the virus can be detected up to 29 days after infection.³⁸ The incubation period for this virus until before it causes symptoms is determined to range from 5.1-14 days. These conditions make this disease difficult to recognize, so it cannot be quickly handled and transmitted to the environment.^{39,40}

Several tests that could diagnose Covid-19 that had never existed before are now being developed using advanced technology. Three types of diagnostic tests developed in pandemic control and patient management are antigen tests that detect proteins, molecular amplification tests (PCR) that detect viral RNA, and serological tests that detect host antibodies in response to received vaccinations or infection.⁴¹ The method used to detect RNA (genomics) is RT-PCR, this method is widely used because this technique can obtain results that are fast and quite reliable. This method is based on two basic reactions: the conversion of RNA into complementary DNA (cDNA) followed by the amplification of the cDNA sample. Currently, RT-PCR is the gold standard for detecting SARS-Cov-2 because this method can measure the genomic portion of the virus directly.⁴²

Laboratory test results in patients with Covid-19 usually show lymphopenia of up to 83%, increased erythrocyte sedimentation, ferritin, tumor necrosis factor- α , C-reactive protein, IL-6, IL-1, abnormal coagulation parameters such as increased D-dimer, thrombocytopenia, and low fibrinogen.¹⁸ ACE-2 receptors are widely expressed in epithelial cells in the mouth, nose, gastrointestinal tract, kidney, and pancreatic β cells, which can indicate direct tissue damage due to SARS-CoV-2 infection, which can affect the occurrence of long-term complications.³² Common complications that usually occur in people with COVID-19 include 75% pneumonia, 19% acute liver injury, 15% acute respiratory distress syndrome, 7%-17% heart injury, 10%-25% acute heart failure, acute kidney injury in 9%, neurological manifestations in 8%, shock in 6% and acute cerebrovascular disease in 3%.¹⁸

Signs and Symptoms of Covid-19

At the beginning of the disease, the symptoms that usually arise are fever, fatigue which causes you to be unproductive, cough, myalgia, and muscle aches. However, apart from these symptoms, other symptoms may also arise, such as headaches, sputum production, diarrhea, nausea, hemoptysis, hyposmia, and hypergeusia.⁴³⁻⁴⁵

Another common symptom that can present is pneumonia which is usually seen on a chest X-ray or chest CT with a small patchy image. Organ dysfunction such as acute kidney injury, acute respiratory distress syndrome (ARDS), acute cardiac injury (arrhythmia and shock), and death may occur in severe cases.^{19,43}

About 80% of patients only show mild flu-like symptoms and seasonal allergies, which has led to an increase in undiagnosed cases. Such patients can spread the infection and are asymptomatic carriers.⁴⁶ The disease is usually severe in men with an average age of 56 years with an immunosuppressed or cardiovascular disease.¹⁷

Risks in Dentistry

Dentists have a high risk of getting infected with the Covid-19 virus because of their proximity to the patient's mouth when carrying out treatment procedures so that they are easily exposed to blood and saliva so that transmission can occur due to direct contact with contaminated blood, saliva, mucous membranes, and instruments, as well through inhalation of aerosols. Therefore dentists fall into the "very high risk of exposure" category.^{5,27}

Transmission of SARSCoV-2 occurs very quickly, and people who are exposed to it may show symptoms or be asymptomatic. Therefore, dental health services can be a source of virus transmission for other patients or health care staff.³ Given the widespread transmission of SARS-CoV-2, dentists and dental nurses have a very high risk of exposure working close to the patient's oral cavity.¹³

Procedures in dental care can be a source of infection, either through direct contact with contaminated objects or inhaling aerosols generated during dental treatment.³ Aerosols during dental procedures can be generated through handpieces and ultrasonic instruments (scalers), which can contaminate the surrounding environment and other instruments.^{13,47} This causes the risk of infection transmission in dentistry to be very high through the aerosols of infected patients.⁴⁷

Since the beginning of the pandemic, to reduce the risk of transmission during dental treatment, several associations have issued protocols and guidelines for dental care, with the key elements of using personal protective equipment (PPE), physical barriers, and good sterilization principles.⁵ Although ideally, patients suffering from COVID-19 should not receive dental treatment, emergencies requiring dental treatment do occasionally occur. This condition causes close contact between the dentist and the patient.⁸ Therefore, the risk of transmitting the Covid-19 virus to dentists will increase if infected patients visit dental clinics and hospitals during the 2019-nCoV epidemic.^{8,17}

Dentists will be potential carriers and transmit the infection to other patients, work teams, and their families.⁷

Therefore, dentists are expected to strictly use personal protective equipment and minimize or even avoid treatments that generate aerosols to prevent cross-infection.⁴⁸

Changes to Dentistry Protocols

The Centers for Disease Control and Prevention have provided a standard operating procedure to be observed in dental clinics in the post-covid period. In addition to those with a suspected or proven SARS-CoV-2 illness, the CDC advises applying extra infection prevention and control measures to all patients entering the clinic.⁴⁹ It is advised to remove any magazines, pamphlets, or other items not easily disinfected from the waiting area that could potentially spread the virus to the patients.^{50,51} Patients should be situated at least one meter apart in a ventilated area, and the surroundings should be kept clean. Patients should not be attended to; if they are, the accompanying individuals will wait outside until the oral treatment is complete.⁵¹ After getting to the dentistry facility, the patient and the guardian must wear

surgical masks and follow proper respiratory guidelines.⁵² Cleaning and disinfection must be applied to all furnishings and equipment in the waiting area, such as door handles, seats, and workstations. Additionally, the elevator must be cleaned frequently, and patients should avoid touching objects with their bare hands.⁵³

Idea⁶, the dental office recommended having good ventilation and negative pressure.⁵¹ Portable air purifiers with a high-efficiency particulate air filter (HEPA) have successfully speed up the elimination of aerosols and can be used in the dental office.⁶ It is crucial that throughout the dental procedure, the entrances must be kept locked.⁵³

In order to decrease cross-contagion, protection procedures should include patients and the staff who provide dental treatment. Inadequate patient protection measures can cause contamination of the workplace setting, staff members, and even the patients themselves, spreading the infection further. Therefore, patients need personal protective equipment (PPE), including disposable shoe covers and cap.⁵¹ Every patient should be regarded as having a possible infection. Therefore, personal protective equipment is highly advised, including scrubs, gown caps, gloves, masks, shoe covers, eyewear protection, and facial shields.⁵⁴ There are several differences in PPE between the pre-covid and post-covid eras. In the pre-covid era, gown and shoe cover is rarely used, but is commonly used now.⁵²

Wearing a mask is a crucial protective measure. Surgical masks are commonly used, but COVID-19 particles are estimated to be 0.06–0.14 mm in diameter. This made the N95 or FFP2 mask models, which filter out 95%, more recommended in the dental office.^{51,54} Even when handling patients who were not contaminated, about 78% of dentists used the FFP2 mask, and 62% covered the FFP2 mask with an FFP1 surgical mask.⁶ However, since the virus may be able to spread through the eyes, wearing the proper goggles or facial coverings could reduce the risk of infections.⁵⁰ Because face shields have better face protection from aerosol droplets than goggles, they may be favored over goggles.⁵⁴

¹ SARS-CoV-2 has angiotensin-converting enzyme 2 (ACE2) receptors in the tongue's epithelial cells, fungiform papillae, oral mucosa, gingival tissues, and salivary glands. The high expression of the ACE2 receptor made the viral loads high in the mouth. The dentist can prevent the transmission using a rinsing protocol with mouthwash before the dental procedure, which could reduce the viral load by 68.4%. Antiseptic options with oxidative content favorably reduce the virus's salivary load without harming the oral mucosa. These are 0,12%-0,2% chlorhexidine, 1%-1,5% hydrogen peroxide, 0,5%-1% povidone-iodine, or 0,05-0,1% cetylpyridinium chloride (CPC).^{51,55} It is suggested to gargle for 1 minute in the oral cavity and the back of the throat.⁵⁶

Using a rubber dam is advised because it greatly lowers the amount of aerosol-containing blood and saliva and reduces the number of droplets by 70%. High-speed saliva ejectors or surgical ejectors can significantly reduce the dissemination of droplets during a dental procedure, and their use is therefore strongly advised. It is also beneficial to assemble two ejectors simultaneously, such as a high-speed ejector and a high-volume evacuator.⁵⁴ Set up only the tools required are easily available in operatories. All other materials and equipment are kept in enclosed storage, away from areas that might be contaminated.⁴⁹

³ All disposable items are taken from the patient after the procedure, and hand washing is advised. Payment is advised to be made using electronic banking services because receiving cash necessitates putting it in plastic bags and dousing it in disinfectant. Additionally, pens have been suggested as potential vectors for the virus's spread. As a result, every worker and

patient needs a personal pen. Finally, the patient should cleanse their hands before leaving the workplace and refrain from handling objects in the dental office. Numerous studies have shown that thorough hand washing can stop the cycle of respiratory disease transmission and lower the risk of transmission by 6 to 14%. This made hand washing important for the patient and dental team before and after dental procedures.⁵¹

Sars-CoV-2's viability was sustained in the atmosphere for at least 3 hours, and its viability half-life was close to one hour. This made all surfaces and instruments in a dental clinic should be regarded as potential sources of the virus.⁵⁴ In order to prevent contamination, it is crucial to carry out daily surface disinfection carefully. The same PPE used for dental staff must be made available to the person performing sanitation.⁵³ To clean the surface area, cleanse each possibly contaminated surface, then use disinfectants with 0.1% sodium hypochlorite, 62%–71% ethanol, or 0.5% hydrogen peroxide to sanitize it.⁵⁴ After every dental procedure, the air should be cleansed with a disinfectant spray for two minutes before opening the entrance. It is important to clean and sanitize reusable face shields and manage laundry and medical waste after routine procedures.^{50,51} Another viable option for sterilization in a dental office is germicidal ultraviolet (UV) radiation. UV light affects microbial DNA and RNA, inhibiting microbial growth, and reducing the negative effects of infectious organisms.⁵⁴ Establishing proper dental settings (the ideal setting is negative airflow), donning, and doffing PPE correctly greatly reduces the risk of infection.⁵³

Conclusion

Covid 19 is a disease easily transmitted through the air and direct or indirect contact. Sars-CoV-2 can last a long time on the surface of objects and in the atmosphere, so after every dental procedure, it requires better handling to prevent transmission. Dentists are professionals with a very high risk of contracting this disease. Therefore, adapting to new protocols in the new normal era is necessary.

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Conflicts of Interest

The authors declare no conflict of interest.

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