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Review Article

# Coronavirus (SARS-CoV-2) World Crisis: Dental Implication. Review of Literature

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## Abstract

SARS-CoV-2 and the disease it causes, coronavirus disease 2019 (COVID-19), have reached pandemic scale worldwide in 2020. In addition, COVID-19 may precipitate anxiety, depression, and sleep problems in patients with COVID-19 and may adversely affect patients with established psychiatric disorders. This topic addresses its historical background, different types of coronavirus, clinical features, course of illness, mode of transmission, and serological test that a dentist can make to detect the presence of antibodies in the blood, giving dental professionals the opportunity to reschedule patients and lower transmission potential throughout the office.

***Keywords:*** *Coronavirus; Aerosol Particle Transmission; Viral Dosimetry; Dental Aerosolization; COVID-19 Serology Tests*

## Historical Background

In the late 2019, a novel human coronavirus now called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged from Wuhan, China [1]. They are enveloped RNA viruses that affect animals and humans [2]. Their particles range 60 - 140 nanometers, with an average of 0.125 micron and have distinctive spikes of 9 - 12 nanometers that give the appearance of "coronas" around the sun (Figure 1). Cell death is observed 96 hours after inoculation on surface layers of human airway epithelial cells [2].

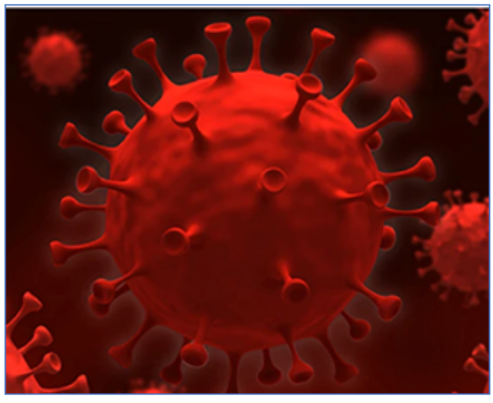

***Figure 1:*** *Coronavirus particles range have distinctive spikes that give the appearance of "coronas" around the sun.*

There are six coronavirus species causing human diseases. Four of them are 229E, OC43, NL63 and HKU1 that often result in symptoms of the common cold [3]. The other two strains are severe acute respiratory coronavirus syndrome (SARS-CoV) and middle-east respiratory coronavirus syndrome (MERS-CoV) which is zoonotic (originally derived from animals and transmitting to humans), more serious, and often associated to lethal disease [4].

The causal agent of the severe acute respiratory syndrome outbreaks in 2002 and 2003 in Guangdong Province, China was SARS-CoV-1 [5]. Nearly 8,098 patients were affected with 774 deaths, resulting in a mortality rate of 9% happened during this outbreak. In elderly individuals the rate was much higher, with mortality rates approaching 50% in those over age 60. SARS-CoV-1 transmission was fairly inefficient since it is transmitted only by direct interaction with infected individuals; the virus spread once a person showed symptoms. The outbreak was largely contained because identifying those individuals who could spread the disease was easy. There have been a few instances of super-spreading incidents that individuals with larger viral loads and the potential to aerosolize the virus have been able to infect several persons. As a consequence of fairly ineffective SARS-CoV-1 propagation, the spread was controllable by means of quarantining individuals in households and health-care centers [6]. Patients with serious acute respiratory coronavirus syndrome 2 (SARS CoV-2), which triggers COVID-19 illness, have reported a spectrum of symptoms varying from none to extreme. Additionally, the median duration of incubation for this disorder is 5.1 days, with symptom initiation occurring two to 14 days after exposure [7].

SARS-CoV-2 ‘s durability is similar to SARS-CoV-1, with a correlation of 80 per cent of genetic structure. All viruses bind the human cell to the angiotensin-converting enzyme 2 receptor (ACE2) through the spike (S) protein to obtain entrance, although a few variations occur (Figure 2). First, there has been a discovery of higher viral loads in nasal passages and the upper respiratory tract of individuals diagnosed with SARS-CoV-2, suggesting coughs and sneezes that produce higher viral loads than their predecessor. Second, there is much greater capacity for individuals diagnosed with SARS-CoV-2 to shed and spread the virus despite becoming asymptomatic, and people in the latent stages of the disease sometimes shed the virus at a higher rate [8].

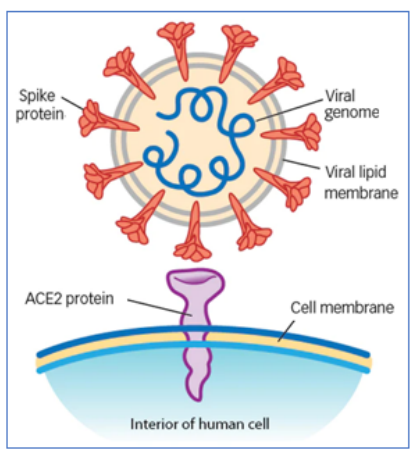


***Figure 2:*** *Shows how SARS-COV-2 binds to the human cells.*

## Mode of transmission (Aerosol particle transmission)

Particles are categorized by size: 2.5 - 10 microns of coarse particles, < 2.5 microns of small particles and < 0.1 microns of ultrafine particles. The nose normally absorbs up to 10 microns of air particles. It may reach the respiratory system if a particle is < 10 microns. When it is < 2.5 microns, it can go through the alveoli. A particle < 0.1 micron, or an ultrafine particle such as the COVID-19 virus, may

enter the bloodstream and target organs such as the heart and mind. The current scientific consensus is that the majority of transmission via respiratory secretions occurs in the form of large breathing droplets instead of small aerosols. Droplets are therefore heavy enough not to fly too far; rather, after rising up to six feet (Figure 3) they slip off the air [9].

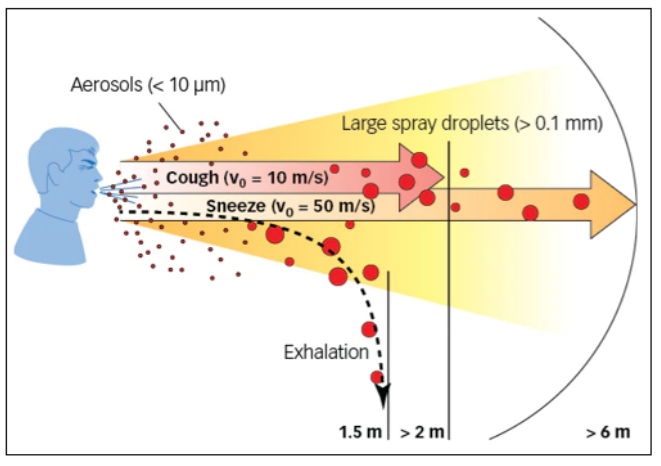


***Figure 3:*** *Shows how COVID-19 is transmitted through aerosol particles.*

The problem happens after a cough, sneeze, or oral hygiene aerosolizes the infectious particles. Throughout these situations, bacteria may theoretically migrate much greater distances from an affected human, with reports of up to 20 feet, and then cause secondary diseases elsewhere in the area. These aerosolized droplet nuclei that linger in an environment, floating in the air, even after the individual who emitted them has left and may therefore infect health-care workers and contaminate surfaces. Some details of COVID-19 's durability in various places [9]: a) The virus can be used up to 72 hours after application on plastic and stainless steel surfaces, b) it can be used up to 24 hours on cardboard surfaces, c) it can be used up to nine hours on copper surfaces, and d) it can be used up to three hours in suspended aerosols.

## Viral dosimetry and dental considerations

Whenever a new virus appears, it is important to raise the question of whether there is a dose-dependent reaction between viral load interaction and disease severity. In other terms, will the amount of viral particles a patient first receives, or regular exposure, decide the symptom severity? One study reported that viral loads in nasopharyngeal swabs from a group of patients with severe COVID-19 were 60 times higher on average than the viral loads seen among patients with a mild form of the disease [10]. If this is the case, dental aerosolization may pose an additional threat.

Does a patient who has viral particles confined to the nasopharyngeal area become susceptible to aspiration of aerosols into the lungs, resulting in increased severity of disease? This issue was motivated by and focused on the study of Bruce L Davidson, MD, MPH - a Seattle pulmonary physician and writer, an specialist in respiratory infection transmission, past president of the National Tuberculosis Controllers Association, and a member of the HHS Secretary's Advisory Council on Tuberculosis Elimination, who has researched extensively aspiratory forms of pneumonia [11]. According to Dr. Davidson, "This very possible probability may be quickly minimized through lowering the biofilm viral load in the mouth and pharynx area through 1.5% peroxide for 60 seconds, thus decreasing the viral load and effectively disinfecting the throat. Peroxide reduces the spread of coronavirus by > 4 logs. Such forms of debridement controls are sometimes ignored." Of course, well-designed controlled trials are required for this study and recommendation to be continued [11].

## Dental aerosolization

Dentists who handle patients with aerosolization face an incredibly harmful chance of themselves being inoculated, their dental assistants, other office staff members, and patients getting reinoculated. Much of the damage comes from splatter and droplet delivery to the dentist's and assistant's midface, as well as the patient's nasal area [12]. Additionally, the incidence of droplet transmission in periodontal treatment is much higher than in prosthetic treatment [13]. During nonsurgical procedures, ultrasonic and sonic transmission had the highest incidence of particle transmission, followed by air polishing, air/water syringe, and high-speed handpiece aerosolization [14]. One study showed that ultrasonic instrumentation would spread 100,000 microbes per cubic foot with an aerosolisation of up to six centimeters, and microbes would live anywhere from 35 minutes to 17 hours if there is an unsuitable air current [15].

Because of these potential hazards to dentists, staff leaders and patients, the Occupational Safety and Health Act (OSHA) has recently issued a new study called "COVID-19 Guidelines on Workplace Readiness." The paper classifies workplace risk as moderate, moderate, mild and lower risk. According to OSHA [16] the jobs engaged with aerosol manufacturing fell into the very high risk group.

Since dentistry is in the very-high-risk range, the "Implement Workplace Controls, Technology Controls" segment advises that dental practices build negative-pressure rooms or airborne contamination exclusion rooms for operations where aerosol procedures are conducted. Wearing personal protective equipment (PPE) masks also include recommendations for the dentist and staff working in areas of direct contact with aerosols. Certain types of suitable respirators include: an R/P95, N/R/P99, or N/R/P100 filtered face respirator; an air purifying elastomeric (e.g. half-face or full-face) respirator with correct filters or cartridges; controlled air purifying respirator (PAPR) with high-efficiency particulate arrest (HEPA) filter; or supplied air respirator (SAR)" [16].

## COVID-19 serology tests and the role of the dental office

Work about how to utilize COVID-19 serology tests to diagnose the existence of antibodies in the blood, helping dental practitioners to reschedule appointments, and reduce the risk for dissemination around the clinic. COVID-19 serological tests measure the presence of antibodies in the blood generated by the immune system when encountering the SARS-CoV-2 virus. Most of the commercially available tests measure antibodies to immunoglobulin M (IgM) and immunoglobulin G (IgG) in either serum, plasma, whole blood venous or, preferably, whole blood finger-stick in a dental office. IgM antibodies are the first antibodies to react to a novel antigen, and a recent one will be suggested. IgG antibodies have a greater affinity to the target antigen and are later produced during infection. Such serology studies are labeled lateral immunoassays of flow which use cassettes (Figure 4) that comprise a membrane-based immunoassay of a specific concept which look to that of an hCG pregnancy test. The serology test profits from ease of usage and comfort, since it can be ready in 10 minutes, making it especially useful in a dental office [17].

***Figure 4:*** *Lateral flow immunoassays.*

Serological testing may play a critical role in combating COVID-19 by helping health care professionals identify individuals who have overcome an infection in the past and developed an immune response. This can possibly be used in the future to help assess, along with other clinical evidence, that these individuals are no longer vulnerable to infection and may return to work. Additionally, these test results can help to determine who can donate a part of their blood called convalescent plasma, which can serve as a possible treatment for those with COVID-19 serious illness [17]. The procedure is helpful in a dental environment to reduce the possibility of transmission to the surgeon, the nurses and other patients. If a patient tests positive prior to dental care, the patient should be rescheduled, the prescriptions are sent home to quarantine, and the results should be submitted to the relevant agencies. In the Occupational Safety and Health Administration (OSHA) hierarchy of control systems to prevent transmission, the highest and most effective form of infectious disease control is this type of elimination control removing the sick patient from the office prior to treatment (Figure 5).

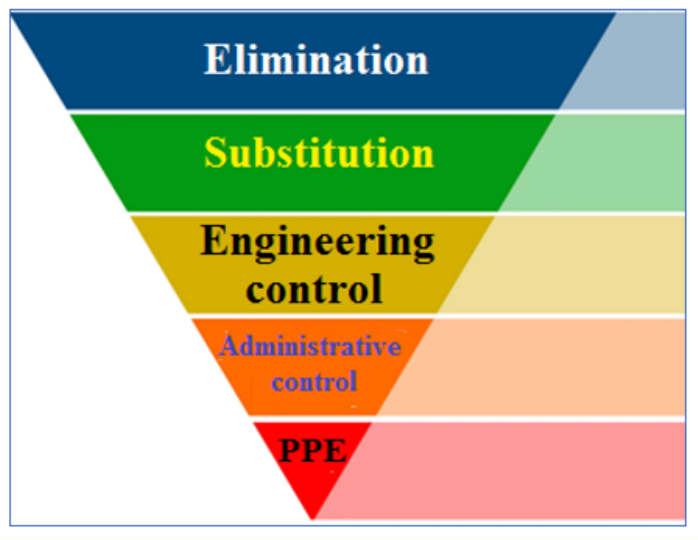


***Figure 5:*** *Hierarchy of control.*

## How accurate are the serology tests?

Several concepts are at place to consider research accuracy: Sensitivity is the percentage of truly beneficial variables that really measure favorably, and how accurately a survey will distinguish optimistic people in a group. In other words, if the patient has the antibodies in the sample, can those antibodies be detected in the test? Some serology experiments appear to have an IgM sensitivity of 62% - 97% and an IgG sensitivity of 86% -100% (with a trust interval of 95%). The issue with such experiments is that in the early incubation period of the outbreak, many would wrongly check the result, thereby decreasing the test accuracy. The specificity is the proportion of true negatives that test negative in reality. It reflects how well an assay performs in a group of individuals negatively affected by disease. Most serology studies tend to have an IgM specificity of 86 percent - 100 percent and an IgG specificity of 90 percent - 100 percent (with a trust interval of 95 percent), suggesting that the amount of people tested false positively is very low [18].

## Can a dentist administer these tests?

With all laboratory research a certificate from the 1988 Clinical Laboratory Improvement Amendments (CLIA) is needed. Within the new COVID-19 terminology there are two valid certificates. A Certificate of Waiver (COW) is approved by the FDA as exempted for laboratory studies. A Certification Certificate (COC) is required for a laboratory performing moderate- or high-complexity studies. For a COW,

the credentials of the Administrator are nominal and the credential is quicker to receive. To receive this credential, request an application from the FDA CLIA to the health department of your jurisdiction. They will instead email you and submit other documents such as ownership registration, your dental license and Tax ID IRS documents (states vary). The COC requirements are much more stringent. A doctor without any previous COC training will need to take a 20-hour course to obtain a fairly complicated laboratory credential. For a highly specific laboratory license, the laboratory operator must be at the level of an anatomical or clinical pathologist [19].

The FDA points out how studies are classified. This has received several authorisations for emergency usage (EUA) for a number of measures. The EUA-approved assessments have an FDA-assigned difficulty level classification. A laboratory research may only be carried out in a extremely complicated environment without an EUA. There are also other experimental experiments for an EUA which are extremely technical. As of the date of this article publication, there are three serology tests (IgG/IgM) approved for COC laboratories of moderately complex level: 1) Chembio Diagnostics Systems Inc.-IgM and IgG; for laboratories approved for high and moderate complexity tests; 2) Ortho Clinical Diagnostics Inc.-total antibody; for laboratories approved for high and moderate complexity tests; and 3) Cellex Inc.-IgM and IgG; licensed laboratories for high- and moderate-complexity testing [19].

There are no eligible and accepted serology studies at this time for use in a COW. Both serology measures other than the three above are generally graded as being extremely complicated. The FDA updates its website on a regular basis and may eventually issue an EUA for these tests which would allow them to be used in a COW [19].

## Conclusion

Many changes in infection control procedures and the associated dental armamentaria can be expected to arise in the post-COVID-19 world of dentistry. Evidence and research into best and safest practices will dictate the extent and severity of the changes. Before mandating a reform that would require an significant financial and technological shift in the existing dental clinic, work will be carried out to assess existing accessible procedures, techniques and instrumentation that can mitigate/obviate the possibility of leakage, whilst remaining financially and technically expeditious.

As governments continue to figure out how the economy will start again and the words monitoring and testing are continuously mentioned when the return-to-normal life resumes. To try to contain the so-called “next wave” of cases, testing is an extremely important method. A dental office can be a center for both testing and surveillance, providing a great ally to this cause. Many people frequent the dentist more frequently than medical clinics, so dental practices must be willing to reach the front lines against COVID-19 by providing ways to minimize possible spread and identify viral carriers.

## Conflicts of Interest

The authors declare no conflict of interest.

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