

# Safety protocols for dental care during the COVID-19 pandemic: the experience of a Brazilian hospital service

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**Abstract:** The coronavirus disease (COVID-19) has been prioritized in relation to other illnesses considered critical, such as cancer, cardiovascular diseases/stroke, diabetes, and autoimmune diseases. The management of patients with these diseases involves dental care to reduce systemic complications caused by odontogenic infections, and/or to treat oral manifestations of systemic comorbidities. In this regard, the dental care of these individuals must be guaranteed during the pandemic. Although a high risk of exposure to and catching of COVID-19 is expected to befall dental professionals, biosafety guidelines reduce the likelihood of infection. Thus, the current scenario poses challenges, and offers decision-making approaches and tools that facilitate the management of individuals with oral manifestations of chronic and/or critical diseases, using hospital-based services. This article presents an overview for hospital service providers who are at the forefront of COVID-19 care, including a secure protocol, and clinical guidelines based on the experience of the Hospital das Clínicas in Belo Horizonte, a public referral service, supported by the Brazilian National Health System.

**Keywords:** COVID-19; Dental Care; Dental Service, Hospital; Personal Protective Equipment; SARS-CoV-2.

## Introduction

Ever since the initial coronavirus disease (COVID-19) outbreak in late December 2019, in Wuhan, Hubei province, China, and as of March 11, 2020, when the World Health Organization (WHO) declared the severe, acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as a global pandemic, the disease has become a global threat with a dramatic impact on healthcare systems.<sup>1,2</sup> The first confirmed case of COVID-19 in Brazil was reported on February 21, 2020.<sup>3</sup> Since then, this nation has become the new epicenter of COVID-19, totaling more than 6.3 million cases and over 172,800 deaths by the end of November 2020. Although efforts have been made to reduce transmission of the epidemic and evolutionary trajectories of SARS-CoV-2 lineages in Brazil, current interventions are still insufficient to keep transmission of the virus under control in the country.<sup>4</sup>

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The concerns and fears of dentists in Brazil and worldwide regarding professional practice during the COVID-19 pandemic are notorious.<sup>5,6</sup> By mid-April 2020, 278 physicians worldwide had died from COVID-19.<sup>7</sup> Among the providers working on the frontline, 6% were dentists. The countries with the largest number of reported deaths of health professionals have been Italy, Iran, the Philippines, Indonesia, China, Spain, the US, and the UK.<sup>7</sup> These professionals succumbed to COVID-19 mainly due to the lack of personal protective equipment (PPE).<sup>7</sup> Thus, the burden imposed by COVID-19 on health workers is overwhelming and undeniable.<sup>8</sup>

The unexpected circumstances of the pandemic caused the healthcare provided to patients with COVID-19 to be prioritized over the care for individuals with chronic diseases.<sup>9</sup> Most importantly, the management of these individuals (*e.g.*, patients with cancer, cardiovascular diseases/stroke, diabetes, autoimmune conditions, and others), in the different stages of their diseases, is interrelated with dental care, which aims to maintain oral health in order to reduce the risk of complications, and to improve the individual's overall quality of life.<sup>10,11</sup> Dental care for these individuals is usually provided by hospital-based dental services. The main purpose of dental treatment for this population is to eradicate outbreaks of oral infection, prevent potentially fatal systemic infections of dental origin,<sup>12,13</sup> relieve oral pain, assist in maintaining adequate nutrition, provide rehabilitation after surgical procedures,<sup>10</sup> and, more recently, as of the emergence of the pandemic, to diagnose and manage oral conditions, whether or not associated with COVID-19.<sup>14</sup>

It has been widely reported that the common routes of COVID-19 transmission include inhalation of droplets generated by coughs and sneezes from infected individuals, and by direct contact with their oral, nasal, and ocular mucosa.<sup>15</sup> Moreover, there is a high probability of transmission of SARS-CoV-2 in dental care settings, from the dual risk of high aerosol-generating procedures, and the saliva of symptomatic and asymptomatic individuals.<sup>16</sup> A study detected SARS-CoV-2 in the self-collected saliva of 91.7% of the individuals with positive RT-PCR, and determined that the virus remained

viral positive even after long periods of infection.<sup>17,18</sup> In this scenario, working in the oral and maxillofacial field is considered to be at high risk of exposure to and catching of COVID-19. Providers who manipulate the particular anatomic region in question are at risk of infecting other patients, healthcare professionals, and their own families.<sup>19</sup>

Seeking to reduce infection by COVID-19, biosafety guidelines adhering to international protection standards have been proposed to be adopted before, during and after dental exposure to patients. To this end, evidence-based protocols must be established to safeguard professionals and patients – particularly those with chronic and/or critical diseases – whose dental care is pivotal to systemic health. We would like to contribute to this effort by providing a safe healthcare protocol and clinical guidelines, also based on the experience of the Hospital das Clínicas in Belo Horizonte, a Brazilian referral service for hospital-based dental service providers.

## Discussion

### Hospital-based dental services

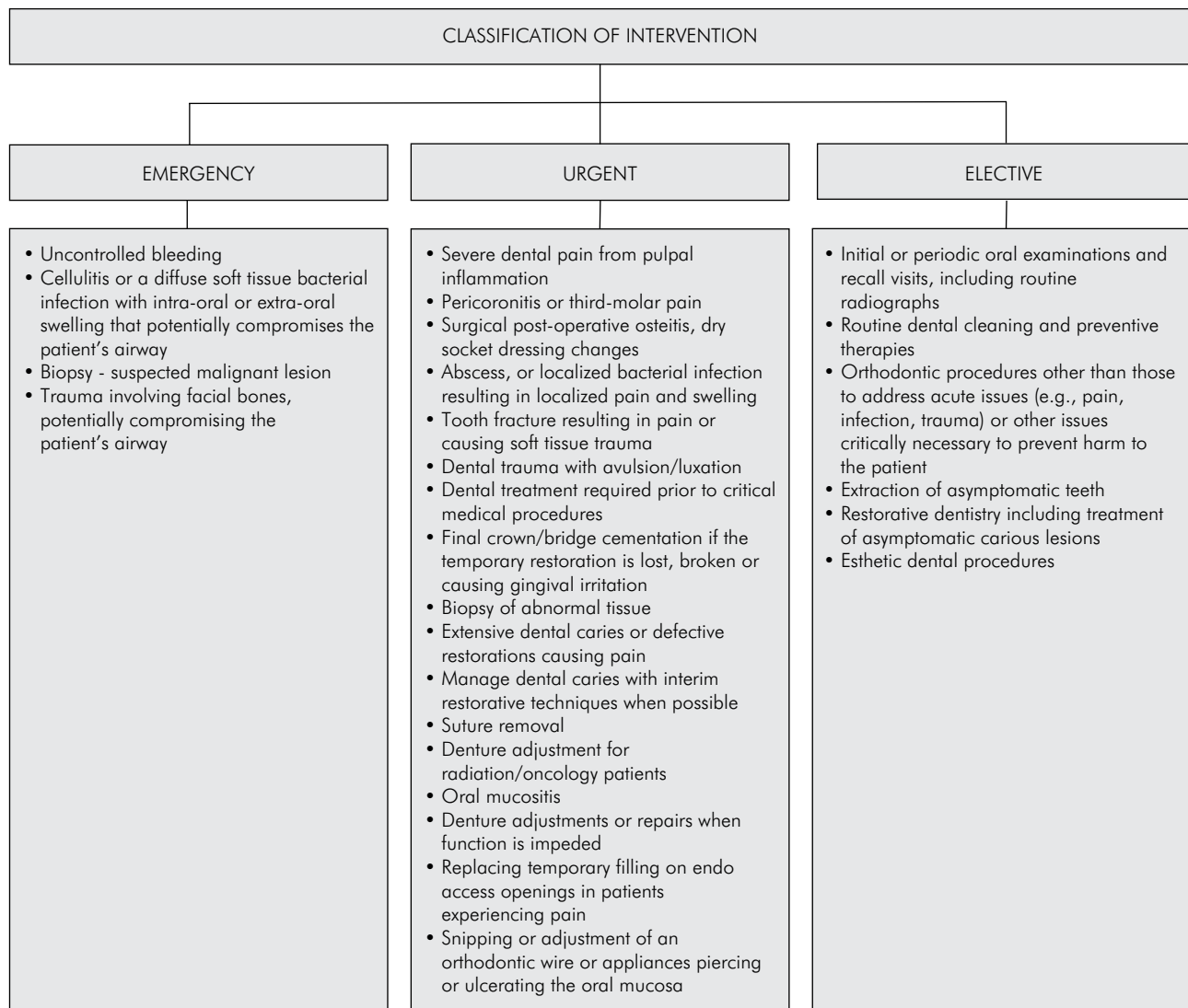
The production of airborne material during dental practice is unavoidable, and represents a risk for the dental team and patients.<sup>20</sup> Aerosols are defined as particles  $\leq 50 \mu\text{m}$  in diameter,<sup>20,21</sup> implying that these particles are small enough to remain in the air for a long time before settling on environmental surfaces or entering the respiratory tract. Smaller aerosol particles (0.5 to  $10 \mu\text{m}$  in diameter) have the potential to penetrate and lodge themselves in the smaller passages of the lungs, and are believed to have the greatest potential for transmitting infections.<sup>20,21</sup> There is evidence that dental aerosol can project out 1 to 3 meters from its source, contaminating distant surfaces.<sup>22</sup> SARS-CoV-2 remains viable and can be detected up to 3 hours after aerosolization, and up to 7 days on different surfaces.<sup>23</sup> The Centers for Disease Control and Prevention (CDC), and the American Dental Association (ADA) have recommended that aerosol-generating procedures should be avoided during the pandemic.<sup>24,25</sup> There are at least three potential sources of airborne contamination during dental treatment: dental instrumentation, saliva and

respiratory sources, and dental equipment (e.g., dental handpieces, ultrasonic scalers, air polishers and air abrasion units, the action of rotary instruments and ultrasonic vibrations, or the combined action of water jets and compressed air).<sup>20</sup>

Considering the characteristics of dental procedures, the focus is on emergency procedures during the pandemic. ADA and others Brazilian regulatory agencies, such as the Federal Council of Dentistry (CFO) and the Brazilian Health Surveillance Agency (ANVISA) – an agency connected to the Ministry of Health and belonging to the Brazilian National Health System (SUS) – recommend that dentists maintain an

emergency, urgent and elective care triad, as illustrated in Figure 1.<sup>25,26,27</sup> For patients with chronic illnesses, this categorization of recommended situations may have some worthy particularities, since the severity of the systemic conditions overlaps dental needs. This is because dental intervention may contribute to overall health improvement and/or prevent the risk of systemic aggravation.<sup>10-13</sup>

At the hospital, dental care may be performed in an outpatient clinic or at bedside. It is preferable to perform dental procedures in an outpatient clinic, because of the physical barriers and specific safety protocols in this environment. When patients cannot



**Figure 1.** Types of procedures to be performed on hospitalized patients or outpatients by the dentist in a hospital environment.

be transported to the dental office, dental interventions at bedside are indispensable to address specific needs. This treatment focuses on controlling the focus of infections before, during and after transplantation, as well as chemotherapy and/or radiotherapy, in order to prevent complications. The procedures that generate aerosols at the hospital bed should be used only under specific circumstances, owing to the high risk of contamination of the medical team, other patients, and patients' companions. When put into place, they must be well planned, and include disinfection protocols.

## Planning dental appointments and categorizing treatments

### Screening of patients, parents, or guardians

The patient's anamnesis should preferably be performed remotely by phone or video call (i.e., teledentistry) one day before the appointment. If the patient does not have flu-like symptoms or a positive COVID-19 result, his in-person consultation will be confirmed. At the appointment, a health professional or staff member wearing complete PPE should check the patient's temperature before he enters the dental office and makes contact with any member of the dental team. The following checklist should be completed:

- Do you have a fever, or have you felt hot or feverish recently (14–21 days)?
- Have you been experiencing shortness of breath or other difficulties breathing?
- Have you experienced recent loss of taste or smell?
- Have you come into contact with any confirmed COVID-19 positive patient or patients?
- Have you traveled to any regions affected by COVID-19 in the past 14 days?

Positive responses to any of these options certainly call for a more in-depth discussion with the dentist before proceeding with the dental treatment. Patients are referred to a consultation by teledentistry in order to define the type of care needed, and to give them guidance on how to go about conducting isolation at home, according to recommendations by the WHO.<sup>28</sup> Remember to maintain patient confidentiality. Remind patients/guardians to limit the number of extra

companions for special care patients and children on their trip to the dental office, and seek to reduce the number of individuals in the reception area. All patients, parents or guardians should wear surgical masks. The screening of the dental team professionals, whether staff, teachers, students, or collaborators, should be performed daily to determine any symptoms and body temperature (considering a feverish state  $\geq 37.8^{\circ}\text{C}$ ), before the clinical activities begin.<sup>29</sup>

### Reception area preparation strategies

Everyone should be reminded of the required hand hygiene and cough etiquette procedure. Provide a hand sanitizing station after entering the facility, with a notice for individuals to use the material before entering the office. Prepare the waiting area, bathrooms, and patient's consultation rooms. If the waiting room has toys, reading materials, or other items, remove or clean them regularly. All surfaces should be cleaned with detergent or soap and water before disinfection.

Ideally, the patient flow should be unidirectional, i.e., defining an entrance and an exit. If this is not possible, the interval between one patient and the other should be longer. Provisions should be made in the event that the presence of more than one patient and/or companion cannot be avoided in the same room. In this respect, the waiting room must be suitably laid out, and the chairs should be spaced at least 1 meter apart.<sup>27,29</sup>

### Methods for reducing airborne contamination

The use of personal barrier protection, such as masks, gloves, eye protection, cap, and gown will eliminate much of the danger from drops splashed from the operation site. A true aerosol or droplet nucleus may remain in the air of the surgical environment for up to 30 minutes after a procedure.<sup>23</sup> Hence, in the event that the operator removes a protective barrier, such as a face mask, to speak to a patient after the procedure has been concluded, the potential for coming into contact with air-contaminated material remains. In addition, an airborne contaminant might enter the ventilation system, and spread to areas where the barrier protection is not used.<sup>20</sup>

The most commonly cited methods for removing airborne contaminants from the treatment room are

the use of high-efficiency particulate air filters, and ultraviolet chambers in the ventilation system.<sup>20</sup> Another system is the high-volume evacuator (HVE), a suction device that draws in a large volume of air over a period of time. The standard HVE device used in dentistry has a large opening, and is connected to an evacuation system that removes an air volume of up to 100 cubic feet per minute. HVE devices has been found to reduce aerosols and splashes from contamination sites by up to 90%.<sup>30,31</sup> If an HVE or equivalent system cannot be used, the environment of the dental office must be ventilated.

### Dental procedures for minimizing airborne contamination

Since providers work indoors, strategies are needed to reduce the risk inherent in overhead transmission of contaminants, as listed below:

- a. Use a rubber dam whenever the procedure allows. When isolation is not possible, give preference to hand instruments and use extractors (e.g., cures, chisels, sickles, hoes, and periodontal files), instead of ultrasonic devices, to minimize the generation of aerosols.
- b. Use high-powered dental suckers. Four-handed work should be encouraged to control dissemination.
- c. Avoid using a triple syringe in spray form, activated by pressing the two buttons at the same time. Adjust the cooling water outlet.
- d. Pre-clean the patient's mouth by mechanical means, and wash his mouth with an antiseptic.

### Methods for reducing surface contamination

There are many techniques that reduce the risk of viral infection on surfaces, including heat sterilization, chemical disinfectants, and ultraviolet germicidal irradiation (UVGI).<sup>32,33</sup> Among the various types of products that can be used against SARS-CoV-2, the following are the more common: quaternary ammonium, hydrogen peroxide, peroxyacetic acid, isopropanol, sodium hypochlorite, octanoic acid, L-lactic acid, glycolic acid, phenol, silver ion, citric acid, ethanol, sodium chlorite, hypochlorous acid, and others.<sup>33,34</sup> It's noteworthy to mention that some materials cannot be sterilized by heat or chemicals.<sup>33</sup> However, only limited information is available on

the effectiveness of UVGI in inactivating viruses on surfaces. A study demonstrated that the effects of UVGI on virus inactivation of surfaces depended on the UV dose. Thus, the effectiveness of UVGI depended heavily on a type of virus nucleic acid.<sup>35</sup> Regarding SARS-CoV-2, further studies are needed to determine virus susceptibility to UVGI.

Reusable PPE (e.g., safety glasses and face shields) should be cleaned with soap and water between patient consultations, or cleaned and disinfected if visibly dirty. Kohn et al.<sup>36</sup> recognize that the dental community requires clear and consistent guidelines about the best way to reprocess dental handpiece devices between patient visits. At the end of each procedure, the handpieces must be heat sterilized, and other intraoral instruments must be sanitized with appropriate disinfectants. This recommendation is based on studies showing that the internal components of air-driven dental handpieces can be contaminated during use, and that this contamination can be expelled into the environment of the next patients during subsequent use.<sup>37,38</sup>

Routine cleaning and disinfection procedures for SARS-CoV-2 (e.g., cleaning products used in water to pre-clean surfaces before applying a US Environmental Protection Agency (EPA)-registered hospital-grade disinfectant to frequently touched surfaces or objects, as indicated on the product label) are recommended in healthcare settings, including chairs, desks, door handles, bathrooms, and elevators, especially in aerosol generation areas.<sup>34</sup>

### PPE

PPE is commonly used in healthcare facilities, such as hospitals, dental offices, doctors' offices, and clinical laboratories. Dental care must be provided with advice on strict personal protection and measures to reduce and prevent the production of droplets and aerosols. The use of protective clothing units is recommended, especially helmets, gloves, face shields, safety glasses, respirators, shoes made of plastic material, or other equipment designed to protect the user from injury, or the spread of infection or disease.

### Surgical masks and N95/PFF2 respirator masks

Surgical masks do not provide complete protection against germs and other contaminants, because of the

loose fit between the surface of the mask and the face.<sup>39</sup> The indication of wearing a surgical mask for dentistry in a hospital and outpatient setting is an administrative concern, and can be considered unnecessary for any activity that does not involve contact at a distance of less than 1 meter from the patient.<sup>40</sup>

In hospital and outpatient areas, the N95 or PFF2 or PFF3 mask, or equivalent, is recommended for any dental procedure performed, including oral evaluation.<sup>25,29</sup> In addition, the CDC recommends that health professionals who provide care in intensive and semi-intensive care units should wear a mask (N95 or FFP2 or FFP3 or equivalent).<sup>41</sup> In procedures in which aerosols will be generated, the mask of choice is the N95 or PFF2, because it offers the best protection.<sup>40</sup> Given the scarcity of equipment for frontline staff worldwide, a study stated that there is sufficient evidence to endorse the disinfection and possible reuse of respirators with N95 filter masks and other PPE in the current scenario of the pandemic, when needed.<sup>32</sup>

Respiratory protection devices are critical to protecting healthcare professionals at high risk for SARS-CoV-2 against infections.<sup>40</sup> The virus measures about 120 nm (0.12 µm), and an aerosol particle size ranges from 3 to 100 nm. In 2008, the Health and Safety Executive evaluated the protection offered by different types of masks against influenza bioaerosols, and recommended the use of class FFP3 disposable respirators when performing clinical procedures such as dental drilling, which is expected to generate aerosols of respiratory secretions from infected patients. The use of an FFP3 respirator, for instance, provides a 99% filtration rate of all particles measuring up to 0.6 µm.<sup>42</sup>

The CDC and the European Centre for Disease and Prevention (ECDC) have recommended the N95 respirator for routine non-aerosol-generating care for individuals with COVID-19, while the WHO and the Public Health Agency of Canada have recommended medical masks.<sup>24,28,34,43</sup> A systematic review compared medical masks (surgical masks) and N95 respirators used to prevent against COVID-19 in healthcare professionals who perform aerosol generation procedures, and N95 respirators were unanimously recommended by national and international guidelines.<sup>40</sup>

### Face shield

The face shield provides barrier protection for the facial area and related mucous membranes (eyes, nose, and lips). The shield should be used as a barrier protection for these anatomical regions against airborne body fluids (*e.g.*, blood, saliva, bronchial secretions, and vomiting).<sup>44</sup> Visors made of acetate, propionate and polycarbonate offer greater visual clarity and optical quality, as well as the potential to reduce eye fatigue.<sup>44</sup> Face shields with visors treated for anti-glare, anti-static and anti-fog properties should be preferred. Protection against infectious agents can be enhanced with face shields that cover at least the full length of the face, and have outer edges that extend across the face at least from ear to ear. Protection should also include chin and forehead protectors, and cover the forehead.<sup>41</sup> Face shields should not function as primary respiratory protection, or be used alone, because aerosols can flow behind the visor,<sup>45</sup> therefore strongly urging that a protective face mask (medical/surgical mask, N95, PFF2) be worn simultaneously.<sup>44</sup>

### Surgical gowns, gloves, cap, and shoes

Some authorities have recommended the use of long-sleeved water-resistant clothing when caring for patients with COVID-19.<sup>34,41,46</sup> The design of the surgical gowns and insulation is based on where the liquid is most likely to make contact (critical zones), and on the likely degree of contact. Since all surgical gowns are expected to come into direct contact with blood, body fluids and pathogens, the entire gown – including the seams – should achieve barrier performance.<sup>47</sup> Considering that there are various levels of performance for clothes and coveralls, one cannot simply conclude that a certain gown is more protective than the other. The appropriate level of protection for the gown should be chosen according to the assessed risk of exposure and type of contact, as well as the duration and type of procedure to be conducted.<sup>27,48</sup> However, no study has compared the effectiveness of gowns and coveralls in reducing the transmission of the virus to healthcare professionals. Thus, clothes and coveralls are generally considered acceptable and effective.

Completing the array of PPE, disposable gloves (nitrile or latex) are recommended to perform the

various procedures to be conducted, but do not replace hand washing. Use of a cap is also mandatory to avoid contamination of the hair. Likewise, shoes made of plastic are recommended (considering our practice of cleaning and disinfecting shoes at the entrance and exit of the surgical environment with 0.05% quaternary ammonium for 5 minutes). Table depicts the type of PPE used in different dental care areas of the hospital.

### Use of mouthwashes

The use of mouthwashes has been found to be effective in reducing the microbial count in the oral cavity.<sup>49</sup> Pre-procedure mouthwashes may be used to decrease the number of microorganisms in dental aerosol.<sup>50,51</sup> A systematic review reported that there is moderate evidence regarding the efficacy of the chlorhexidine, cetylpyridinium chloride, and essential oils contained in pre-processed mouthwashes, in reducing the number of viable bacteria in the aerosol generated by different dental procedures.<sup>49</sup> A study documented that chlorhexidine promoted a significantly greater reduction in aerosolized bacteria than essential oils.<sup>52</sup> Concerning the use of mouthwashes against SARS-CoV-2 before clinical practice, there is currently insufficient evidence to come to any conclusion.<sup>53</sup>

Mouthwashes considered to be effective against SARS-CoV-2 have been recommended based on studies using disinfectant substances on the surface.

Relying on collateral inference, we find references to cetylpyridinium chloride (quaternary ammonium), hydrogen peroxide, and povidone (oxidants) in the literature.<sup>54</sup> According to this premise, a rinse containing these substances has been proposed for use in the pre-procedure in order to reduce the viral load in the aerosol, and consequently decrease the risk of contamination of health professionals during manipulation of the oral cavity. This recommendation was based on clinical experience obtained in Spain.<sup>55</sup> Although use of chlorhexidine as a mouthwash may not be effective in killing SARS-CoV-2,<sup>25,26</sup> a study with only two individuals revealed that the viral load in saliva decreased transiently for two hours after using this antiseptic.<sup>56</sup> In this context, the use of mouthwashes remains under investigation, and those containing povidone,<sup>55</sup> 1% hydrogen peroxide,<sup>57</sup> 0.05% quaternary ammonium,<sup>58</sup> 0.12% chlorhexidine,<sup>56</sup> and  $\beta$ -cyclodextrin combined with citrox<sup>59</sup> are indicated until randomized clinical trials can be published to demonstrate their effectiveness more conclusively.

### Outpatient dental treatment

The dental treatment for both outpatients and hospitalized patients was stratified into categories<sup>48</sup> to facilitate patient guidance strategies, as follows:

- a. Oral care guidance: oral hygiene. Hand washing before manipulation of the oral cavity for tooth brushing and flossing, in order to avoid contamination by the virus.

**Table.** Personal protective equipment proposed against COVID-19.

| Protection type                              | Hand hygiene | Waterproof apron | Cap | Surgical mask | N95/PFF2 masks | Glasses or face protector | Gloves | Appropriate shoes |
|--|--------------|------------------|-----|---------------|----------------|---------------------------|--------|-------------------|
| Dental staff                                 |              |                  |     |               |                |                           |        |                   |
| Administrative/receptionist                  |              |                  |     | ✓             |                | ✓                         |        |                   |
| Screening patients                           | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Anamnesis                                    | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Radiology services                           | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Dental assistance without generating aerosol | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Dental assistance with aerosol generation    | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Asymptomatic individuals                     | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Outpatient care                              | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      | ✓                 |
| Ward   | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      | ✓                 |
| Individuals with COVID-19                    | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      |                   |
| Intensive care unit                          | ✓            | ✓                | ✓   |               | ✓              | ✓                         | ✓      | ✓                 |

- b. Urgency/emergency treatment: to be performed regularly.
- c. Oropharyngeal decontamination treatment: indicated in procedures that produce aerosol, for dental pre-procedures and for oral hygiene.
- d. Patients under mechanical ventilation: patients receiving preventive treatment of ventilator-associated pneumonia should be regarded as COVID-19 patients.

Strict adherence to all precautions described by the CDC<sup>24</sup> and the ADA<sup>25</sup> is recommended as a guideline. It is important to note that there is an indefinite risk for asymptomatic patients, particularly in regions with high transmission rates (5 per 100,000 inhabitants).<sup>24</sup> These risks to health professionals can be minimized, prevented or reduced by adopting PPE. When the patient arrives at the clinic for face-to-face screening, he will again answer the questions asked in the remote screening (see above). The risk will be suspected if the patient responds positively to any of the questions. Subsequently, screening should be performed to define non-emergency dental procedures or urgent/emergency dental procedures.

If the patient is symptomatic, he should be submitted directly to the rapid/RT-PCR test. If the result is negative, or the patient does not present or report signs and symptoms of SARS-CoV-2, the elective and dental emergency/urgency procedures should be performed by a dentist with protection level 3 (use of PPE) in an isolated room (preferential treatment), and treatment 2, 3 categories should be adopted. However, if the patient's result is positive, or if screening confirms COVID-19 infection, the signs and symptoms of acute respiratory distress syndrome (ARDS) must be evaluated, such as: SpO<sub>2</sub> < 92%, RR > 22/min, hypotension, and signs of difficulty breathing. If the patient shows the above clinical changes, he should be referred for medical evaluation, and his case should be reported to the hospital. If the patient does not present ARDS symptoms, dental emergency/urgency procedures should be performed by a dentist with protection level 3 (use of PPE) in an isolated room, and treatment 2, 3 categories should be incorporated. The following procedure should be adopted in either case (negative or positive status

without ARDS signs): if the patient's treatment ends after the procedure, then the treatment 1 category should be endorsed, but if treatment did not end, the patient must undergo all the screening levels upon his return to continue treatment.

### Hospital dental assistance

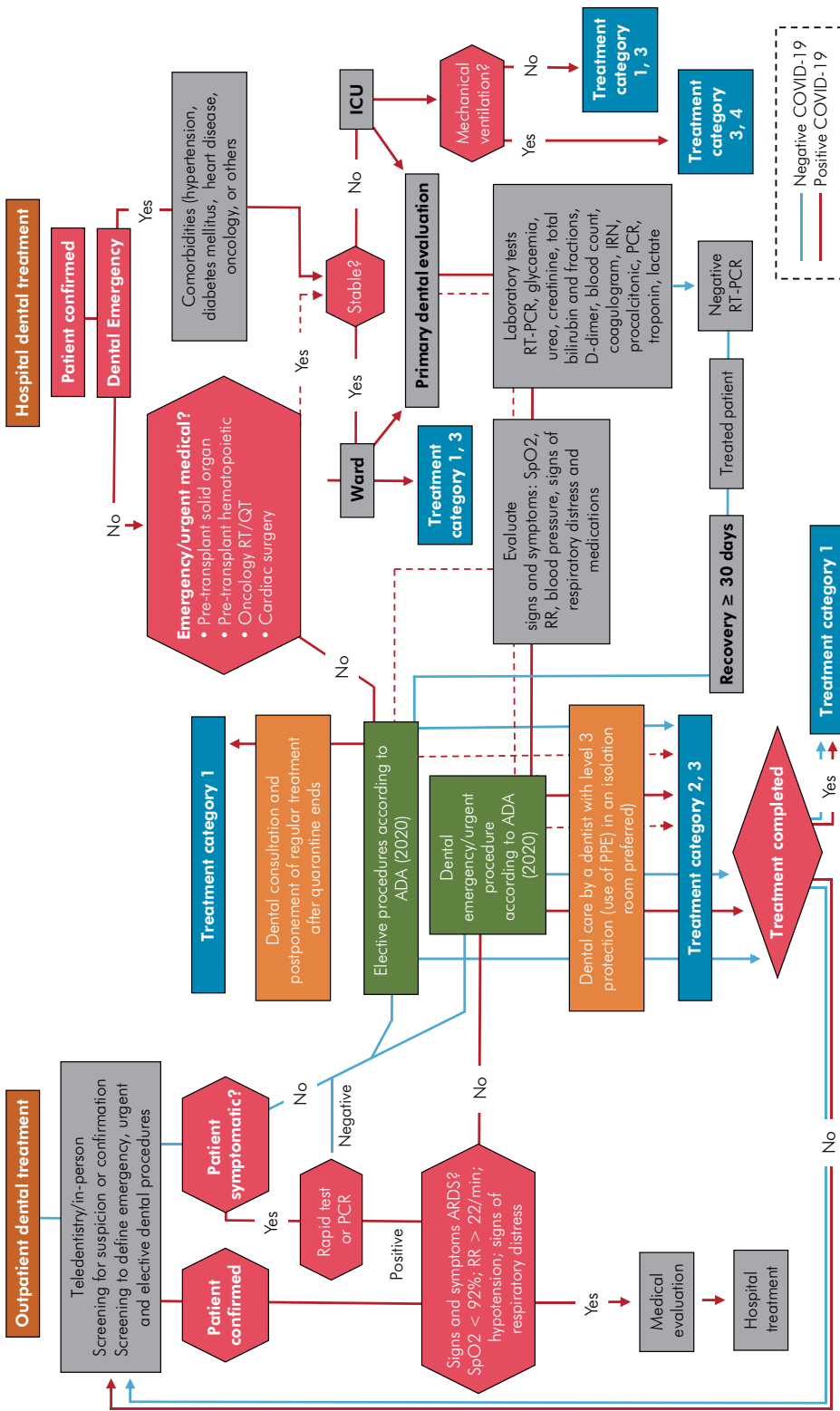
The management of individuals with COVID-19 can be performed during hospitalization. SARS-CoV-2 is known to cause substantial lung disease, including pneumonia and ARDS. Extrapulmonary manifestations affecting various organs and systems have been documented, such as hematological, cardiovascular, renal, gastrointestinal, hepatobiliary, endocrinological, neurological, ophthalmological, and dermatological conditions.<sup>60</sup>

The Sepsis Survival Campaign (SSC) COVID-19 recommends performing aerosol generation procedures in patients with COVID-19 in a negative pressure room (statement of recommended practice), with fitted breathing masks (N95, FFP2 respirators or equivalent), and an additional type of PPE (i.e., gloves, lab coat and eye protection, such as a face mask or safety glasses).<sup>61</sup>

COVID-19 patients may have several laboratory abnormalities (lymphopenia, leukocytosis, neutrophilia, and thrombocytopenia). In addition, an increased erythrocyte sedimentation rate, C-reactive protein, ferritin, IL-6, and lactate dehydrogenase have been described. Moreover, altered coagulation indices, high D-dimer and fibrinogen, prolonged prothrombin time, and partial thromboplastin time have been reported. Thromboembolic complications were first reported in intensive care units in China<sup>62</sup> and in the Netherlands<sup>63</sup> in up to 30% of the patients (arterial occlusive disease and other vascular events, including acute myocardial infarction, acute limb ischemia and stroke, in severely affected individuals).<sup>60</sup>

At the hospital, many patients with COVID-19 who need dental care should be classified according to the medical and dental emergency/urgency. If there is no dental or medical emergency, regular treatment and elective procedures should be postponed until after the end of quarantine, at which time category 1 treatment will be initiated, as shown in Figure 2.





ARDS: acute respiratory distress syndrome; INR: international randomized ratio; PCR: polymerase chain reaction; PPE: personal protective equipment; RR: respiratory rate; RT-PCR: reverse transcription polymerase chain reaction; SpO<sub>2</sub>: blood oxygen saturation.

**Figure 2.** The flowchart describes how dental care should be conducted during and after the pandemic, on an outpatient and hospital basis. A specific type of treatment will be instituted for all patients according to their classification (see treatment category). The initial assessment of an outpatient begins with remote screening in order to identify suspected cases, and to decide whether to perform the rapid test to confirm COVID-19. It is important to assess the patient's signs and symptoms in order to identify acute respiratory distress syndromes, such as SpO<sub>2</sub> < 92%; RR > 22/min, hypotension, and signs of respiratory distress. Patients screened and identified with signs and symptoms of acute respiratory distress syndrome will be referred for medical evaluation, and will be admitted to the hospital. Hospitalized patients will be classified according to the type of emergency/urgent/elective care in question, especially for individuals with solid organ pre-transplantation, hematopoietic pre-transplantation, and individuals undergoing chemotherapy/radiotherapy and heart surgery. Considering the comorbidities and clinical alterations of patients with COVID-19, such as venous thromboembolism, and hepatic, renal, cardiac and pulmonary disorders, the severity of the disease will define the patient's admission to the ward or intensive care unit (ICU). Important laboratory tests (see laboratory markers) should be performed to assess the patient's organic function, and support discussions regarding the risks and benefits of the treatment categories, among the members of a multidisciplinary team. All patients should be evaluated for signs and symptoms in advance of the dental treatment categories instituted at each stage of the disease.

A COVID-19 patient needing oral adequacy for a pre-transplant solid organ, pre-transplant hematopoietic organ, radiotherapy/chemotherapy, or heart surgery is categorized as a medical emergency/urgency. Hence, dental care by a dentist with protection level 3 (use of PPE) in an isolation room, and routine treatment and category 3 treatment is instituted.

Nonetheless, it is essential to know whether the patient is clinically stable. We must recognize his clinical condition. Is it stable? If the answer is "yes," the patient will undergo clinical treatment in the ward. To this end, the patient will receive an assessment from the primary dentist to determine his dental needs, and to initiate category 1, 3 treatments immediately. In addition, it is imperative to evaluate any laboratory markers of abnormal cell counts, such as lymphopenia, leukocytosis, neutrophilia, thrombocytopenia, and any elevation of serum inflammatory markers such as C-reactive protein, rate, and D-dimer. In addition, lactate dehydrogenase is predictive of subsequent critical illness and mortality in patients with COVID-19. Higher serum levels of IL-6 have also been linked to a worse prognosis, and have been found to correlate with fibrinogen levels in patients with COVID-19. Troponin elevation in hospitalized patients has been associated with more severe diseases and worse outcomes when measuring troponin concentrations to identify acute myocardial infarction. The prevalence of elevated serum creatinine, elevated urea nitrogen in blood, and an estimated glomerular filtration rate below 60 ml/min/1.73m<sup>2</sup> has shown that patients with kidney disease have a significantly higher risk of in-hospital death. Increased procalcitonin values seem to have a role in predicting patient evolution toward a more severe form of the disease. Elevated hepatic transaminases and elevated bilirubin levels are linked to progression toward liver damage.<sup>60,62,63</sup> The case of the COVID-19 patient should be discussed by a multidisciplinary team, and then the procedure should be scheduled and performed in an isolated room. During hospitalization, laboratory tests are performed frequently, including RT-PCR. When the patient has a negative RT-PCR, dental care may be performed normally after 30 days.<sup>64</sup>

If the patient shows signs and symptoms of clinical instability, he will be admitted to the intensive care unit. Is mechanical ventilation necessary? If "yes", institute category 3, 4 treatments. If "no", institute category 1, 3 treatments. The patient in an intensive care unit who needs dental treatment will be submitted to primary dental evaluation, and the flow of care will be the same for patients admitted to the ward. Usually, what changes is the severity of the patient's case, and/or the presence of an endotracheal tube. In this case, the discussion of the cases to be seen to must be detailed. SSC-COVID-19 recommends that supplemental oxygen should be administered in adults with COVID-19, if SpO<sub>2</sub> is < 92% or < 90%. In adult patients with COVID-19 and acute hypoxemic respiratory failure with oxygen therapy, it is recommended that SpO<sub>2</sub> should not be maintained above 96%. Dental intervention is a borderline decision. In some cases, the patient must be stabilized before he can receive dental care.

## Conclusion

In summary, COVID-19 has represented a major change in dental clinical practice, mainly in hospital services. In this article, we discussed our experience at the Hospital das Clínicas in Belo Horizonte, a public referral service supported by the Brazilian National Health System and at the forefront of COVID-19 care. Although face-to-face consultations must be reduced in order to decrease the risk of infection, clinicians must ensure a continuum of care, especially for patients with critical systemic diseases, and with urgent dental demands. The high exposure of dentists who are on the frontline against COVID-19 requires providers to follow essential precautionary practices that are crucial to their protection and to that of their relatives and patients during the pandemic. In addition, universal measures must be adopted in view of the sizable proportion of asymptomatic individuals, and the difficulty in tracing disease-related data in Brazil and worldwide.

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