Abstract. - OBJECTIVE: Coronavirus disease 2019 (COVID-19) has spread rapidly worldwide since it has been first identified in November 2018. It is transmissible via air droplets from infected individuals. Close contact between dentists and patients has aggravated the pandemic situation in Russia. It is necessary to reduce the risk of spreading COVID-19 during dental appointments by adhering to the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommendations.

SUBJECTS AND METHODS: Questionnaires were developed to assess levels of COVID-19 infection and preventive measures in private and state-funded dental practices in Moscow and other cities in Russia. Two questionnaires were developed to assess the COVID-19 situation among dental professionals and their patients. The first, for dentists, included four domains: demographic data, signs, and symptoms of COVID-19 experienced by dentists, personal protective measures taken by dentists, and presence or absence of dental practice during the pandemic. For dentists' patients, the second included domains regarding their health status after their dental appointment. 1,500 questionnaires were sent to different cities and regions of Russia; 1,011 questionnaires (67.4%) were returned. We used statistical observation (monitoring) and clustering to analyze the data. The $x^2$ was used to check the significance level.

RESULTS: We found a direct relationship between those patients who contracted COVID-19 after dental treatment by those dentists who did not follow recommended measures in the dental clinic. However, patients were less likely to become infected after dental treatment by those dentists who followed the measures, such as the disinfection of surfaces and dental equipment several times a day, the wearing of medical masks by all patients, and the airing of the dental office after each patient for 10 minutes.

CONCLUSIONS: Dentists wearing an FFP2 or FFP3 respirator, as well as a sterile disposable microfiber medical gown, prevented their patients from becoming infected with COVID-19 at dental appointments and, as a result, the spread of the virus. A key aspect of this study is its knowledge regarding preventive measures against COVID-19. The findings of this study can potentially help in formulating strategies to reduce the prevalence of COVID-19.

Key Words: COVID-19, Dentist, Awareness, Infection, Infection control, Protective measures.

Introduction

COVID-19 has affected many countries worldwide. As of August 2021, 201,224,770 cases of COVID-19 had been reported, including 4,274,727 deaths. Among the countries, the United States of America had the highest number of cases at 36,184,225, of which 631,331 were fatal, followed by India and Brazil. The Russian Federation had the fourth-highest number of cases (6,379,904), with 162,509 deaths. Unfortunately, the number of cases continues to grow. That is why it is necessary to introduce preventive and reductive measures to control the spread of COVID-19 worldwide.

In March 2020, the CDC and the WHO developed preventive measures to control the spread of COVID-19, including the enforcement of total lockdowns in affected countries. The first recorded cases of the COVID-19 outbreak occurred in Wuhan, China, and quickly spread across the country. Airborne droplets transmit this virus from an infect-
ed person to a healthy one\textsuperscript{3,7-9}. Medical profession-
als, including dentists, are at risk due to the close
contact between the dentist and the patient during a
dental appointment. The disease can be transmitted
through saliva, aerosol clouds, blood, and microor-
ganisms while the doctor inspects the patient’s oral
cavity. A lack of preventive measures during dental
appointments can also lead to the increased risk of
COVID-19 infection among dentists.

It can be assumed that medical staff is faced with
bodily excretions of those patients who carry coro-
navirus and be infected during a dental appointment.
Therefore, dental care should only be provided in
acute pain and emergency conditions.

However, there is a lack of studies investigat-
ing effective preventive measures during dental
appointments. A previous study\textsuperscript{10} has shown that
the virus remains viable and contagious for several
hours in the air and on surfaces. To improve the
outcomes of the pandemic, strict compliance with
safety measures is mandatory. This condition is es-
pecially true for dental clinics. Failure to comply
with safety protocols to reduce COVID-19 during
the gradual return to normal schedules will increase
the risk for the patients, dentists, and clinical staff\textsuperscript{5,11}.

An important component of these safety measures
includes wearing personal protective equipment
(PPE): a protective suit, mask, gloves, and shoes\textsuperscript{10-12}.

This study aimed to establish dentists’ levels
of awareness about how to protect themselves
and their patients against infection during the
COVID-19 pandemic.

Subjects and Methods

Study Design

The study protocol was registered with the World
Pandemic Research Network (WPRN-486352). The
survey was designed as a cross-sectional survey using
a previously standardized questionnaire.

Study Setting

The study was conducted between March 2020 and
November 2021 (Figure 1). The central management
team contacted 1,011 collaborating dentists working
with research groups in Russia. Cities in Russia that
participated in the survey are shown in Figure 2.

Study Population

The study included 1,011 registered dental
professionals working within the national health
system and private or public clinics, including gen-
eral dentists and dental specialists. No exclusion
criteria were applied. The total number of working
dentists was obtained to establish a sample size
of the study. The study also included registered
patients who came for their dental appointments.

Development and Refinement

of the Questionnaire

The questionnaire was not pre-tested in the Rus-
sian Federation. The questionnaire for dentists consists
of four main domains. The first domain contained de-

dographic data, such as age, gender, area of residence,
occupation, and occupational status. The second do-
The study protocol: COVID-19 awareness and perception among dentists in the Russian Federation

The main contained questions concerning the symptoms or signs of COVID-19 infection. The third domain contained working conditions and PPE, which dentists used throughout the pandemic. The fourth domain contained questions on each dentist’s knowledge of COVID-19 risk factors. A random sample of dentists from different regions and specializations was invited to evaluate the questionnaire. To determine the reliability of the questionnaire, it was re-sent to the experimental sample four to seven days after the first survey, without any recommendations. The questionnaire was conducted and analyzed through online surveys (Google Form google.com/forms/about/). The questionnaire for patients included questions regarding their contagious status after the dental appointment.

Data Management
The questionnaires were anonymous; only the author and the table creator had access to the data presented in the table. The data from dentists and their patients from all regions of the Russian Federation were exported and sent to the authors for statistical analysis using different software programs.

Statistical Analysis
We used statistical observation (monitoring) and clustering to analyze the data. Data were presented as absolute and relative values and were compared. The information was encoded using Microsoft Excel™ 2019 (Microsoft Corp., Washington, WA, USA) for Mac (or Windows equivalent) and analyzed for accuracy. The x² was used for checking the significance level.

Results
A total of 1,500 questionnaires were sent to different cities and regions of the Russian Federation. Among these, 1,011 questionnaires (67.4%) were returned. The number of questionnaires distributed by region, COVID-19 prevalence in the general population, and the number of questionnaires retrieved are shown in Table I.

In all regions, female predominance was observed. Additionally, there were 10% fewer dentists working in the national health system than those practicing privately (Table II). The highest proportion of dentists (2/3 of respondents) who acknowledged having experienced at least one symptom of COVID-19 was in Moscow. The proportion of dentists who tested positive and were hospitalized due to COVID-19 was generally low. In Moscow, this figure was more than 5%.

Figure 2. Participating regions and cities of the Russian Federation.
Based on the characteristics and effectiveness of the use of protective equipment, a statistical analysis was carried out. As a result of this analysis, and following statistical differences, the following conclusions were formulated:

1. Protective equipment for which no statistical differences were found — $p > 0.05$ (unproven effectiveness as a result of the questionnaire): medical mask, disposable protective face mask, waterproof disposable protective robe, disposable protective robe, safety glasses, sterile disposable gloves, disposable gloves that were not sterile, rotating tools with check valve.

2. Statistical differences — $p < 0.05$ (proven effectiveness due to the questionnaire) were revealed for such means of protection as FFP2 or FFP3 respirator, a sterile disposable medical gown made of microfiber.

It is necessary to note several points that will complement the results of the statistical analysis:

1. Medical masks have shown the least effectiveness as a means of protection.

### Table I. Sent/received questionnaires and the prevalence of COVID-19 in the regions of the Russian Federation.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Sent questionnaires</th>
<th>Received questionnaires</th>
<th>Confirmed cases of COVID-19 on August 3, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moscow</td>
<td>500</td>
<td>390</td>
<td>243406</td>
</tr>
<tr>
<td>Moscow oblast</td>
<td>350</td>
<td>260</td>
<td>154936</td>
</tr>
<tr>
<td>Saint-Petersburg</td>
<td>50</td>
<td>36</td>
<td>92794</td>
</tr>
<tr>
<td>Nizhny Novgorod</td>
<td>30</td>
<td>34</td>
<td>6236</td>
</tr>
<tr>
<td>Ekaterinburg</td>
<td>50</td>
<td>23</td>
<td>12279</td>
</tr>
<tr>
<td>Rostov-on-Don</td>
<td>50</td>
<td>30</td>
<td>13205</td>
</tr>
<tr>
<td>Samara</td>
<td>50</td>
<td>23</td>
<td>6975</td>
</tr>
<tr>
<td>Central Federal District</td>
<td>50</td>
<td>29</td>
<td>57253</td>
</tr>
<tr>
<td>Southern Federal District</td>
<td>50</td>
<td>18</td>
<td>28500</td>
</tr>
<tr>
<td>North Caucasian Federal</td>
<td>50</td>
<td>19</td>
<td>120830</td>
</tr>
<tr>
<td><strong>District</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volga Federal District</td>
<td>50</td>
<td>49</td>
<td>43205</td>
</tr>
<tr>
<td>Northwestern Federal District</td>
<td>50</td>
<td>23</td>
<td>16647</td>
</tr>
<tr>
<td>Ural Federal District</td>
<td>50</td>
<td>32</td>
<td>22686</td>
</tr>
<tr>
<td>Far Eastern Federal District</td>
<td>50</td>
<td>22</td>
<td>13310</td>
</tr>
<tr>
<td>Siberian Federal District</td>
<td>50</td>
<td>23</td>
<td>16608</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1500</td>
<td>1011</td>
<td>850870</td>
</tr>
</tbody>
</table>

After analyzing the statistical data of our survey, we obtained the following indicators for protective equipment and measures used during COVID-19.
The statistical analysis data for waterproof disposable medical gowns cannot be correct because a disposable medical gown was used as a means of protection in most cases. That introduces an error in the measurement of statistical differences.

As for the analysis of the application of protective measures in the organization of the dental reception and the effectiveness of these protective measures, the following results were obtained:

1. As a result of data analysis, statistical differences (the proved effectiveness of protective measures) were revealed only for mandatory wearing of medical masks by all patients and for disinfection of surfaces and dental equipment of the dental clinic several times a day.

2. No statistical differences were found for all other protective measures, indicating their ineffectiveness in preventing viral infection spread.

Based on the statistical analysis of the questionnaire, we concluded that certain means and measures are the most effective in preventing the transmission of the COVID-19 virus between a dentist and a patient. These are FFP2 or FFP3 respirator, a sterile disposable medical gown made of microfiber, wearing medical masks by all patients, disinfection of surfaces, and dental equipment of the dental clinic several times a day. Using these protective means and measures significantly reduces the risk of transmission of a viral infection at a dentist’s appointment.

**Discussion**

The proximity between dentists and their patients during dental appointments emphasizes the significance of preventive measures for controlling the spread of COVID-19. However, no consensus has been reached regarding dental services during the COVID-19 pandemic. The CDC published recommendations; however, the consensus is yet to be reached due to the rapid deterioration of the epidemiological situation. The study conducted by Wolf et al. showed that only 12 dentists were tested and declared COVID-19 positive. Only 87 dentists reported having treated SARS-CoV-2 infected patients. The scientists from the Università Cattolica del Sacro Cuore determined that the saliva of contagious patients contains a high level of biomarkers, such as IgA1, IgA2 subclasses, and salivary free light chains. This study confirmed that the oral cavity is a biological environment for COVID-19, strengthening the argument in favor of using preventive measures during dentistry. Thus, absolute compliance of dentists with these preventive measures is essential.
measures, including the use of PPEs, is necessary during the pandemic.

Previous studies\(^5\) have proven the effectiveness of masks, particularly N95 respirators, in reducing the risk of COVID-19 infection. Moreover, Tokuc et al\(^18\) determined that the use of FFP2/N95 and FFP3/N99 respirators increased by 50.7% compared to that of surgical masks. Using medical masks, observing hand hygiene, and maintaining social distancing contribute to the prevention of the spread of COVID-19 and other respiratory diseases\(^19\). The effective implementation of these preventive measures can help reduce the spread of infection during surgical and dental procedures\(^7,20,21\). Mustafa et al\(^22\) revealed that 85.9% of dentists argued that the use of personal protective medical equipment, such as dental protective eyewear, masks, and gloves, is useful for protecting them from asymptomatic COVID-19 patients. There is evidence\(^6,8\) that dental tips should have special cleaning check valves to eliminate the risk of cross-contamination. Our hypothesis regarding the high risk of patients’ contagiousness was supported by updated research from the UK. The researchers found that 16.3% of dentists had SARS-CoV-2 antibodies in their blood samples, compared to an estimated 6% to 7% of the general population. These findings strongly confirm that medical staff is in a high-risk group\(^23\). Notably, other scientists from Brazil have recently shown that salivary glands are a biological reservoir for SARS-CoV-2 and saliva. Their excretion plays a great role in spreading COVID-19, both for medical staff and patients\(^24\).

It should be noted that dentists are in a high-risk group because before dental appointments, patients do not undergo a medical examination, and none of them take a Polymerase Chain Reaction (PCR) test. As a result, dentists are unaware of their patients’ health status. Thus, our colleagues from India\(^25\) recommend making it mandatory to get a negative COVID-19 test before receiving dental treatment.

The prevention and control of infections during medical care are always recommended, especially when a COVID-19 infection is suspected. However, no consensus has been reached regarding dental services during the COVID-19 pandemic. For instance, Bakaeen et al\(^26\) also emphasizes that dentists need to limit their medical practices to survive crises that restrict services for a considerable period. Dental organizations should pay special attention to cleaning, disinfecting the premises, and ventilating passages. Furthermore, procedures that produce aerosol-cloud formations should be used only when needed. These measures will help reduce the aerosol particle dispersion in the environment\(^3,5\).
Contrary to our opinion, participants of a recent study\textsuperscript{27} argue that aerosol (water droplets) does not contribute to COVID-19 spread. We would like to note that our assumption about the availability of therapeutic methods for preventing COVID-19 was true. Our colleagues from the University of Genoa\textsuperscript{28} have demonstrated that lipid-encapsulated ozonized oil (HOO) and water-soluble HOO (HOOws) treatment could be used for COVID-19 prevention. This combination of drugs allows neutralizing SARS-CoV-2 directly in the cells and even suppressing its reproduction. As a result of their daily use, the lung’s oxygen level was high.

Moreover, some researchers in the University of Pavia, Italy\textsuperscript{29} recommend using bio-inspired systems in dental appointments to reduce the risk of bacteremia and aerosol generation, which is necessary for the COVID-19 pandemic. In addition, nowadays, due to the widespread vaccination against COVID-19, dentists can become more protected in a dental appointment. Therefore, most of them are eager to be vaccinated to protect themselves. According to the questionnaire held in India, 65% of dentists responded that they want to be vaccinated\textsuperscript{30}. However, according to the worldwide statistic, most people who do not have an attitude towards medical staff do not wish to be vaccinated\textsuperscript{31}. As a result, the spread of coronavirus infection was reduced. Furthermore, knowledge regarding these preventive measures is crucial for our research.

**Institutional Review Board Statement**

The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethical Board of I.M. Sechenov First Moscow State Medical University. The protocol of the study was registered in the WPRN-486352.

**Informed Consent Statement**

Informed consent was obtained from all subjects involved in the study. Each research group applied for ethical approval under the rules and laws of the Russian Federation.

**Conflicts of Interest**

The authors declare no conflict of interest.

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**References**


