

# Photodynamic therapy procedures in coronavirus (COVID-19) outbreak: perception of health risks among clinical dental faculty and dental students

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**Abstract. – OBJECTIVE:** The aim of the study was to investigate clinical faculty members and final year dentistry students' perceptions regarding their health concerns and risks of performing photodynamic therapy (PDT) procedure in dental clinics amidst the COVID-19 pandemic.

**SUBJECTS AND METHODS:** A 21-item questionnaire comprising open and closed questions was sent to dental faculty members (n=43) and final year dentistry students (n=99) of Riyadh Elm University during mid-January 2021 that ended only after two weeks. The survey included health risks perception of performing PDT procedures, the impact of the COVID-19 outbreak on PDT performance and stress levels, perceived efficacy of the preventive steps, perception of the effect of the probable suspension of PDT procedure in dental clinics, and influence of alternative teaching methods of PDT procedure on clinical competence were reported.

**RESULTS:** A response rate of 82% for faculty members (n=35) and 75% for students (n=74) was recorded. 91% of faculty members and 95% of students felt that their health was not at risk during performing PDT procedure in dental clinics amidst the COVID-19. 82% of faculty and 83% of students expressed that the PPE and universal preventive steps to perform PDT procedure were enough for preventing the cross-infection with the virus. 89% of faculty members and 91% of students thought that a provisional suspension of PDT procedures in dental clinics would assist in containment of the virus and reduce the infection risk from the contact and not the PDT procedure.

**CONCLUSIONS:** Students and faculty members reported that their health is not at risk while performing PDT procedure in dental clinics amidst the COVID-19 outbreak.

*Key Words:*

COVID-19, Health risks, Photodynamic therapy, SARS-CoV-2.

## Introduction

At the end of December 2019 in the Huanan seafood market in Wuhan, Hubei Province in China, which is famous for selling live animals, including rabbits, marmots, birds, snakes, frogs, and bats encountered an outbreak of the novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2)<sup>1</sup>. Since then, SARS-CoV-2 has transmitted and spread exponentially. On 30 January 2020, the COVID-19 outbreak was declared as a Public Health Emergency of International Concern by the World Health Organization (WHO) Emergency Committee<sup>2</sup>. As of mid-February 2021, the COVID-19 pandemic has been reported among 219 different countries, with over 109,445,477 laboratory-confirmed cases and 2,412,710 confirmed deaths globally<sup>3</sup>. Similar to the Middle East respiratory syndrome (MERS-CoV) of 2012 and severe acute respiratory syndrome (SARS-CoV) outbreak of 2002-2004, the COVID-19 is a zoonotic disease of viral origin, with confirmation that Chinese pangolins and bats might be an intermediary host for transmitting the SARS-CoV-2<sup>4,5</sup>. The exact origins of SARS-CoV-2 is the primary topic of current research<sup>4,5</sup>. The most frequently occurring symptoms of COVID-19 include dry cough, fever, and malaise, while diarrhoea, rhinitis, nasal congestion, and musculoskeletal pains are mildly associated symptoms<sup>6</sup>.

Human-to-human spread of COVID-19 is induced mainly *via* airborne transmission (a diameter of >5-10  $\mu$ m) by talking, sneezing, and coughing as well as close physical contact<sup>7</sup>. However, more recent reports<sup>8</sup> have revealed that there is high presence of SARS-CoV-2 in human saliva. Moreover, reports<sup>9</sup> have demonstrated that salivary glands, along with oral mucosal cells serve

as reservoirs for SARS-CoV-2. Hence, dentists are at extremely high risk of being infected, considering various parameters such as generation of aerosols during the dental procedure, contact with patients' saliva, and the distance between patients' mouth and dentists<sup>10</sup>.

The remarkable growth in technological and scientific progress within dentistry has led to an extensive range of innovative therapeutic techniques for dentists to utilize. Photodynamic therapy (PDT) is an emerging, well-established, and a non-invasive therapeutic modality currently being applied in several domains of dentistry including dental implantology, periodontology, preventive dentistry, endodontics, oral medicine, oral pathology and maxillofacial surgery<sup>11-15</sup>. PDT mandates the employment of a photosensitizer (PS) that, after being excited by visible light, reacts with the atmospheric oxygen ( $^3\text{O}_2$ , dioxygen), generating reactive oxygen species (ROS) including hydrogen peroxide, hydroxyl radicals, superoxide anion and/or singlet oxygen. These ROS could damage cells and tissues by reacting and oxidizing the biological molecules (i.e., nucleic acids, lipids, and proteins)<sup>16</sup>.

Due to the nature of the profession, dental faculty members, as well as clinical dentistry students performing PDT procedures in dental clinics, are at high risk of being exposed to COVID-19 infection<sup>1</sup>. Although guidelines are available regarding the dental treatment of patients along with safe dental practice and avoiding the risk of COVID-19 transmission, however, the COVID-19 pandemic and any dental treatment in an academic institute during the pandemic is a huge challenge<sup>17</sup>. Hence, the present study aimed to examine the perceptions of dental faculty members as well as clinical dentistry students regarding health risks while performing PDT procedures amidst the COVID-19 outbreak.

## Subjects and Methods

### *Ethical Considerations and Study Participants*

This study was submitted, reviewed, and approved by the Research Ethics Committee of the Riyadh Elm University with an approval number (FRP/2021/387/606/580). Clinical faculty members (n=43) and final year dentistry students (n=99) were included in this study and were sent electronic surveys through email at the Riyadh Elm University in mid-January 2021. The Qualtrics online platform was employed to host the 21-item questionnaire. The follow-up reminder

was sent after one week, and the survey was terminated after two weeks.

### *Research Tool and Data Collection Method*

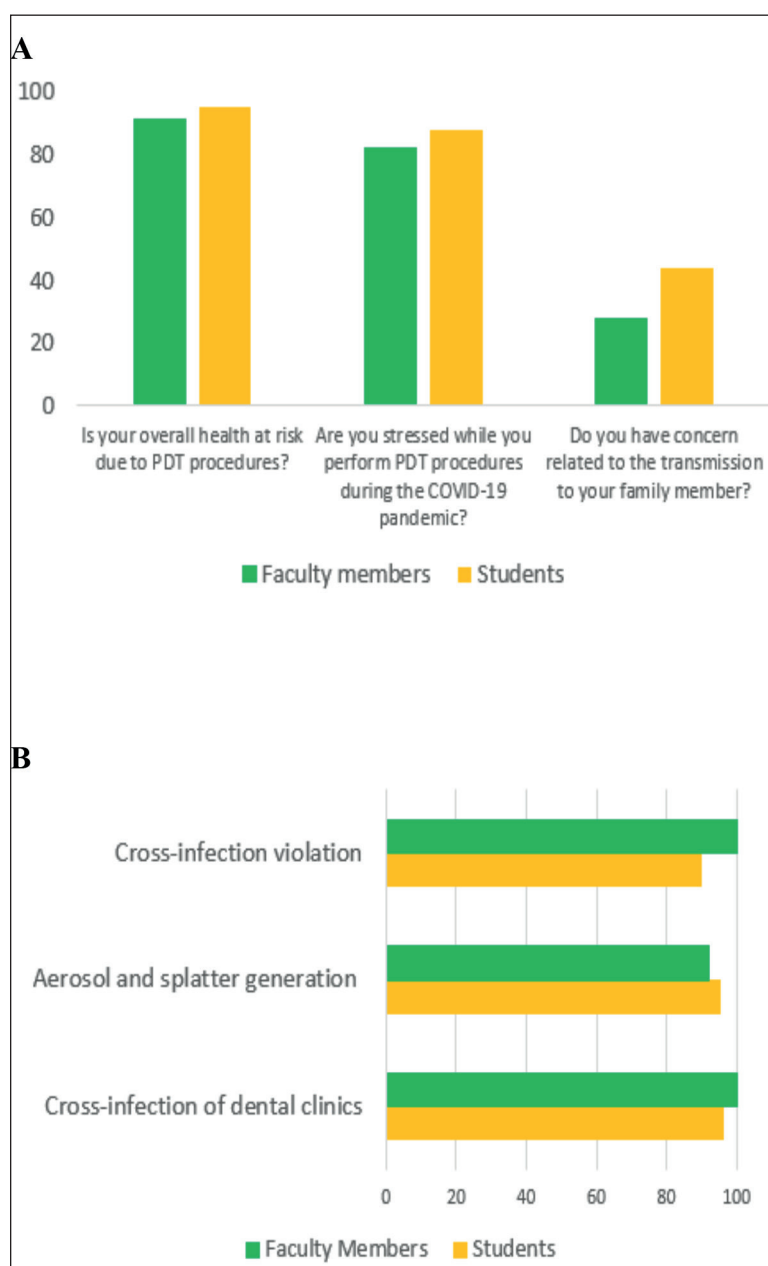
The survey, consisting of open and closed questions, focused on the perceptions of dental faculty members as well as clinical dentistry students regarding their health risks while performing PDT procedures in the dental clinics amidst the COVID-19 outbreak. The survey was unknown and encompassed aspects including health risks perception of performing PDT procedures in dental clinics during the COVID-19 outbreak. This section included questions related to their overall health being at risk, how stressed they feel while performing PDT procedures, and concerns related to the transmission to their family members. In addition, the impact of the COVID-19 outbreak on PDT performance and stress levels, perceived efficacy of the preventive steps and personal protective equipment (PPE), perception of the effect of the probable suspension of PDT procedure in dental clinics, and influence of alternative teaching methods of PDT procedure on clinical competence were also reported. Responses were gathered and average percentages were recorded. The analysis of qualitative information from open questions was performed using an inductive approach<sup>18</sup>. The primary themes were determined, defined, and associated quotes were clustered into themes. The anonymity of the research participants was ensured utilizing randomly allocated numbers to the faculty staff and dental students.

## Results

A response rate of 82% for faculty members (n=35) and 75% for students (n=74) was recorded for the present survey after the exclusion of incomplete surveys.

### *Health Risk Perceptions and COVID-19 Cross-Infection*

Figure 1A describes the responses as 'NO' that relates to the health risks perception of performing PDT procedures in dental clinics during the COVID-19 outbreak. It was observed that 91% of faculty members and 95% of students felt that their health was not at risk during performing PDT procedure in dental clinics amidst the COVID-19. This led to their reduced levels of stress with 82% of faculty members and 88% of students responding that they are not stressed while performing PDT

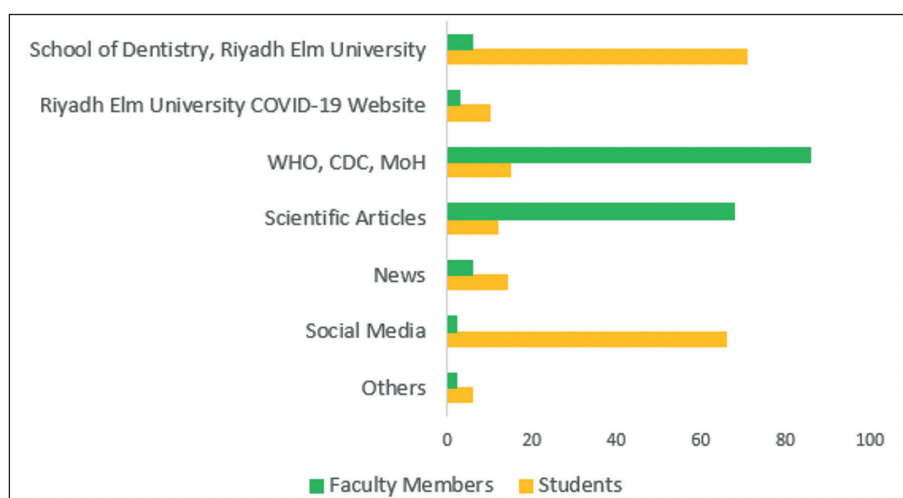


**Figure 1.** A, Items and their responses related to health risks perception of performing PDT procedures in dental clinics during the COVID-19 outbreak. B, Items and their responses related to the perception of cross-infection and aerosol generation with PDT.

procedures during the pandemic. Only a fraction of participants (28% of faculty member and 44% students) had concerns about the transmission of the virus to their family members because of performing PDT procedure in dental clinics.

The nature of PDT performed during dental operating procedure, exposure to body fluids, and proximity to patients were stated by faculty members and students as justifications to perceived health risks: “Before the application of PDT, although we are utilizing ultrasonic and

high-speed dental instruments that form airborne blood, saliva, and moisture products, we are sure enough that PDT employ only the application of photosensitizer and thereafter laser light application. We wear enough personal protective equipment (PPE) for safety against the virus” (Faculty member 12). The risk for transmitting the virus to family members was also stated: “Risk of getting infected with the virus and the transmission to my parents is generally low” (Student 13); “Although I have old-aged parents at my home, hence the



**Figure 2.** Information source used by the faculty members and students on the prevention of COVID-19 transmission in clinics.

chance of transmitting the virus is extremely low” (Faculty member 8). A total of 100% of faculty members responded that PDT does not involve cross-infection and neither there is any violation of it in the dental clinics. A total of 95% and 92% of the students and faculty members think there is chances of aerosol and splatter generation while performing PDT procedures (Figure 1B).

#### ***Influence on PDT Performance***

Over half (58%) of students stated that their PDT performance in dental clinics was negatively influenced by the COVID-19 outbreak, whereas only 18% of faculty members thought so. Around 90% of the students expressed their concerns related to the influence on the attendance of PDT-requiring patients in dental clinic due to the COVID-19 pandemic. The influence of faculty members’ PDT performance was associated with reduced time duration for clinical education (teaching): “Less time discussing with students about the PDT performance/clinical cases” (Faculty member 24). For students, the negative influence on their PDT performance regarding unexpected suspensions and worries about clinical quota to fulfil: “Several cancellations and panic about requirements to fulfil the number of patients requiring PDT” (Student 64).

#### ***Efficacy of Personal Protective Equipment and Preventive Steps***

Around 82% of faculty members and 83% of students expressed that the PPE and universal preventive steps to perform PDT procedure were enough for preventing the cross-infection with the virus. Most of the faculty members (94%) and

students (90%) would not treat patients requiring PDT who presented with upper respiratory tract infection. Furthermore, around 86% and 81% of faculty members and students, respectively, would not treat patients requiring PDT who had recently been to a foreign country having high incidence of the virus. According to the faculty members, the recent implementation of screening steps would help to avoid sick patients attending the clinics. Students stated that they would stick to the Faculty’s patient screening measures and described the reasons for delaying the PDT procedure. For the patients who just arrived from any other country, the reinforcement of Saudi Arabia’s Ministry of Health (MoH) implementing self-isolation policy was appreciated by the students and faculty members.

#### ***PDT Procedure Precautionary Steps***

As per the information sources about prevention of the COVID-19 spread within the institution, around 71% of students mentioned dependence on the School of Dentistry updates, whereas 86% of faculty members relied upon the WHO, Centre for Disease Control and Prevention, and Saudi MoH data. More faculty members in comparison with students depended on scientific publications (68% vs. 12%), whereas more students in comparison with faculty members relied on social media updates (66% vs. 2%). Other sources stated are: (a) the Dental Council of Saudi Arabia Dental Association; (b) Material Safety Data Sheets; and (c) manufacturer’s guidelines for wipes and disinfectants (Figure 2).

On inquiring about the possible supplementary precautionary steps for avoiding the COVID-19

cross-infection while performing PDT procedure in dental clinics, the majority of the study participants (students and faculty members) selected the following three options, i) the use of advanced techniques for surface disinfection (96% and 99%); ii) the utilization of advanced personal protective equipment (89% and 97%); and iii) the implementation of the use of high volume suctions (79% and 94%), respectively. The members from the faculty also proposed antibacterial mouthwash rinsing before PDT application (76%), decrease use of high-speed instruments before and after PDT (85%), treatment of emergency cases (61%) and superior ventilation (71%) should be employed as supplementary precautionary steps (Figure 3).

After inquiring about the steps which were implemented, both the student body and faculty supported the use of i) personal protective equipment (93% and 100%); ii) improved methods of surface disinfection (95% and 100%) and iii) high volume suction (84% and 96%) before the use of PDT, respectively (Figure 4).

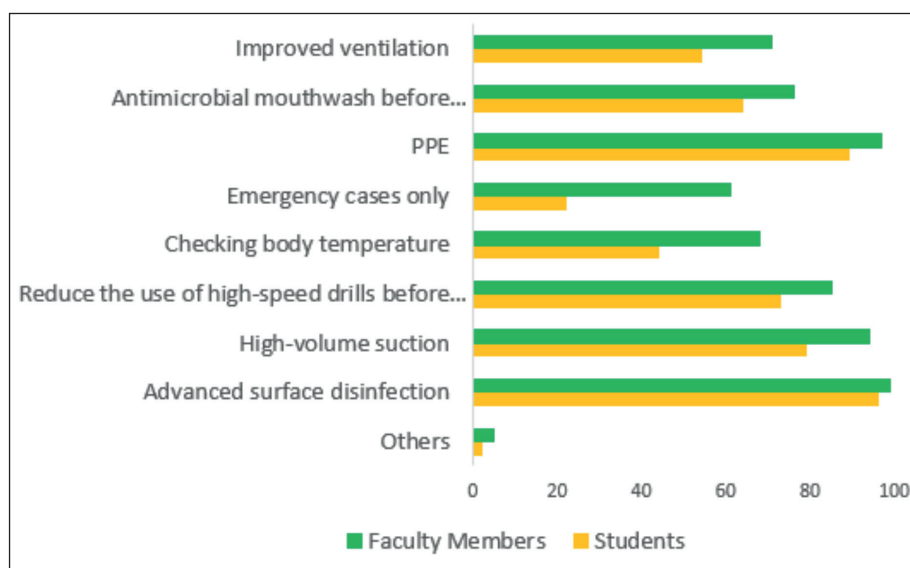
### **Temporary Suspension of PDT Procedure and Alternative Teaching Options**

Around 89% of faculty members and 91% of students thought that a provisional suspension of PDT procedures in dental clinics would assist in containment of the virus and reduce the infection risk from the contact and not the PDT procedure.

On inquiring how the temporary suspension of PDT procedure in dental clinics would influence on the students' clinical PDT performing capacities, the faculty members (41%) and students (82%) expressed the effects to be severe. After inquiring about the aspects of alternative PDT teaching methods if a temporary suspension for performing PDT procedures in dental clinics were to be implemented, the majority of students selected three methods, where the most selected method was simulation clinics for demonstration of PDT (79%), followed by online case-based discussion (68%) and online tutorials (56%), respectively. According to the faculty members, online case-based discussions (76%) and online tutorials (59%) were the preferred alternative options to teach PDT performing skills (Figure 5).

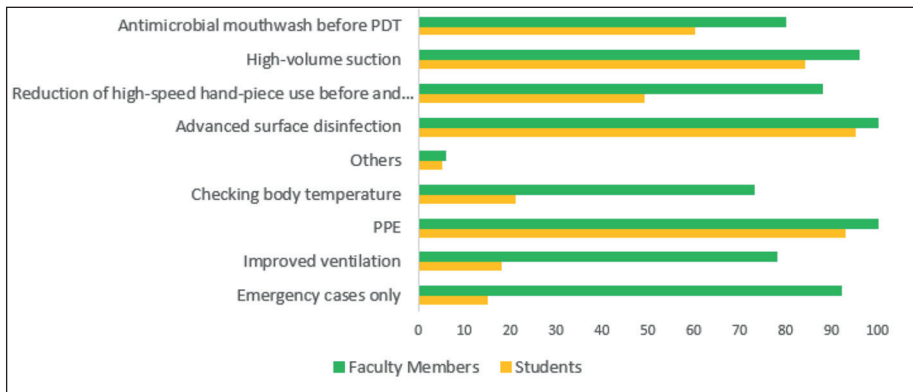
## **Discussion**

The present survey investigated clinical faculty members and final year dentistry students' perceptions regarding their health risks while performing PDT procedures in dental clinics during COVID-19 pandemic, supplementary precautionary steps that faculty members and dental students thought should be implemented and adopted to avoid possible COVID-19 transmission in PDT performing clinics, and alternative teaching methods preferred by students and faculty mem-



**Figure 3.** Supplementary precautionary steps that faculty members and dental students thought should be implemented to avoid possible COVID-19 transmission in PDT performing clinics.





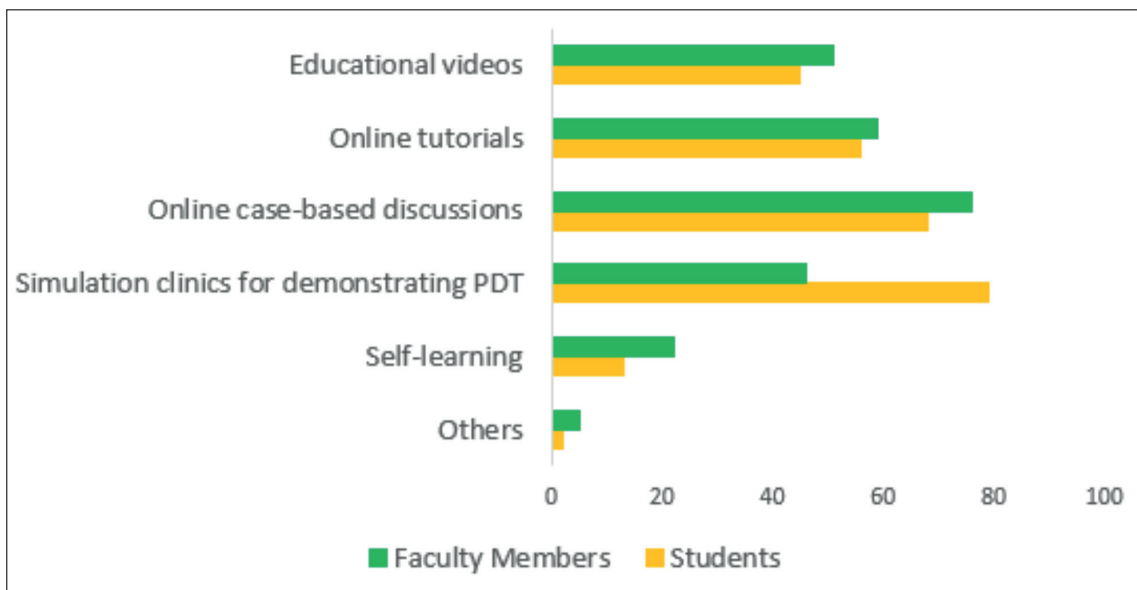
**Figure 4.** Additional steps actually adopted by all participants to avoid COVID-19 transmission in PDT performing clinics.

bers during the suspension of PDT procedure in dental clinics.

According to the outcomes of the present study, the majority of both students (95%) and faculty members (91%) were not concerned about their respective health and risk of COVID-19 transmission whilst performing PDT in dental clinics. Unlike other dental procedures, PDT is not associated with any aerosol-producing agent as it involves the use of a photosensitizer and laser light of a specific wavelength<sup>18</sup>. The majority of the faculty members were also in consensus with the finding that PDT does not involve and violate cross-infection protocols. The increased assurance on this matter also helped in reducing the stress levels

amongst both sets of individuals, as more than 80% of faculty members and students reported lower stress levels. This could be explained by the fact that PDT involves the application of a photosensitizer chemical which is generally contained within a syringe system. The application within the oral cavity is either through a blunt canula/syringe, or through the micro-brush applicator in case of large lesions which reduces the risk of any splatter or contamination<sup>19</sup>.

A distinct difference was observed amongst the faculty members and student body regarding the influence of the COVID-19 outbreak on PDT performance. The results reported that over 58% of students believed that the COVID-19 out-



**Figure 5.** Alternative teaching methods preferred by students and faculty members during the suspension of PDT procedure in dental clinics.

break harmed the PDT performance. On the other hand, only 18% of faculty members perceived the same outcome. The perspective of students is understandable as due to the COVID-19 pandemic; fewer patients came to the dental clinics for their respective dental treatments. A recently conducted survey<sup>20</sup> reported a considerable decrease of 38% in the utilization of emergency dental services at the initiation of the COVID-19 pandemic in China, indicating that the oral healthcare-seeking behaviour of people was influenced by the viral pandemic. This may be since people were hesitant to leave their house and go outside, being less motivated to visit dental clinics. According to a recent study, an increase in oral healthcare negligence due to the inability to attend dental appointments would result in extra requirements for oral healthcare services after the pandemic is reduced or finished<sup>20</sup>.

To avoid the transmission of COVID-19 infection inside the premises of the dental clinics, both the faculty members and students expressed mixed opinions on the prevention protocols issued within the institution. The majority of the students (71%) followed the protocols provided by the School of Dentistry, and they also heavily relied (66%) on social media to keep themselves updated regarding the latest precautionary regimes. Whereas, the faculty (86%) relied on the precautionary measures provided by the WHO, Centre for Disease Control and Prevention, and Saudi MOH. Similarly, 68% of the teaching staff implemented the updates provided in the scientific publications. A vast difference in the application of the intervention protocols amongst the study participants raises a significant argument. This evident difference in responses clearly explains how the senior faculty members relied wholly and solely on the well-recognized organizations for health assessments and scientific data. Therefore, to establish an effective treatment strategy, all the protocols need to be studied properly for the implementation of a sound policy to avoid any mishaps and repercussions.

According to the obtained results, the use of PPE and implementation of the necessary precautions were heavily advocated by both the faculty and student body as major tools for preventing cross-infection during PDT. Keeping into perspective that COVID-19 has a high transmission rate, the establishment of pre-check triages and screening methods should be done to keep a record of the individuals with a history of any respiratory tract infections (cough, malaise, fever, loss

of taste, loss of smell), any traveling history from a country with the high rate of COVID-19 incidence or any contact with a COVID-19 infected individual<sup>17</sup>. Strict implementation of these guidelines will help to identify diseased individuals. Moreover, the deferment of the treatment of these patients would play a huge role in controlling the transmission of disease on a larger scale.

Certain limitation should be considered. A reduced sample size of both the faculty members and final year students can be considered as one of the main limitations of the present study. Moreover, apart from PDT, adjunctive therapies can also be accommodated which will provide data which will result in the formulation of better treatment strategies in the current pandemic<sup>21-24</sup>.

## Conclusions

Clinical dentistry students and faculty members surveyed in the present study reported that their health is not at risk while performing PDT procedure in dental clinics amidst the COVID-19 outbreak. However, majority of participants thought that a provisional suspension of PDT procedures in dental clinics would assist in containment of the virus and reduce the infection risk from the contact and not through the PDT procedure.

## Conflicts of interest

The author declare that he has no conflict of interest.

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