

# Awareness comporment and attitude of dental practitioners for photodynamic therapy during COVID-19 pandemic: a global survey

Z. QAMAR<sup>1,2</sup>, A.S.M. ALHAID<sup>3</sup>, R.M. ALTAMI<sup>4</sup>, A.M.W. BACHAT<sup>4</sup>,  
D.M.S. ALDOSSER<sup>5</sup>

<sup>1</sup>Department of O&MFS and Diagnostic Sciences, Faculty of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia

<sup>2</sup>Department of Oral Biology, Liaquat College of Medicine and Dentistry, Karachi, Pakistan

<sup>3</sup>Faculty of Dentistry, King Khalid University, Abha, Saudi Arabia

<sup>4</sup>Faculty of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia

<sup>5</sup>College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

**Abstract. – OBJECTIVE:** The aim of the study is to evaluate the awareness, comportment and attitude/perception of dentists regarding the use of photodynamic (PD) therapy before and during COVID-19 pandemic around the globe.

**SUBJECTS AND METHODS:** An online survey was performed by sending out an online questionnaire comprising 21 questions among dental practitioners working in four different countries: Saudi Arabia, Pakistan, Malaysia and United Kingdom. The survey evaluated dental practitioners' level of awareness about the PD therapy, comportment and attitude for its implication and prevalence in daily clinical practice. For statistical significance the Chi-square analysis with Spearman Correlation coefficient was conducted to assess the sub-groups and correlating the factors with the level of awareness of the dental practitioners.

**RESULTS:** A total of 1,219 dental practitioners from four different countries (Saudi Arabia, Pakistan, Malaysia and United Kingdom) responded to the questionnaire. The median age of the respondents from was 37, 34, 36 and 39 respectively. The majority of dental practitioners demonstrated to have an acceptable level of awareness regarding PD therapy. Nearly 76%, 74%, 79% and 80% of the individuals from Saudi Arabia, Pakistan, Malaysia and United Kingdom respectively were aware of the role/mechanism of action of the PD therapy. Moreover, in preponderance, practitioners were confident that the effect of PD therapy will not be reduced in patients infected with COVID-19. The majority of dental practitioners were convinced that successful dental treatment due to PD therapy is linked majorly with therapies done in relation to four major dental specialties: prosthodontics, endodontic, restorative dentistry and peri-

odontology. Approximately more than 90% of the dentists were sure that the rate of COVID-19 transmission can be reduced by using PD therapy in oral treatments. The dental practitioners from Saudi Arabia (91%), Pakistan (82%), Malaysia (83%) and United Kingdom (82%) were contented to learn about PD therapy for its use in clinical practice. Nearly more than 95% of the practitioners from the four countries were keen to attend the lectures/hands-on workshops regarding PD therapy to enhance their skills and knowledge. More than 80% of dentists do not refuse the peripheral role of PD therapy with their patients.

**CONCLUSIONS:** The respondents from the four countries displayed passable level of awareness regarding basic information of PD therapy and its clinical implication in dental specialty. Nevertheless, there is a need to develop awareness regarding the use of PD therapy among dental practitioners during their undergraduate program. Furthermore, lectures and hands-on workshops should be arranged to train dental practitioners in order to enhance their skills for its solicitation in clinical practice. It is perceived by the dentists in the four countries that the use of PD therapy can effectively reduce COVID-19 rate of transmission.

*Key Words:*

Photodynamic therapy, Awareness, Comportment, Attitude, COVID-19.

## Introduction

The coronavirus is a single-stranded RNA virus having the potential of causing lethal pneumonia-like chest infections. The transmission of

COVID-19 happens *via* aerosols/droplets or due to direct contact of oral/nasal/conjunctival tissues with contaminated fluid. In dental practice, the aerosols are developed due to use of hand-pieces, ultra-sonic scalers and triple jet syringes. Thus, there should be a series of infection control procedures to prevent the transmission of the disease to/from the dental -practitioners, -auxiliary staff and patient<sup>1</sup>. These procedures include the use of equipment for personal protection, pre-operative fixation of rubber dam and disinfection by the use of mouth-rinses. In current era decontamination of equipment and instruments is easily feasible by the use of photodynamic (PD) therapy with photo-irradiation using visible light<sup>1</sup>.

The light of a specific wavelength is used to initiate photosensitizing agents in the presence of oxygen. Photo- irradiation of the sensitizing agents helps in the formation of oxygen and radicals, which in turn leads to the cellular death of the tissues/microbes<sup>2-4</sup>. In clinical practice it is considered as a cytotoxic reaction. Based on the need and type of the photosensitizing agent, there are different routes of administration like topical, oral or intravenous<sup>5</sup>.

In current era, PD therapy is considered a treatment of choice for various oral diseases like oral -cancerous, -fungal, -bacterial, -viral and auto-immune disorders<sup>5-15</sup>. The usage of PD therapy is considered a common practice in countries with advanced dental education. But, still, there is a disagreement over a point on the use of PD therapy in general dental practice other than the academic institutes<sup>16,17</sup>. In general fore-seeing the future of dentistry it can be predicted that laser-based technologies, including PD therapy, will become as a vital constituent of the contemporary dental practice<sup>18</sup>.

To date, employing laser in dental practice is common, but the use of PD therapy is limited in underdeveloped countries. However, the prevalence of oral diseases was common before/during the COVID-19 pandemic in such countries<sup>19</sup>. This was primarily attributed to the lack of awareness and expert training and treatment cost for the use of PD therapy. Thus, studies are required to evaluate these insufficiencies and compare the underdeveloped and developed countries. Therefore, the aim of the study was to evaluate the awareness, comporment and attitude/perception of dentists for the use of PD therapy before and during COVID-19 pandemic around the globe.

## Subjects and Methods

After receiving the ethical approval from the Ethics Committee of Riyadh Elm University, a survey using a modified questionnaire from a previous study<sup>20</sup> was conducted among the dental practitioners of Saudi Arabia, Pakistan, Malaysia and United Kingdom on their consent. In the previous survey<sup>20</sup>, general questions were asked regarding the use of PD therapy in the dental specialty, therefore it was modified in order to identify the use of PD therapy in relation to various dental specialties. In particular the questionnaire was modified to identify PD perception and benefits during COVID-19 pandemic among dentists from different countries. The questionnaire was sent using Google Forms *via* various media (Facebook, WhatsApp and e-mails).

The inclusion criteria defined for the participants were: i) the participant was a dental graduate (completed one-year internship); and ii) the participant was a graduate from the dental school of the four selected countries. Participants graduated from countries other than Saudi Arabia, Pakistan, Malaysia and United Kingdom were excluded from the study. The questionnaire had 20 questions to evaluate the level of awareness, comporment and attitude/perception of the PD towards use of PDT before and during COVID-19 pandemic. Participants responded the questionnaire voluntarily/anonymously. There were six true/false questions under awareness section. Ten questions with Likert scale and two open ended questions were added. The approximate time for completion of the questionnaire was 8 min.

The first part of the questionnaire was focused on the socio-demographic status of the respondent including the age, gender, designation, experience in clinical practice, graduating institute and country. The second part was regarding awareness including six questions of true/false and one question with a selection of multiple best options regarding knowledge for the use of PD therapy in various dental treatments. Next two sections included ten questions using Likert scale evaluating the comporment and the attitude of the dental practitioner towards the use of PD therapy. The respondents had the option to select a single best answer based on their clinical experiences. There were two open ended optional questions inquiring about the photosensitizer used by the clinician before/during COVID-19 pandemic.

Responses from the dental practitioners for questions with the Likert Scale were given a

maximum score of 4 and a minimum score of 1 for questions under the comportment and attitude section.

### **Statistical Analysis**

The data were analyzed using IBM SPSS software Version 21 (IBM Corp., Armonk, NY, USA). A non-parametric test Chi-square analysis was conducted for comparison of sub-groups based on their age, experience and academic ranks. Statistically, in order to observe the correlation between the level of awareness, comportment and attitude in the dental practitioners Spearman's Correlation coefficient was applied.

## **Results**

The questionnaire was sent *via* various social media platforms to the dental practitioners of four different countries. A total of 1,219 dental practitioners responded to the questionnaire with 539 (44.21%) respondents were males whereas 680 (55.79%) were females. Table I displays the socio-demographic characteristics of the respondents. The participants graduating from 14 different institutes of Saudi Arabia, 15 institutes from Pakistan, 8 dental schools respectively from Malaysia and United Kingdom responded to the questionnaire. The age range of the participants was 24-57.

Figure 1 shows true/false correct responses by the dental practitioners of four different countries in the knowledge/awareness section towards the use of PD therapy. More than 60% dental practitioners from each country displayed to have awareness regarding the use and mechanism of action for PD therapy. Figures 1 A-D summarize the number of responses and percentage for six questions by the participating dental practitioners with true and false answers to six questions respectively. The maximum score of 5 was achieved by an average of 46% of dental practitioners. The last question in the awareness part was regarding the perception of the use of PD therapy in dental treatments related to various dental specialties. The majority of dental practitioners perceived that PD therapy could be used for dental treatments linked to operative/restorative dentistry and endodontics therapies.

Figure 2 displays the response of dental practitioners' comportment towards the use of PD therapy. Figure 2 A-B displays the comportment of dental practitioners discussing the use of PD

therapy. Almost 52-95% of dental practitioners from different countries did not discuss the use of PD therapy with the patients reporting to the clinic. Additionally, a wide range of patients did not inquire nor had information regarding the use of PD therapy (62-92% range).

The attitude and perception of the dental practitioners towards the use of PD therapy before and during COVID-19 pandemic has been displayed in the Figures 3 and 4. The majority of dental practitioners in different countries perceived that use of PD therapy during COVID-19 pandemic could have a favorable response in reducing the rate of transmission particularly during oral therapies (63-82%) (Figure 3 A). A spiking range of dental participants had a positive attitude toward learning regarding the use of PD therapy in their clinical practice (82-90%). Furthermore, many dental participants responding to question 13 from different countries showed keenness to attend lectures/workshops regarding training for the use of PD therapy Figure 3 C. The majority of dental practitioners did not receive training regarding the use of PD therapy during their training in the dental schools (74-98%) (Figure 3 C). A wide range of dental practitioners disagreed/strongly disagreed with the perception that patients expect them to discuss regarding the role of the PD therapy in oral therapies. Furthermore, they also rejected the perception of considering discussing the use of PDT as a peripheral role of the dental practitioner (Figure 3 D).

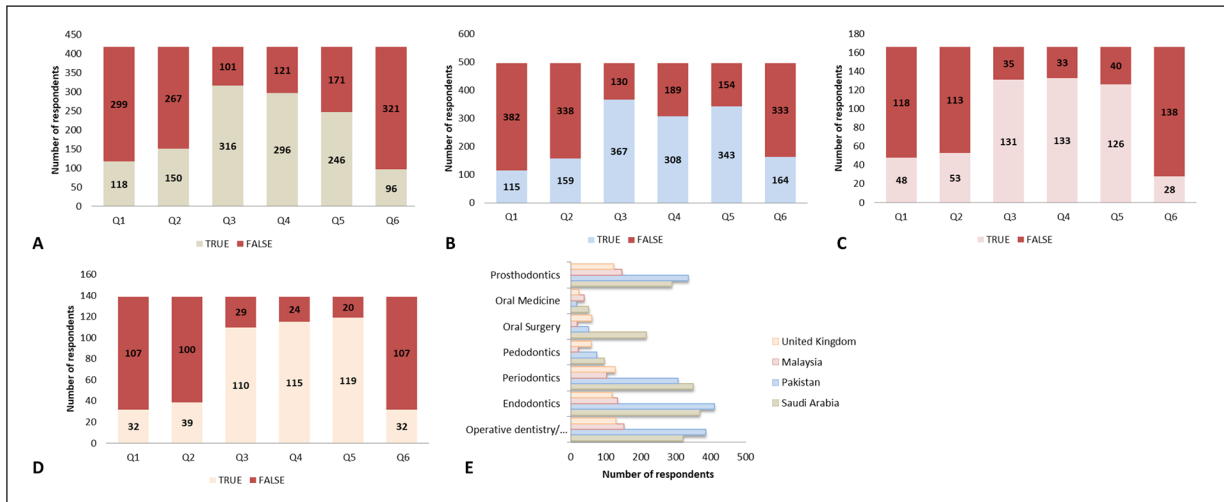
Figure 4 A displays the use of PD therapy, used for the oral treatment, linked to various dental specialties before and during COVID-19 pandemic. It has been observed that the PD therapy is majorly used for dental treatments linked to restorative/operative dentistry, endodontics and prosthodontics both before/during COVID-19 pandemic. A striking range of dental practitioners from four different countries perceived their level of knowledge as good/acceptable regarding the PD therapy (57-92% range) (Figure 4 B). The majority of the respondents did not reply to the question 19 and 20 (optional) regarding the type of photosensitizer used before/during COVID-19 pandemic, but some of the respondent's included curcumin, rose Bengal and Methylene blue to be used as a common photosensitizer before/during COVID-19 pandemic.

On comparing the fixed variable of designations, a statistically significant difference was observed between the level of knowledge for the lectures ( $p = 0.039, 0.032$ ), assistant professors

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**Table I.** Socio-demographic data of the respondents.

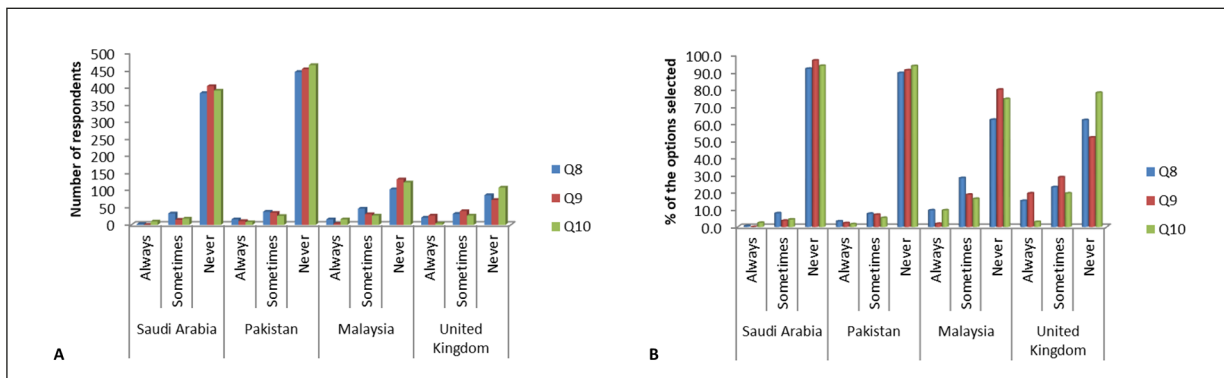
	Saudi Arabia		Pakistan		Malaysia		United Kingdom	
	n (%)		n (%)		n (%)		n (%)	
<b>Age (interquartile range)</b>	26-53 (Median 37)		24-57 (Median 34)		26-48 (Median 36)		28-53 (Median 39)	
<b>Gender</b>								
Male	258 (61.87)		146 (29.38)		49 (29.52)		86 (61.87)	
Female	159 (38.13)		351 (70.62)		117 (70.48)		53 (38.13)	
<b>Designation</b>								
Resident	143 (34.29)		142 (28.57)		47 (28.31)		47 (33.81)	
Lecturer	95 (22.78)		161 (32.39)		54 (32.53)		30 (21.58)	
Senior Lecturer	68 (16.31)		97 (19.52)		32 (19.28)		22 (15.83)	
Assistant Professor	47 (11.27)		55 (11.07)		18 (10.84)		16 (11.51)	
Associate Professor	32 (7.67)		26 (5.23)		8 (4.82)		12 (8.63)	
Professor	11 (2.64)		12 (2.41)		3 (1.81)		4 (2.88)	
Others	21 (5.04)		4 (0.80)		4 (2.41)		8 (5.76)	
<b>Clinical experience in years</b>								
<1	18 (4.32)		18 (3.62)		7 (4.22)		6 (4.32)	
1-5	186 (44.60)		226 (45.47)		74 (44.58)		62 (44.60)	
6-10	167 (40.05)		203 (40.85)		53 (31.93)		55 (39.57)	
≥11	46 (11.03)		50 (10.06)		32 (19.28)		16 (11.51)	
<b>Graduating dental school</b>								
	King Saudi University of Health Sciences	68	De' Montmorency College of Dentistry	76	University of Malaya	47	University of Dundee	18
	King Abdul Aziz University	61	Riphah International University	72	Universiti Kebangsaan Malaysia	28	Queen Mary, University of London	37
	King Khalid University	48	Nishtar Medical University	63	International Medical University Malaysia	22	University of Manchester	23
	Imam Abdulrahman Bin Faisal University	56	Khyber College of Dentistry	38	AIMST University	9	Plymouth University	5
	Jazan University	11	Liaquat College of Medical & Dentistry	53	Universiti Sains Malaysia	37	University of Aberdeen	26
	Taibah University	29	FMH College of Medicine & Dentistry	61	SEGi University	14	Queen's University of Belfast	21
	King Faisal University	8	Ziauddin Medical University	37	MAHSA University	6	University of Birmingham	4
	Qassim University	7	Baqai Medical University	28	Melaka Manipal Medical College	3	University of Glasgow	5
	Al Jouf University	2	Sohail University	16				
	Prince Sattam Bin Abdulaziz University	14	Jinnah Sindh Medical University	14				
	King Saud bin Abdulaziz University for Health Sciences	41	Dow University of Health Sciences	8				
	Umm Al-Qura University	17	Karachi Medical and Dental College	13				
	Princess Nora bint Abdulrahman University	32	Bahria Medical College	9				
	Riyadh Elm University	12	Bin Qasim Medical Institute	2				
	Dar Al Uloom University	7	Altamash Institute of Dental Medicine	7				
	Al Farabi Dental College (Vision Colleges)	4						



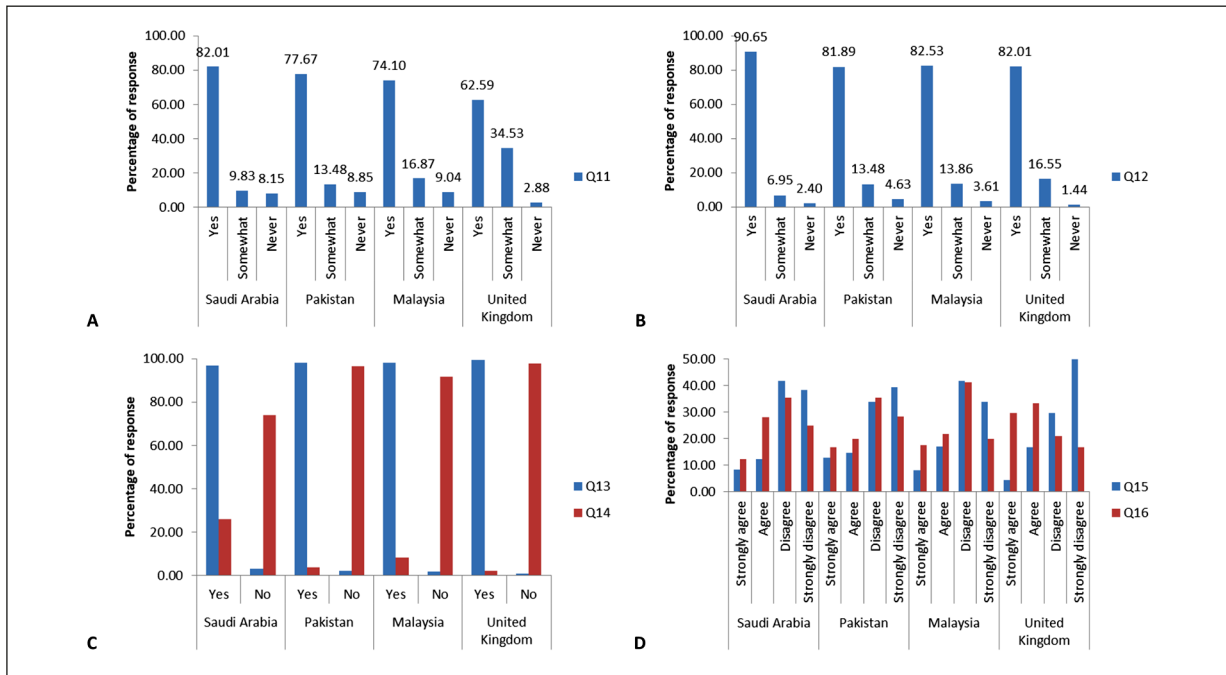
**Figure 1.** The figures display responses of dental practitioners from different populations towards awareness regarding the use of PD therapy (red color displays section for the respondent’s selection option False for Figures A-D). Q1: In dentistry, photodynamic therapy (PDT) is considered as an invasive technique (correct answer: false); Q2: The role of photosensitizing agents and laser diode does not have a significant role in the PDT (correct answer: false); Q3: The radicals produced during PDT have a pivotal role in the destruction of the target tissue (correct answer: true); Q4: In predominance, photosensitizing agents are irritated by red light with a wavelength of 630-700 nm (correct answer: true); Q5: PDT primarily targets the microbes and the tissue (correct answer: true); Q6: The effect of PDT in the oral cavity is reduced in patients infected with COVID-19 (correct answer: false). **A**, Response of the six questions from Saudi Arabian dental practitioners for six question (individuals answering correctly for six questions 71.7%, 64%, 75.8%, 71%, 59%, 77%); **B**, Responses from Pakistani dental practitioners (individuals answering correctly for six questions 76.9%, 68%, 73.8%, 62%, 69%, 67%); **C**, answers from Malaysian dental practitioners (individuals answering correctly for six questions 71%, 68%, 79%, 80%, 76%, 83%); **D**, Responses from dental practitioners in United Kingdom (individuals answering correctly for six questions 77%, 72%, 79%, 83%, 86%, 77%); **E**, (Q7) Perception of the use of PD therapy in various dental treatments by the dental practitioners of different countries.

( $p = 0.041, 0.037$ ) and associate professors ( $p = 0.044, 0.038$ ) in Saudi Arabia and Pakistan as well as for the questions regarding comporment and attitude. But a significant difference only for lectures ( $p \leq 0.05$ ) and assistant professors ( $p \leq 0.05$ ) was observed among the dental prac-

tioners from Malaysia and United Kingdom. In general, there was no correlation observed between the level of knowledge, comporment [ $r$  (inter-quartile range) = 0.16,  $p \geq 0.05$ ] and attitude [ $r$  (inter-quartile range) = 0.07,  $p \geq 0.05$ ] of the dental practitioners from four different countries.



**Figure 2.** Comporment of dental practitioners towards the use of PD therapy. Q8: Do patients reporting to dental clinic have information regarding the use of the PDT?; Q9: Do you discuss therapeutic options of PDT with your patient?; Q10: Do you refer patients to clinicians for PDT to treat problems such as dental caries, oral cancer, viral, bacterial and fungal infections? **A**, The answer selected by the number of respondents from different countries; **B**, The percentage of answer selected by the dental practitioners of various countries.

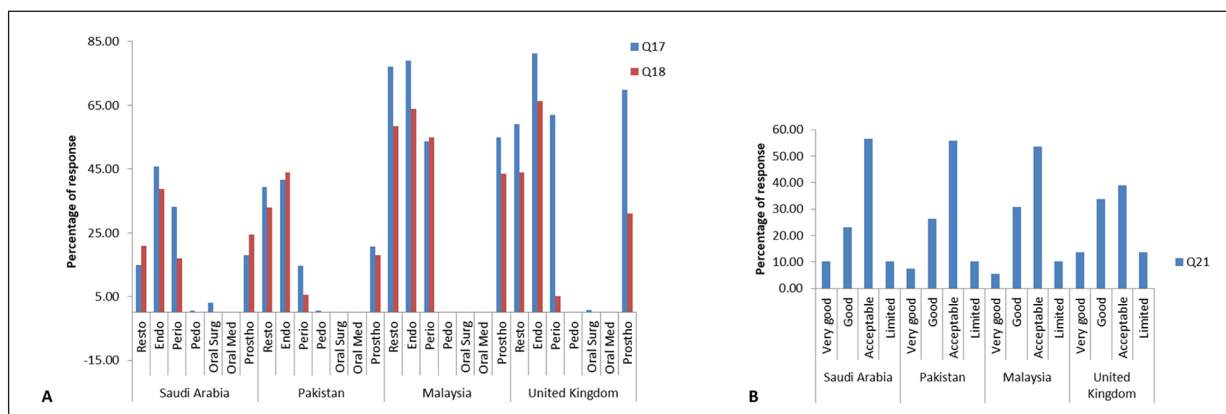


**Figure 3.** Attitude of dental practitioners towards the use of PD therapy. Q11: Do you think the use of PDT during COVID-19 pandemic can reduce the transmission rate?; Q12: How contented are you to know about PDT in details for your clinical practice?; Q13: Would you like to attend lectures/workshop to enhance knowledge on PDT and its use in dentistry?; Q14: Did you receive training for the use of PDT in dental school?; Q15: All the patients reporting to dental clinic expect me to discuss PDT option for dental care; Q16: Discussing option for PDT with my patients is peripheral to my role as a clinician. **A-D**, Percentage of answers selected by the number of dental practitioners from different countries.

### Discussion

The main aim of the study was to evaluate the awareness, comporment and attitude of dental practitioners residing in different countries towards the use of PD therapy before and during COVID-19 pandemic. The study

established the level of awareness among dental practitioners in encouraging the use of PD therapy. Additionally, the respondents showed a positive attitude towards learning innovative techniques for using the PD therapy in different dental treatments by attending the lectures/workshops.



**Figure 4.** Attitude of dental practitioners in percentage from various countries for using PD therapy. **A**, Q17: use of PD therapy before COVID-19 pandemic for treatments related to various dental specialties; Q18: PD therapy used for treatment during COVID-19 pandemic. **B**, Level of knowledge perceived by general dental practitioners.

Questions evaluating the comportsment of the dental practitioners towards the PD therapy were atypical. More than 90% of the respondents from all the four countries believed that PD therapy could reduce transmission rate of COVID-19 *via* aerosols. Furthermore, the majority of the practitioners do not consider discussing PD therapy as an option with their patients. The pattern for referring the patients to clinicians/physicians for PD therapy was found to be discouraging. This pattern could be attributed to the less/no availability of the PD or laser therapy. It is crucial to understand that the level of dental practitioners' basic knowledge and coordination between the laser specialist and team has a key role in the success of PD therapy<sup>21</sup>. In addition, PD therapy being an exorbitant technique needs professional training of the dental practitioners in advising such therapeutic options to the patients<sup>22</sup>.

It was observed on average; nearly 90% of the dental practitioners did not receive training regarding the use of PD therapy during their undergraduate dental training. The majority of the dental practitioners from Pakistan and United Kingdom responded not having training for the PD therapy. The training regarding PD therapy *via* lectures and workshops is important as it enables understanding of key concepts in order to make an individual expert undertake its use in research projects, produce knowledge by scrutinizing/interpreting the results. They can also practice it in their clinics after training under the supervision of an expert therapist. It requires seminars/workshops of continuous professional development (CPD) regarding the use of PD therapy to acquire adequate skills for clinical practice. But outmost the level of self-perceived knowledge of dental practitioners was inspiring, which might be attributed to the involvement of the graduating students in research activities making them learn regarding the use of PD therapy in dental setup<sup>23-26</sup>.

It was interesting to see that the majority of the dentists have a strong confidence in using PD therapy for reducing the rate of COVID-19 transmission. This is more likely linked to the information provided *via* various medium that the virus of COVID-19 spreads *via* aerosols<sup>1</sup>. The results are interesting, displaying that dental practitioners are contented to learn regarding PD therapy. On the other hand, approximately 55% of dental practitioners from the four countries disagreed/strongly disagreed with discussing PD therapy peripheral as their role to suggest the use

of the technique in their clinical practice. Nearly 77% of dental practitioners from the four countries disagreed/strongly disagreed to the point that the patients are interested to know about the PD therapy during their dental treatment.

According to the results of the research, it is suggested<sup>17</sup> that dental practitioners should develop innovative techniques working in collaboration with laser therapists and patients to attain a healthier outcome. In order to carry out the PD therapy effectively in their clinical practice, dental practitioners should consider actively participating in training for PD therapy which will help to enhance their level of knowledge regarding the use of PD therapy. Moreover, hands-on workshops will enhance clinical skills for PD therapy to improve their clinical practice.

## Conclusions

Considering the limitations of the survey, it can be affirmed that dental practitioners of the four countries have an adequate level of awareness regarding PD therapy and its practical application in the dental specialty. Awareness should be developed among dental practitioners during undergraduate programs regarding the use of the PD therapy. Nevertheless, expert skills with respect to handling and training for the use of PD therapy are necessary to incorporate this technique in their monotonous clinical practice. Furthermore, dental practitioners are strongly convinced to use PD therapy during COVID-19 pandemic as its application can actively help to reduce the transmission rate of the viral infection.

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### Conflict of Interest

The Authors declare that they have no conflict of interests.

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### Authors' Contribution

Conceptualization, Z. Qamar; methodology, Z. Qamar, A.M.W. Bachat, R.M. Altami, D.M.S. Aldosseri and A.S.M. Alhaid; software, Z. Qamar, A.M.W. Bachat and R.M. Altami; validation, Z. Qamar, D.M.S. Aldosseri and A.S.M. Alhaid; project administration, Z. Qamar, R.M. Altami and D.M.S. Aldosseri; funding acquisition, Z. Qamar, A.M.W. Bachat and A.S.M. Alhaid. All authors have read and agreed to the published version of the manuscript.

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### Ethics Approval

The study was approved by the Ethics Committee of Riyadh Elm University.

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### Informed Consent

Not applicable.

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