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# Multifaceted impact of COVID-19 on dental practice

## American dental care professionals prepared and ready during unprecedented challenges



Supplemental material is available online.

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### ABSTRACT

**Background.** The purpose of this study was to evaluate the multifaceted impact of the COVID-19 pandemic on dental practices and their readiness to resume dental practice during arduous circumstances.

**Methods.** The authors distributed an observational survey study approved by The University of Texas Health Science Center at San Antonio Institutional Review Board to dental care practitioners and their office staff members using Qualtrics XM software. The survey was completed anonymously. The authors analyzed the data using R statistical computing software,  $\chi^2$  test, and Wilcoxon rank sum test.

**Results.** Nearly all participants (98%) felt prepared to resume dental practice and were confident of the safety precautions (96%). Only 21% of dentists felt the COVID-19 pandemic changed their dental treatment protocols, with at least two-thirds agreeing that precautions would influence their efficiency adversely. Although most participants were satisfied with the resources their dental practice provided for support during the pandemic (95%), most were concerned about the impact on their general health and safety (77%) and to their dental practice (90%), found working during the pandemic difficult ( $\approx 60\%$ ), and agreed there are challenges and long-term impacts on the dental profession ( $> 75\%$ ).

**Conclusions.** Dental care professionals, although affected by the COVID-19 pandemic and at high risk of developing COVID-19, were prepared to resume dental practice during most challenging circumstances.

**Practical Implications.** The pandemic has affected dental care practitioners substantially; thus, there is need to formulate psychological interventions and safety precautions to mitigate its impact. Further research should evaluate the long-term effects on dentistry and oral health and interceptive measures for better communication and programming around future challenges.

**Key Words.** Pandemic; COVID-19; dental practice; dentists.

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The ongoing global COVID-19 pandemic is caused by severe acute respiratory syndrome coronavirus 2, a highly contagious novel coronavirus that causes COVID-19 infectious disease. Infected patients most notably have clinical symptoms of dry cough, dyspnea, fever, and bilateral lung infiltrates on imaging.<sup>1</sup> Later, it was found that COVID-19 can be manifested in almost every organ system of the body with highly variable clinical symptoms. It was first identified in Wuhan, China, in December 2019,<sup>1,2</sup> and then the World Health Organization declared it a Public Health Emergency of International Concern in late January 2020 and, shortly after, a pandemic in March 2020.<sup>3,4</sup>

According to COVID-19 statistical data, as of October 4, 2021, more than 235 million cases worldwide (more than 43 million cases in the United States) have been confirmed, resulting in more than 4.8 million deaths (more than 701,000 deaths in the United States). COVID-19 was the third leading cause of death in the United States in 2020, behind heart disease and cancer,

making it the deadliest pandemic in United States history. More Americans have died from COVID-19 than during World War II.<sup>4</sup>

COVID-19 was reported to be zoonotic, and it is more likely to affect older men with comorbidities and preexisting health conditions (such as heart or respiratory and lung disease, obesity, and diabetes), with a varying incubation period of 7 through 24 days. Clinical symptoms range from none to mild (resembling flulike symptoms and seasonal allergies) through very severe, with possible life-threatening complications and acute respiratory distress syndrome.<sup>4,5</sup> According to the Centers for Disease Control and Prevention (CDC), possible symptoms may include, but are not limited to, fever and chills, cough, shortness of breath, fatigue and myalgia, headache, sore throat, loss of taste and smell, congestion, nausea and vomiting, and diarrhea. Older adults and those with severe underlying medical conditions appear to be at higher risk of developing more serious complications.<sup>6</sup> COVID-19 is transmitted mainly through person-to-person contact (respiratory droplets and aerosols) and via contaminated surfaces.<sup>7-9</sup>

CDC guidance for dental settings, the standard of care for COVID-19 infection control, recognizes that dental settings have unique characteristics that warrant strict infection control precautions and protocols to be put in place during a pandemic to minimize the harm and risk of experiencing potential exposure to personnel and patients. Prevention actions outlined by the CDC have included wearing personal protective equipment (PPE) such as masks covering nose and mouth for health care personnel, maintaining 6-foot social distancing, avoiding crowds and poorly ventilated indoor spaces, washing hands often with soap and water, and getting vaccinated.<sup>10</sup>

Handpieces and ultrasonic instruments used during dental procedures unavoidably generate aerosols containing blood and saliva droplets, which could result in the airborne spreading of COVID-19.<sup>11-15</sup> Consequently, the American Dental Association, in concordance with CDC guidelines, suggested that dental care practitioners limit their interventions to emergency treatments in the early days of the pandemic. The American Dental Association subsequently developed a guidance toolkit for management of dental practice to help protect patients, staff members, and dentists as offices returned to providing nonemergent care during the pandemic.<sup>16</sup>

A *New York Times* article that was cited by other papers ranked health care professions at the highest risk of developing COVID-19, among which dentistry was placed at the top.<sup>14,15,17,18</sup>

Miscellaneous studies in various countries (United States, Israel, Hong Kong, China, Turkey, Italy, Saudi Arabia, Pakistan, Poland, Brazil, and others) have found significant impacts of COVID-19 on dental practice with elevated stress levels, concerns, fear, and anxiety reported by dental care practitioners owing to increased risk of developing infection and substantially increased infection protocols.<sup>19-31</sup> Therefore, an elevated provision of psychological support and counseling services for health care workers has been found to be crucial for maintaining a healthy workforce during the pandemic.<sup>15,27,28</sup>

Most dental care professionals were aware of dental treatment protocol changes and modified services per CDC guidelines.<sup>14,15,18,25,27,29,31-33</sup>

The COVID-19 pandemic, its associated policies, and the steps taken to contain its spread have affected the dental practice economy and the health care system.<sup>15,18,27,31,34,35</sup>

The rapid and extensive spread of COVID-19 has become a major concern for the dental care profession. The purpose of our study was to assess the impact of the COVID-19 pandemic on dental practices in Texas, specifically the short- and long-term effects on the dental care profession, including economic, health, and psychological. We assessed the safety, preparedness, and confidence levels of dental care practitioners as they resumed dental practice during the pandemic. We distributed this survey during a peak period of COVID-19 spikes in Texas, which was declared a COVID hotspot as it was among the first in the United States to partially reopen and ease restrictions after the lockdown. Texas is a large state with a diverse population, and many dental care practitioners went to dental school outside Texas.

## METHODS

We engaged dental care practitioners who are members of Texas Dental Association (TDA), the San Antonio District Dental Society (SADDS), and the South Texas Oral Health Network (STOHN), a Texas dental practice-based research network, with an observational survey study approved by The University of Texas Health Science Center at San Antonio Institutional Review Board (protocol HSC20200374E). We piloted the survey, which consisted of 25 items, among 3

## ABBREVIATION KEY

<b>CDC:</b>	Centers for Disease Control and Prevention.
<b>PPE:</b>	Personal protective equipment.
<b>SADDS:</b>	San Antonio District Dental Society.
<b>STOHN:</b>	South Texas Oral Health Network.
<b>TDA:</b>	Texas Dental Association.

through 5 dental care practitioners to test its accessibility and usability, as well as the time for completion. We delivered the survey study online using the web-based survey platform Qualtrics XM (Version August 2020) and distributed it via an anonymous survey link to members of the professional organizations. The Qualtrics survey was protected from ballot box stuffing to prevent participants from taking the survey more than once, given that a member of 1 participating organization may also have been a member of another participating organization. Study recruitment took place from August 14, 2020, through October 19, 2020. Responses were voluntary and anonymous, and participants were not offered any incentive to complete the survey.

Dental care practitioners received an email invitation (that also encouraged participation of their dental staff members) from the representative of the participating organizations explaining the study and inviting them to participate voluntarily using a web link to the questionnaire. Participants were licensed in the United States and members of dental associations or research networks and maintained an active email address at which they could be contacted. Variables assessed in the survey included participant demographics, sources of information related to COVID-19, resources and working satisfaction, concerns, challenges, and the impact of COVID-19. Participants were also provided with a section to leave comments about their experience during the COVID-19 pandemic. A subset of participants, those who are involved in clinical dental practice or direct patient care, were asked additional clinically related questions about challenges, concerns, treatment changes, safety precautions, and preparedness while resuming dental practice, as well as views on dentistry as a career that has been affected during the pandemic.

The survey is presented in [online additional material](#), available online at the end of this article. Scales for questions and methodology used to compile responses into positive versus negative responses are described in the results section.

### Statistical analysis

We analyzed the data obtained from the survey using R statistical computing software (R Foundation for Statistical Computing). We conducted statistical comparisons of responses by the following demographic groups: sex, age, and years of experience in dental practice. The reported *P* values are from the  $\chi^2$  test. In addition to *P* values, we report 95% CIs for the proportions in each group, along with odds ratios (ORs) comparing the group with the higher rate with the group with the lower rate. For sentiment analysis of the participants' comments, we used Wilcoxon rank sum test (nonparametric test) to compare whether the overall sentiment of the group deviated from neutral (alternative hypothesis: true location shift is not equal to 0).

Hypotheses related to the survey were that dental care professionals were concerned about the impact of COVID-19 on their dental practices and their own well-being but still were comfortable with their dental career choices and confidently prepared to resume dental practice despite concerns about challenges, long-term impacts, financial resources, and efficiency. We used a level of significance of *P* equaling .05 for all statistical tests.

## RESULTS

We implemented the survey study via use of organizational distribution avenues: TDA, SADDS, and STOHN. We invited 7,805 dental care practitioners to participate in this survey study.

Of 7,805 invited members, 622 participated in the survey (different response rates from the participating organizations: 73% response rate from STOHN [120 members], 37% from SADDS [920 members], and a combined response rate of 8% for all participating organizations when combined with the response rate from TDA, which has thousands of members). A total of 572 participants completed the first part of the survey (general questions). Of that group, 514 (90%) completed the second clinical practice–related portion. At the time of the survey, 42 (7%) of total participants reported that they or a household member had tested positive for COVID-19. [Table 1](#) shows demographics as reported by participants. [Figure 1](#) shows that 71% of participants were general dentists, 24% were specialists, and 5% were administration or allied dental staff members (because most of the members of participating organizations were dentists). Four of 10 participants in the first part of the survey identified as female, 44% were 55 years or older, 79% had been in

**Table 1.** Demographics and distribution of participants.

DEMOGRAPHICS	COMPLETED PART 1, NO. (%)	COMPLETED PARTS 1 AND 2, NO. (%)
<b>Total Participants</b>	572	514
<b>Age, Y</b>		
18-24	1 (0)	0 (0)
25-34	80 (14)	74 (14)
35-44	108 (19)	98 (19)
45-54	131 (23)	121 (24)
≥ 55	252 (44)	221 (43)
<b>Sex</b>		
Female	227 (40)	197 (38)
Male	341 (59)	313 (61)
Preferred not to answer	4 (1)	4 (1)
<b>Race</b>		
Asian	52 (9)	46 (9)
Black	14 (3)	13 (3)
Hispanic or Latino	70 (12)	64 (12)
Other	13 (2)	11 (2)
White	423 (74)	380 (74)
<b>Marital Status</b>		
Never married	45 (8)	39 (7)
Significant other	16 (3)	14 (3)
Married	478 (84)	432 (84)
Widowed	7 (1)	5 (1)
Separated or divorced	26 (4)	24 (5)
<b>Education</b>		
High school or some college	7 (1)	4 (1)
Associate's or bachelor's degree	14 (3)	9 (2)
Master's degree or PhD	18 (3)	15 (3)
Professional degree, DDS/DMD	516 (90)	470 (91)
Professional degree or other	17 (3)	16 (3)
<b>Income, \$</b>		
< 10,000	5 (1)	5 (1)
10,000-29,999	5 (1)	2 (0)
30,000-59,999	18 (3)	14 (3)
60,000-100,000	45 (8)	38 (7)
> 100,000	499 (87)	455 (89)
<b>Status</b>		
Administrator or staff member	27 (5)	19 (4)
Dentist	545 (95)	495 (96)
<b>Dentistry-Related Work, Y</b>		
< 1	13 (2)	13 (3)
1-3	29 (5)	26 (5)
3-5	24 (4)	20 (4)
5-10	54 (10)	48 (9)
> 10	452 (79)	407 (79)

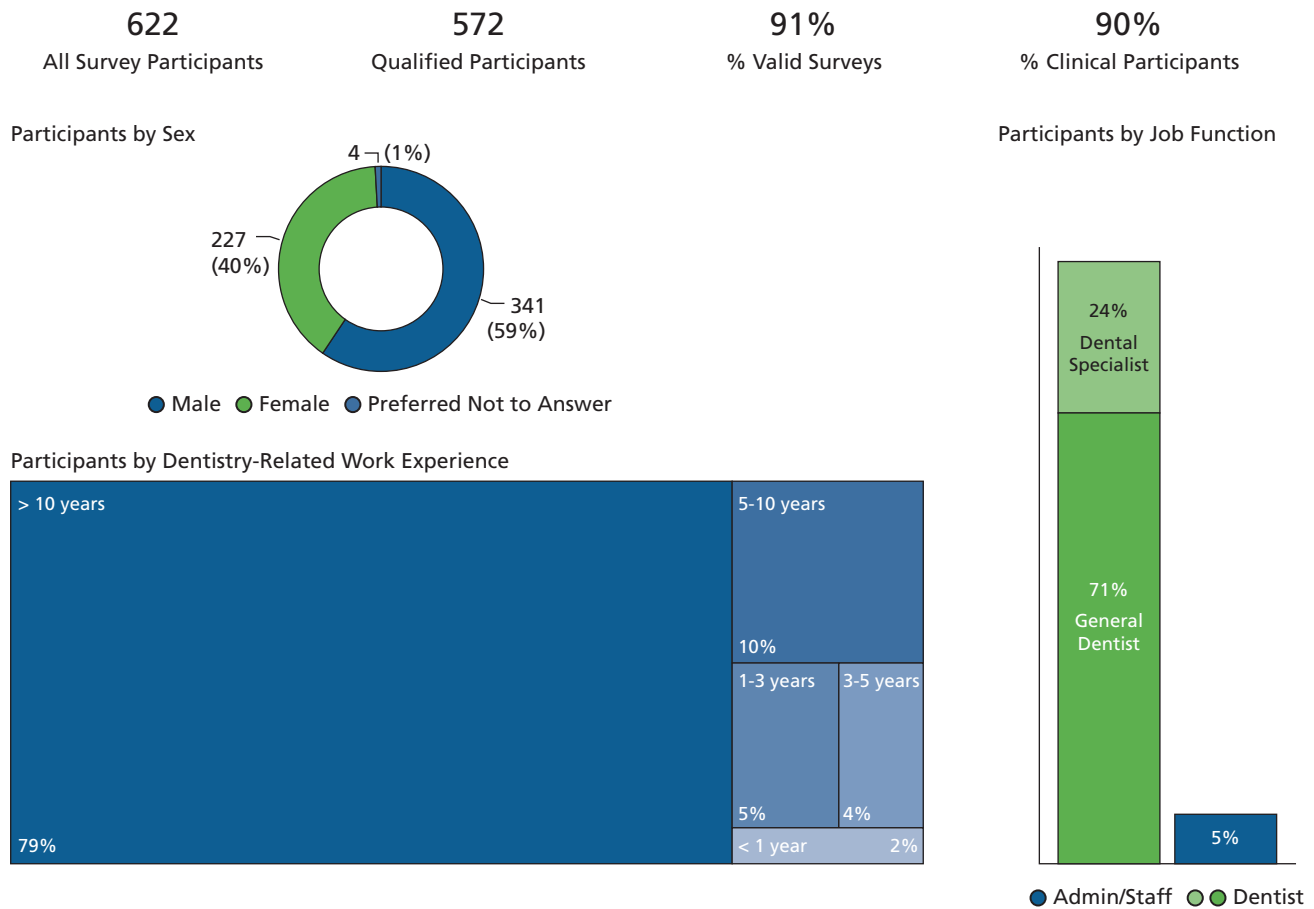


Figure 1. Demographics and groups distribution of study participants. Admin/Staff: Administration/Staff members.

dental practice at least 10 years, and 95% were dentists. Participants of the clinical practice–related second part had nearly identical demographics as the participants of the first part.

### General challenges during the pandemic

A series of questions asked participants to provide their opinions and beliefs using a 5-point scale. We used a common standard methodology for surveys to further compile the positive responses into 1 and the negative responses into another: a positive response included words of agreement (might, slightly, somewhat, moderately very, strongly agree, yes), and a negative response included words of disagreement (neither, might not disagree, not, no). The results of this part of the survey are shown in Table 2.

More than one-half the participants found working during the pandemic difficult ( $\approx 60\%$ ). Participants were concerned about the impact of COVID-19 on their general health, safety, and well-being (77%) and even more so about the impact to their dental practice (90%). However, 95% of participants were satisfied with the resources their dental office provided to help support them during the pandemic. There was a statistically significant difference between men and women regarding concern about general health, with 83% of women being concerned (95% CI, 78% to 88%) compared with 72% of men being concerned (95% CI, 67% to 77%) (OR, 1.86;  $P = .003$ ). There was also a statistically significant difference by age, with participants in the highest age group ( $> 55$  years) being more likely to respond that work was difficult during the COVID-19 pandemic (66% [95% CI, 60% to 72%] in oldest age group versus 56% [95% CI, 51% to 61%] in other age groups [OR, 1.55;  $P = .043$ ]). This possibly was because older adults (with preexisting health conditions) seem to be at a higher risk of developing more serious complications from COVID-19. There were no statistically significant differences by job function or years of experience.

**Table 2.** Beliefs and opinions by sex (dichotomous, with  $\chi^2$  test).

QUESTION AND RESPONSE	MALE, NO. (%)	FEMALE, NO. (%)	P VALUE
<b>How easy or difficult is it for you to work during the COVID-19 pandemic situation?</b>			
Somewhat to very easy	133 (39)	90 (40)	.88
Not easy to very difficult	208 (61)	137 (60)	
<b>How concerned are you about the impact of COVID-19 on your general health, safety and well-being (physical and psychological)?</b>			
Not concerned	95 (28)	39 (17)	.003
Slightly to very concerned	246 (72)	188 (83)	
<b>How concerned are you about the impact of COVID-19 on your dental practice?</b>			
Not concerned	37 (11)	20 (9)	.43
Slightly to very concerned	304 (89)	207 (91)	
<b>How satisfied are you with the resources your dental office is providing to help support you through the COVID-19 situation?</b>			
Slightly to very satisfied	325 (95)	214 (94)	.58
Not satisfied	16 (5)	13 (6)	

Another question asked participants to rank the importance of their main sources of information to keep updated regarding COVID-19 (Figure 2). We selected 2 methods to evaluate the responses. The first was average importance, in which a value of 1 was assigned to the most important resource, 2 to the second most important, and so on, after which a mean value of the importance score across all participants was calculated. The second was favorability rating, which reported the percentage of participants who ranked the resource in the top or bottom 2.

The participants rated the COVID-19 websites and internet search engines in the top 2 of importance more often (84%) than any other resource and had the fewest number of members rate it at the bottom. Journals and publications, despite the longer lead time to publish, were rated in the top 2 by 58% of the participants. Television channels and news were rated at the bottom by more than one-half of the participants. Social media sites had the lowest favorability rating, possibly a reflection of the generally older age of the participants.

### Challenges related to resuming dental practice

Participants in the clinical practice—related part of the survey were asked to respond using a 5-point scale to 8 statements and questions regarding their opinions and beliefs on challenges related to dental practice during the pandemic. Responses are presented in Table 3, grouped into 2 response levels as described above.

### Results of importance

- Nearly all participants (98%) felt at least slightly prepared to resume dental practice. There was no statistical difference by age, sex, or years of experience.
- More than 75% of participants agreed (somewhat or strongly) that there were challenges and long-term impacts on dentistry that needed to be considered. There was a statistically significant split in the strength of those opinions by sex; challenges were endorsed by 83% (95% CI, 78% to 88%) of women versus 72% (95% CI, 67% to 77%) of men (OR, 1.91;  $P = .006$ ), and long-term impacts were identified by 92% (95% CI, 88% to 96%) of women versus 76% (95% CI, 71% to 81%) of men (OR, 3.56;  $P < .001$ ).
- More than 95% of all participants were slightly or more confident of the safety precautions and PPE provided by their dental practice to protect them while performing aerosol-generating dental procedures. There were no significant differences by any demographic group.
- Only 21% (95% CI, 17% to 24%) of dentists felt that COVID-19 changed types of dental treatments offered to patients, perhaps because of the strict safety precautions and infection control measures already practiced by dentists who are, in general, at higher risk of developing infections and, thus, are used to handling risks of developing infections properly. Women were

## What are the main sources of information you use to keep updated regarding COVID-19?

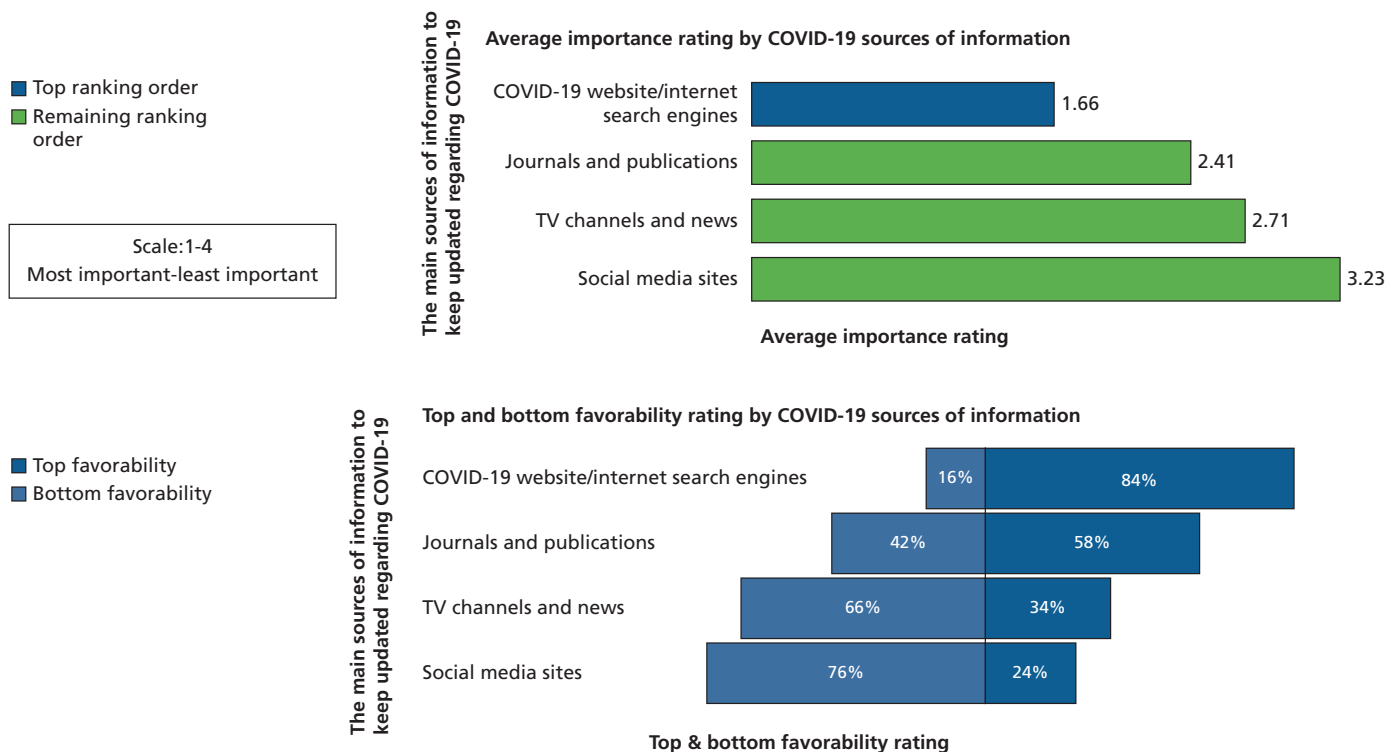


Figure 2. Ranking results for all participants.

also more likely than men to endorse changes in dental treatments (30% of women [95% CI, 24% to 37%] versus 18% of men [95% CI, 14% to 22%] [OR, 1.97,  $P = .002$ ]). At least two-thirds of all participants agreed that the precautions would influence their efficiency adversely, with no statistical evidence of difference by demographic group.

- Approximately 70% would probably or definitely not reconsider their dental career choices and would still recommend studying dentistry to others. Women were more ambivalent about their career choices, with 36% (95% CI, 29% to 42%) unsure or thinking of reconsidering compared with 25% (95% CI, 20% to 30%) of men (OR, 1.66;  $P = .013$ ).

Participants were also asked to rank the importance of 9 challenges while resuming dental practice during the pandemic (Figure 3). More than 60% of all participants rated PPE availability and having patients willing to come in for dental treatment in the top 3 of importance, far more often than any other challenge. The process of testing dental staff members was rated as of least concern, with two-thirds of all participants rating this in the bottom 3.

### Substantial differences by demographic group

Grouping answers by top 3 and bottom 3 importance is a useful tool for comparing the challenges, but there has not been a statistical method established for this particular type of analysis. However, it is appropriate to identify challenges with a substantial difference in opinion between demographic groups. For groupings that were relatively balanced (sex, age, years of experience), we decided to use a 20 percentage point difference as evidence of a substantial difference.

- There were no substantial differences in opinion by sex or years of experience.
- There were 2 substantial differences by age group. Participants older than 55 years were more likely than those 18 through 34 years to rate patients willing to come in for treatment as a top 3 challenge than a bottom 3 challenge (69% versus 47%). The youngest age group was less likely to identify financial losses of the dental practice as a top 3 challenge (36% compared with 56% among all the other participants).
- Only one-fourth of dentists rated concern about outbreaks and spikes as a top 3 concern.



**Table 3.** Beliefs and opinions related to resuming dental practice, by sex (dichotomous, with  $\chi^2$  test).

QUESTION AND RESPONSE	MALE, NO. (%)	FEMALE, NO. (%)	P VALUE
<b>How prepared do you feel to resume dental practice with the COVID-19 lockdown being lifted?</b>			
Slightly to very prepared	310 (99)	192 (97)	.30
Not prepared	3 (1)	5 (3)	
<b>COVID-19 highlighted challenges with dental practice.</b>			
Agree	226 (72)	164 (83)	.006
Not agree or disagree	87 (28)	33 (17)	
<b>COVID-19 will have long-term impacts on the practice of dentistry.</b>			
Agree	238 (76)	181 (92)	< .001
Not agree or disagree	75 (24)	16 (8)	
<b>Confidence in safety precautions and personal protective equipment during dental procedures that generate aerosols.</b>			
Slightly to very confident	300 (96)	189 (96)	.99
Not confident	13 (4)	8 (4)	
<b>Has COVID-19 changed types of dental treatments you provide?</b>			
Yes	57 (18)	60 (30)	.002
Maybe or no	256 (82)	137 (70)	
<b>COVID-19 might adversely influence your efficiency in performing dental procedures.</b>			
Agree	200 (64)	142 (72)	.069
Maybe or disagree	113 (36)	55 (28)	
<b>Would you reconsider your dental career choices?</b>			
No	235 (75)	127 (64)	.013
Maybe or yes	78 (25)	70 (36)	
<b>Would you still recommend studying dentistry?</b>			
Yes	228 (73)	128 (65)	.074
Maybe or no	85 (27)	69 (35)	

- Testing patients for COVID-19 infection was a low concern for dentists, with nearly two-thirds rating it in the bottom 3.
- 55% of dentists were worried about the financial status of the dental practice and rated it in the top 3, and 23% of dentists rated it in the bottom 3.
- 43% of dentists rated concern about the resources of patients in the bottom 3.

### Participants' feedback and sentiment analysis

The final question of the survey asked participants whether they had any other comments regarding their experiences during the pandemic. We performed sentiment analysis of the comments on the basis of the participants' words; we extracted the individual words from the comments and identified words that indicate positive or negative sentiment to perform the sentiment analysis (Figures 4 and 5).

### Sentiment comparison

The overall sentiment for each provider based on the number of positive or negative words used in their comment ranged from  $-8$  through  $8$  with the median being neutral. The overall mean was  $-0.19$  with a standard error of  $2.4$ . We used Wilcoxon rank sum test to compare whether the overall sentiment of the group deviated from neutral. We found that it did not. We found no statistically significant overall negative sentiment for general dentists compared with specialists.





In comparison with the previously discussed the School of Dentistry at The University of Texas Health San Antonio study<sup>27</sup> that evaluated some similar factors but was conducted early in the pandemic, our study, which evaluated a much broader dental community and was conducted during the COVID-19 peak period in Texas, found that the responses, overall, reflected fewer concerns, more satisfaction with resources provided for support, and much higher levels of preparedness to resume dental practice and confidence in safety precautions, with a significantly lower percentage of dentists feeling the pandemic changed their dental treatment protocols. Most participants rated PPE availability and having patients willing to come in for dental treatment as main challenges while resuming dental practice but reported they would not reconsider their dental career choices and would still recommend studying dentistry to others. The respondents in our study were mostly men compared with the dental school study in which most of the respondents were women; as reported in the literature, female sex is associated with higher levels of stress, anxiety, and depression and a greater psychological impact from COVID-19.<sup>22,27</sup>

The findings of our study are consistent with the hypotheses related to this study that dental care professionals were confidently prepared to resume dental practice despite being concerned about the impact of COVID-19 on their dental practices and their own well-being, as well as challenges, long-term impacts, financial resources, and efficiency during the pandemic.

Although this study was distributed during a peak period of COVID-19 in Texas, the second largest state in the United States with a diverse population and many dental care practitioners who went to dental school outside Texas, people who were more interested in participating may not reflect the rest of the dentist population. Future research with larger, nationwide samples should evaluate the long-term effects of the pandemic on dentistry and oral health of the population.

## CONCLUSIONS

Almost all participants (98%) in this study felt prepared to resume dental practice and were confident of safety precautions their dental practices provided to protect them while performing dental procedures. Only one-fifth of dentists reported that they felt that the COVID-19 pandemic changed their dental treatment protocols, with more than two-thirds agreeing that the precautions would influence their efficiency adversely.

Most respondents were satisfied with the resources their dental practices provided for support during the pandemic; were concerned about the impact of the pandemic to their dental practice and on their general health, safety and well-being; and agreed that there were challenges and long-term impacts on the dental profession.

Most respondents rated COVID-19 websites and internet search engines as their main sources of information to keep updated. Although most rated PPE availability and patients willing to come in for treatment as top challenges while resuming dental practice, they would still recommend studying dentistry and would not reconsider their dental career choices. ■

## SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: <https://doi.org/10.1016/j.adaj.2021.07.023>.

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