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The impact of the COVID-19 pandemic on U.S. orthodontic practices in 2020

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Introduction: This study aimed to investigate the immediate impact and long-term implications of severe acute respiratory syndrome coronavirus on orthodontic practices in the United States in 2020. **Methods:** A 35-item survey was developed and validated to investigate the impact of the coronavirus disease (COVID-19) pandemic on the orthodontic specialty. The survey contained 5 domains, including respondent's demographic information, COVID-19 information acquisition, practice ramifications of the COVID-19 pandemic, financial implications of the COVID-19 pandemic, and patient management strategies during the COVID-19 pandemic. This voluntary survey acquired responses from active orthodontists in the United States. Associations of demographic and practice characteristics with items related to COVID-19 were assessed using chi-square tests, with a 5% significance level. **Results:** The survey was disseminated to 5,694 orthodontists, and 507 complete surveys were obtained (response rate of 8.9%). Respondents indicated that they obtained the most useful information regarding the COVID-19 pandemic through professional associations and internet or online news resources. However, 30% of the orthodontists believed information regarding personal financial guidelines was lacking. Most respondents identified delayed treatment progress and temporary staff layoffs as the 2 most negative ramifications of mandated office closures. Approximately 93% of practices applied for and used some sort of stimulus funding offered through the Coronavirus Aid, Relief, and Economic Security Act. Respondents indicated that the COVID-19 related office closures resulted in an average of 50% decrease in net revenue. **Conclusions:** The survey found that the COVID-19 pandemic had a broad and significant impact on patient care and financial aspects of U.S. orthodontic practices in 2020. Although generally accepting of the federal and state recommendations, respondents appeared to desire more guidance during the early phase of the pandemic. (*Am J Orthod Dentofacial Orthop* 2022;161:198-207)

Cross-species virus transmission and the emergence of viral pandemics are immense threats to public health. Unrecognized viruses that affect humans and animals have been responsible for the emergence of epidemics and pandemics such as severe acute respiratory syndrome (SARS), Ebola, AIDS, and swine flu.¹⁻⁵ The most recent examples of these epidemics are the severe acute respiratory syndrome coronavirus (SARS-CoV) of 2003 and the influenza

virus A (H1N1) outbreak in 2009 that resulted in hundreds of deaths and economic disruption.^{3,6,7}

SARS-CoV-2 belongs to the coronavirus family of viruses and is responsible for the coronavirus disease (COVID-19) pandemic. COVID-19 is a single-stranded RNA virus that is extremely contagious, with confirmed patients in nearly every region of the globe.⁸ Because of the significant impact of COVID-19 on all aspects of life, various mandates have been imposed on communities worldwide that encourage public social distancing and self-isolation to help prevent the spread of this deadly virus.⁹ Social distancing and self-isolation practices have obvious ramifications on businesses and medical professions, including dental/orthodontic offices.

Considering the association between exposure to disease, the physical proximity to others, and high patient volume in an orthodontic practice make orthodontists one of the professionals at greatest risk in the United States.^{10,11} On March 16, 2020, the American Dental Association (ADA) recommended dentists postpone elective procedures for 3 weeks

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nationwide.¹² On April 1, 2020, the ADA issued an interim recommendation that “dentists keep their offices closed to all but urgent and emergency procedures until April 30 at the earliest.”¹² As a result, many orthodontists closed their offices and discontinued seeing nonemergency patients daily.

These unprecedented and extraordinary circumstances have raised many questions regarding office closures, business survival, patient care, and employee management. Because of the tremendous impact that the COVID-19 pandemic has had on the orthodontic community, it is critical that the immediate and projected impact of this pandemic on orthodontic private practices be investigated. Understanding the driving factors of the specialty’s real-time decision-making process in a period of crisis will give insight into whether the decisions made were prudent and how similar crises might be handled in the future.

This study aimed to evaluate the resources and entities that best-aided orthodontists to remain informed on the COVID-19 situation, the strategies orthodontists used to help their businesses survive, the methods used to manage active and future orthodontic patients, as well as the effect of the pandemic on orthodontic practice employees in 2020.

MATERIAL AND METHODS

After establishing 5 desired survey domains, the principal investigators developed questions that would aid in the acquisition of information to understanding these thematic areas. The questionnaire was divided into the following 5 sections/domains: (1) demographic information (9 items), (2) COVID-19 information acquisition (6 items), (3) practice ramifications of the COVID-19 pandemic (9 items), (4) financial implications of the COVID-19 pandemic (8 items), and (5) patient management strategies during the COVID-19 pandemic (3 items).

A draft questionnaire was developed by 2 full-time orthodontic faculty (D.A. and K.S.) and an orthodontic resident (H.M.) at the Indiana University School of Dentistry Department of Orthodontics and Oral Facial Genetics. The devised questions were then presented to a panel of 14 orthodontists from across the United States to assess the survey and provide input. This process was conducted to garner feedback regarding the survey length, relevance of domains and questions, question sequence, and appropriateness of answer choices. These reviews served to establish the construct, content, and face validity of the survey and ensure the information gathered would be pertinent to developing a greater understanding of the immediate and potential

long-term effects the COVID-19 pandemic has had on orthodontists and orthodontic practices.

Using the collected feedback, the investigators changed the survey to address identified deficiencies and reduce potential biases. The survey was then entered into SurveyMonkey (San Mateo, Calif), an online surveying platform, and prepared for dissemination. After the online survey was formatted, the orthodontist review panel completed an additional survey review. This additional review was undertaken to confirm the survey’s validity and ensure a positive respondent user experience. The final 35-item survey used a number of different question formats, including dropdown, Likert scale, multiple-choice, open-ended, and rating scales.

Before dissemination, the final survey was granted exemption from the Indiana University Institutional Review Board (no. 2004274320). This voluntary survey solicited responses from 1085 active members of the American Association of Orthodontists. Respondents were contacted by e-mail through the use of the American Association of Orthodontists (AAO) Partners in Research Program. In addition, 109 Indiana University Department of Orthodontics alumni practicing outside the state of Indiana were contacted via e-mail to complete the survey. Finally, approximately 4500 U.S. orthodontic practitioners associated with selected Facebook orthodontic groups (Women in Orthodontics, Orthodontic Pearls, and OrthoPreneurs) were approached to participate.

Statistical analysis

Survey responses were summarized (frequencies and percentages). Associations of demographic and practice characteristics (Domain 1) with items related to COVID-19 (Domains 2-5) were evaluated. Pearson chi-square tests were used to test associations between variables when both variables had nominal response categories; Mantel-Haenszel chi-square tests for ordered categorical data were used when 1 or both variables had ordinal response categories. A 5% statistical significance level was used for all tests. Analyses were performed using SAS (version 9.4; SAS Institute Inc, Cary, NC).

RESULTS

The study used a cross-sectional design and disseminated a validated survey instrument to obtain relevant information regarding the COVID-19 pandemic and orthodontic business survival, models of sustained patient care, and employee management by orthodontists in the United States. The survey was distributed to 5,694 orthodontists, and 586 accessed the survey. Survey submissions that either answered

Table I. Number and percentage of respondents per state

State	n	%
Alabama	4	0.79
Arizona	7	1.38
Arkansas	2	0.39
California	54	10.65
Colorado	19	3.75
Connecticut	7	1.38
Delaware	1	0.20
Florida	35	6.90
Georgia	9	1.78
Idaho	6	1.18
Illinois	23	4.54
Indiana	34	6.71
Iowa	3	0.59
Kansas	5	0.99
Kentucky	3	0.59
Louisiana	8	1.58
Maryland	10	1.97
Massachusetts	14	2.76
Michigan	23	4.54
Minnesota	12	2.37
Mississippi	5	0.99
Missouri	10	1.97
Montana	1	0.20
Nebraska	4	0.79
Nevada	7	1.38
New Jersey	22	4.34
New Mexico	4	0.79
New York	28	5.52
North Carolina	9	1.78
North Dakota	1	0.20
Ohio	13	2.56
Oklahoma	1	0.20
Oregon	10	1.97
Pennsylvania	18	3.55
South Carolina	3	0.59
South Dakota	1	0.20
Tennessee	7	1.38
Texas	38	7.50
Utah	5	0.99
Virginia	11	2.17
Washington	12	2.37
West Virginia	1	0.20
Wisconsin	8	1.58

only Domain 1 (demographic information) questions or failed to answer sufficient demographic information questions for the examiners to draw the desired correlations were excluded. Using these parameters, 79 respondents were excluded, yielding a total sample size of 507 and a response rate of 8.9%.

Table I lists the practice locations of the survey respondents by state. For some of the statistical analysis, states were combined according to their AAO constituent society groups to enhance group numbers (Table II). The data shows that some states had zero

Table II. Number and percentage of respondents per AAO constituency

Region	n	%
Great Lakes	70	14.06
Middle Atlantic	51	10.24
Midwestern	62	12.45
Northeastern	49	9.84
Pacific Coast	90	18.07
Rocky Mountain	35	7.03
Southern	87	17.47
Southwestern	54	10.84

representation, whereas Indiana was overrepresented within the sample set.

The respondents consisted of 250 females (50%) and 252 males (50%), with 3 (1%) respondents preferring not to disclose their gender. The age distribution of the respondents was broken down into 10-year increments. The largest group of orthodontists were aged 30–39 years (40%, n = 202) and 40–49 years (32%, n = 161). Orthodontists aged 50–59 years represented 18% (n = 90) of the respondents, whereas only 9% were aged >60 years (n = 44).

Regarding the respondents' practice information (level of experience, practice type, and practice setting), the majority of responding orthodontists indicated they maintained a solo private practice (53%, n = 266). Twenty percent reported being associates in either private practices (11%, n = 57) or corporate practices (9%, n = 43). The remainder were practice owners practicing with an associate (10%, n = 48), practitioners in group practices (12%, n = 60), or orthodontists in academia or hospital practices (3%, n = 13). Most orthodontists in the survey claimed to practice in suburban areas (70%, n = 355), whereas 19% (n = 96) practice in urban areas, and only 11% (n = 56) in rural practices. Levels of experience were grouped into 5-year increments. The largest group of participants had <5 years in a practice group (26%, n = 132). Each subsequent 5-year span decreased in participation from 22% (n = 111) for those with 5–10 years in a practice, 18% (n = 93) for those with 11–16 years in a practice, and 10% (n = 49) for those with 16–20 years of practice. The most senior orthodontists were grouped into a >20 years in a practice group, and they represented nearly 1 quarter of the respondents (n = 121).

Office size before the COVID-19 pandemic was estimated by the number of employees within the practice. Most of the offices included in the sample (38%, n = 194) had 5–10 employees. The next most common practice size employed 11–15 people, representing 22% of responses (n = 110). The smallest

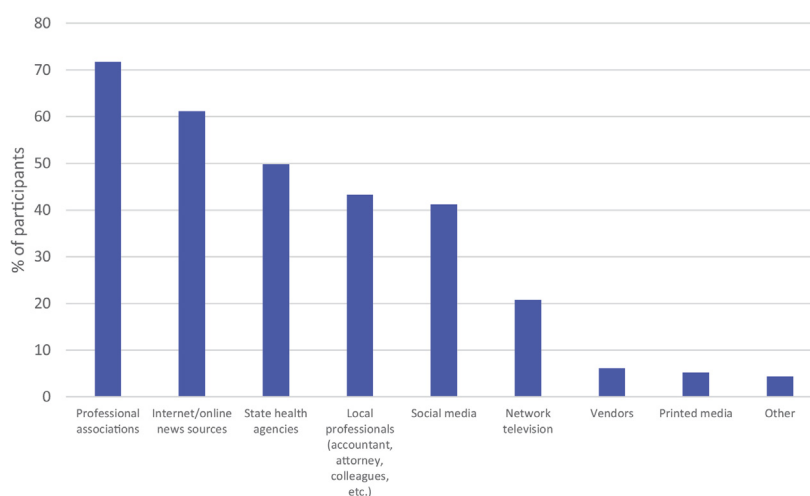


Fig 1. Most commonly accessed COVID-19 information sources.

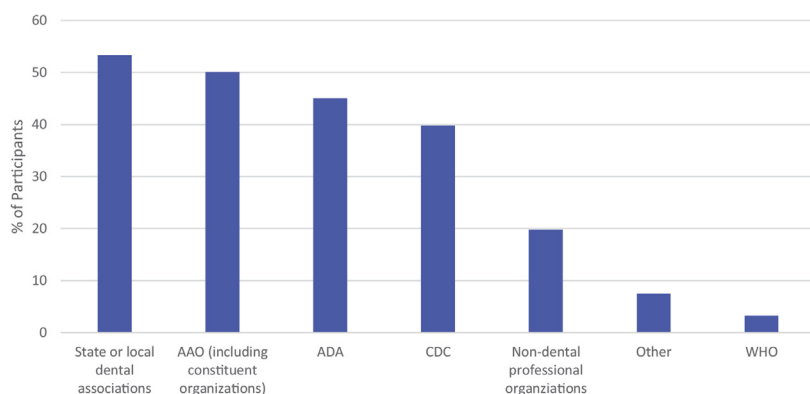


Fig 2. Most helpful COVID-19 information sources.

offices, with a staff of <5 employees, represented 16% ($n = 81$) of the sample, and the largest practices in the survey employed 16–20 staff members or had over 20 employees, and represented 8% and 16% of the sample, respectively ($n = 41$ and 81).

After collecting the above demographic information, the next subset of questions sought to gauge orthodontists' opinions on the initial federal and local responses to the emerging pandemic. These Likert scale questions were used to measure the level of satisfaction of the respondents to the federal and state or regional responses to the COVID-19 pandemic. The majority of the respondents (67%, $n = 340$) rated the federal response as fair to poor, whereas there were slightly more respondents satisfied with their state/regional response, which yielded fair to good assessment from 74% of respondents ($n = 375$).

Regarding opinions about the specific, more locally directed mandates/recommendations, younger

orthodontists tended to agree with the necessity of such guidelines, whereas their more senior colleagues did not ($P = 0.038$). In addition, significantly more females felt the mandates were necessary compared with males. In addition, 59% of females and 45% of males felt the limitations placed on patient care within orthodontic practices were necessary ($P = 0.006$). Just over 50% of the participants felt that guidelines set by local and state governments regarding limitations to all but emergency and essential care in orthodontic practices were necessary overall, and the subset of the sample most critical to these mandates were practitioners in solo and group private practices ($P = 0.044$).

Figure 1 illustrates the information sources survey respondents used most during the early stages of the pandemic. Approximately three-quarters of the participants accessed information from professional associations, and 61% used internet/online news sources. The gathering of information from the internet and

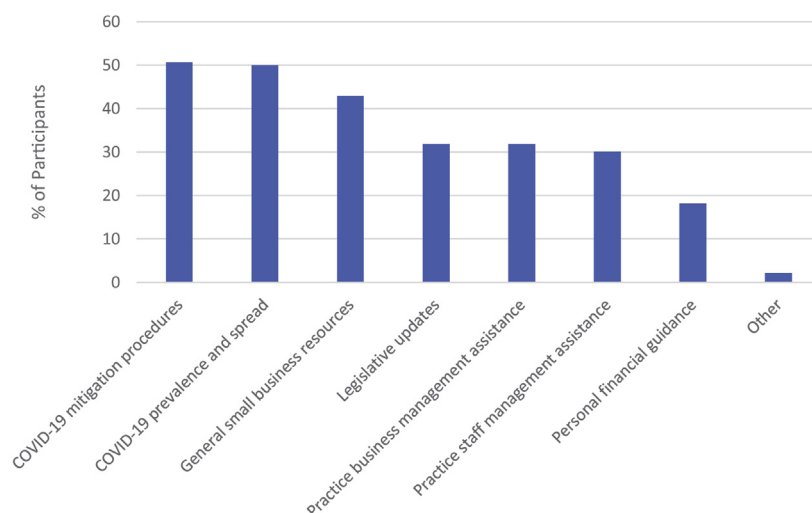


Fig 3. Most helpful topics found in sources.

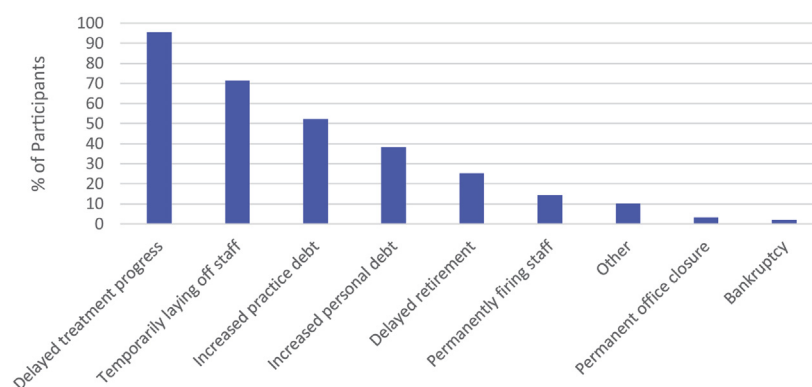


Fig 4. Negative ramifications of mandated office closures.

online news sources was statistically significant with the youth of the respondent ($P = 0.024$), but the use of social media, specifically, was not similarly correlated with age. Although obtaining information from vendors and print media was not selected by many participants, the orthodontists that selected this option were in the most senior age groups ($P = 0.001$ and $P = 0.005$, respectively) and practicing in suburban and rural areas ($P = 0.034$). Figure 2 illustrates which sources provided participants with the most helpful information. Roughly half of the respondents stated that the most helpful sources of information were state or local dental associations (53%) and the AAO (50%).

According to the participants, the most helpful sources providing information regarding COVID-19 were the state or local dental associations, AAO, ADA, and the Centers for Disease Control and Prevention, in

descending order. The older the participants' age group, the more they used the AAO as a source for obtaining information ($P = 0.004$), and the larger the practice, the more likely the respondents were to select the AAO as a helpful information source ($P = 0.003$). The same trend held regarding age and practice size and the attitudes toward the ADA as an information source ($P = 0.038$). Practitioners in rural and suburban practice settings and those in smaller practices also tended to rate professional associations highly as sources of helpful information ($P = 0.018$ and $P = 0.007$, respectively). Half of the respondents ranked COVID-19 mitigation, prevalence, and spread as the topics for which they could collect the most useful information. Information regarding practice business management, small business resources, and personal financial guidance was generally rated as lacking by about one-third of the participants

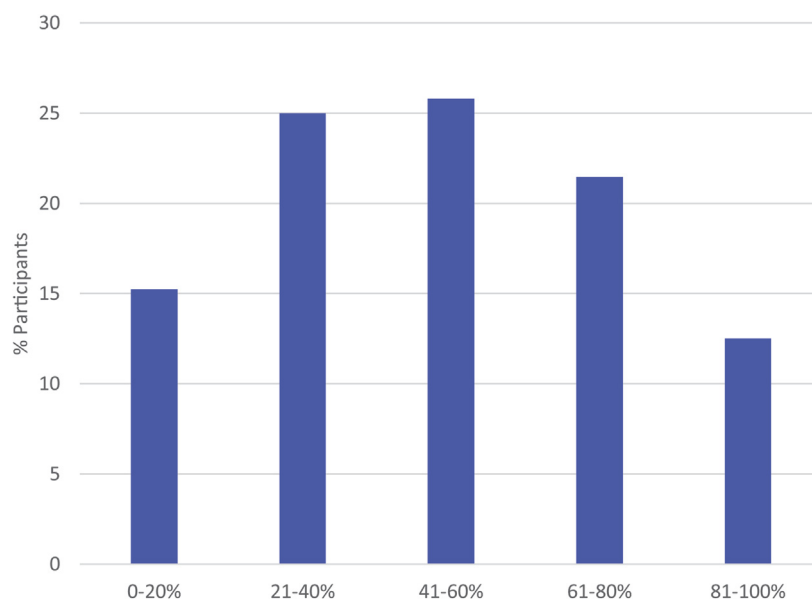


Fig 5. Estimated percentage of revenue loss.

(Fig 3). It is interesting to note that while professional associations, such as the AAO and ADA, were listed as useful sites to glean information, when asked if guidelines set forth by these organizations were helpful in the early management of the pandemic, 55% of respondents felt the professional associations did not provide sufficient guidance in these critical early days. Two demographic groups responded counter to this trend. Orthodontists practicing in rural settings and practitioners with smaller practices (10 employees or less) tended to believe that professional association guidelines were helpful in the early management of the pandemic ($P = 0.003$ and 0.022 , respectively).

Among the 481 participants who volunteered their opinion on recommendations to limit practices to emergency or essential care in orthodontic practices, 252 (52%) believed that the guidelines set by local and state governments were necessary. Significantly more females (59%) than males (45%) thought that the guidelines were necessary ($P = 0.006$). Approximately two-thirds (63%) of orthodontists <30 years agreed with the necessity of the guidelines, whereas only 43% of orthodontists >60 years shared that perspective ($P = 0.038$).

When inquired about negative ramifications to orthodontic practices caused or anticipated by the various local lockdown orders, 95% of respondents selected delayed patient treatment as a primary concern. In addition, 71% of participants were concerned about the potential need to temporarily furlough staff. Figure 4 highlights the response choices of survey participants

in descending order for this question. These 2 top concerns were also listed as negative ramifications that could have been lessened or avoided with more timely information and resources. When taking the survey, 73% of practices stated they laid off >60% of their staff. Only 1 in 4 practices relayed that they did not release at least 1 employee permanently because of the effects on the business caused by the pandemic-related shutdowns. A vast majority (87%) of practice owners encouraged their furloughed staff to apply for unemployment benefits.

Only practice owners or participants who managed the financial aspects of their practices answered the financial-related items within the survey. Within this subset of participants, 93% ($n = 375$) stated that they used at least some of the programs within the Coronavirus Aid, Relief, and Economic Security Act, and a full 98% used the Payroll Protection Program. Just over half of these respondents (54%) used the Economic Disaster Loan. Only 26 participants decided to forego these programs, and of these orthodontists, 65% stated they did not need the support or were unsure of the financial ramifications of using the programs (38%) or did not have adequate knowledge to comfortably agree to them (15%). Most orthodontists (77%) consulted with a certified public accountant before making these financial decisions for their practices. Other common sources of guidance for financial matters were consulting a colleague (43%) and professional associations (16%). Over 1 in 5 respondents stated they conducted their own research.

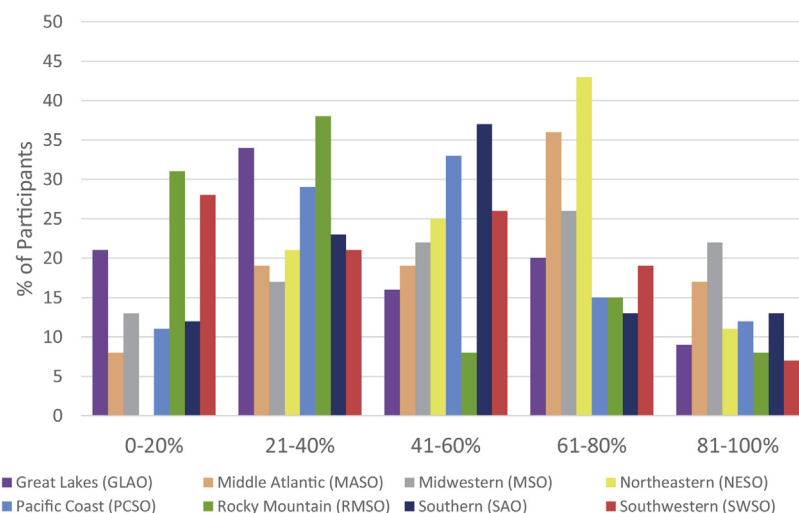


Fig 6. Percentage revenue loss by AAO constituency.

Participants were asked to estimate the net financial impact of the lost time in practice, shown in (Fig 5). On examination of the financial ramifications of the pandemic by geographic regions, certain trends were noted. Estimation of lost revenue was grouped into percentile ranges for respondents to choose. Practices within states that would fall into the AAO constituent societies of Northeastern Society of Orthodontists (NESO), Middle Atlantic Society of Orthodontists (MASO) demonstrated particularly heavy losses. In fact, no practice within the NESO geographic area stated that their losses were within the least impactful range (0%-20% estimated loss year over year), meaning all practices suffered at least 20% losses. In addition, practices within these 2 geographic areas had the highest percentage responses in the 61%-80% estimated losses range. In contrast, practices in the Rocky Mountain Society of Orthodontists and Southwestern Society of Orthodontists geographic regions had approximately 30% of practices with 0%-20% losses (Fig 6).

Another potential financial impact explored in the survey was whether a planned practice transition was affected, including hiring an associate. Around 60% of practices stated they were at some stage of planning a practice transition. Of those practices, just over 50% stated the COVID-19 pandemic negatively impacted those plans.

The final aspect of orthodontic practice that the instrument surveyed was the management of patients during the shutdown. This section collected input from 463 respondents. The choices given were teleorthodontics (65%, $n = 299$), phone calls to patients (72%, $n = 332$), emails to patients (67%, $n = 310$), and texts

to patients (64%, $n = 298$). Nearly a quarter (24%) of respondents ($n = 111$) reported that they limited patient contact strictly to handling emergencies. The orthodontists who used teleorthodontics did so for a variety of situations. A significant majority (82%) used it to assist with emergency patient management, but 79% used it for patients in active aligner treatment, 78% used it for patients in active fixed appliances, and 47% used it for retention checks. A number of practitioners used teleorthodontics for new patient consults (58%) and for monitoring patients between phases for future treatment (43%).

A number of questions allowed participants to submit other thoughts and concerns regarding the issues related to the pandemic. A word cloud (Fig 7) was generated from these free-form responses. Although not statistically measured, these comments were very instructive about the attitudes and opinions of the survey respondents.

DISCUSSION

The demographic data from this survey were compared with demographic data available from the AAO¹³ to determine the representative caliber of our sample. Overall, our sample compares favorably to national demographics of practice geography, practice location (urban, suburban, and rural), and practice type (a large percentage of solo private practice owners). In addition, 75% of the survey participants were private practice owners, whereas 20% were associates in either private practices or corporate practices. When considering the national distribution of orthodontists, our sample was slightly overweighted geographically to

appreciated what was presented but were disappointed that there was not more.

Regarding net revenue loss, the average percentage loss over all demographic categories was around 50%. Financial ramifications were also examined relative to AAO constituency geographic regions, and some interesting findings were seen. The hardest-hit regions were geographic areas in which the reported virus outbreaks were equally devastating. The NESO, MASO, Pacific Coast Society of Orthodontists, and Southern Association of Orthodontists constituencies were particularly ravaged, as evidenced by fewer practices that experienced minimal losses and the higher percentage of practices that reported loss estimates in the 41%-80% range. Rocky Mountain Society of Orthodontists practices represent the only region to have >50% of practices report losses in the lowest 2 range possibilities (0%-40%). The ADA Health Policy Institute has published survey data from the dental community at large on a biweekly basis since March 23, 2020.¹⁶ Examining these results against the ADA Health Policy Institute survey numbers, the percentage of dental practices reporting >50% decrease in volume of collections from May 18, 2020 to June 1, 2020 (the periods within the scope of our survey) were 76.9% and 59.7%, respectively. Some mitigating factors that could impact general dental practices differently than orthodontic practices are that although treatments are suspended within an orthodontic practice, active patients are still under contract and possibly making payments. In contrast, emergency visits are likely more billable in a general dental practice than they would be in an orthodontic practice.

Although not directly examined by our instrument, free-form responses yielded insights into concerns among respondents that were not specifically queried in the survey. A concern that was brought up in a number of ways was recommendations, utilization, and availability of personal protective equipment (PPE). In a recent article published by Suri et al,¹⁷ a summary was presented regarding the clinical management of patients during the COVID-19 pandemic.¹⁷ At the time of their writing, the Centers for Disease Control and Prevention guidelines for PPE use included a fit-tested N95 mask, eyewear with side shields or full-face shields, hair covers, over gowns, fluid-impermeable shoes, and double gloving. Although these recommendations will likely change with time, they highlight the increased demands in cost, supply, and compliance that are being placed on orthodontic practices. In a recent ADA "Morning Huddle" e-mail blast, articles by ABC News and Bloomberg were highlighted, reporting the looming threat of increasing PPE shortages for health care workers. The ADA Health Policy Institute survey also

questioned dentists regarding PPE supply. Roughly 20% of dental offices reported having less than the 8-day supply of N95 masks, and over one-fourth of practices have a similarly limited inventory of gowns. The issues surrounding PPE availability will likely be the most immediate threat to workplace safety and the return to whatever the new normal post-COVID-19 operations will be.¹⁷ Our survey comments loudly echo these concerns.

CONCLUSIONS

The survey found that the COVID-19 pandemic has made a broad and significant impact on the patient care and financial aspects of U.S. orthodontic practices. Although generally accepting of the federal and state recommendations, respondents appeared to desire more guidance during the early phase of the pandemic, and as the reopening proceeded, our respondents sought better guidance in obtaining PPE and making definitive recommendations on PPE usage and reopening protocols.

Crises present challenges but also afford opportunities. Respondents to this survey continue to look to our professional associations for help and guidance. Providing orthodontists with robust and timely information and resources is both a challenge and an opportunity. Examining our responses to the difficult and fluid circumstances surrounding the COVID-19 pandemic can help our specialty meet the challenges and seize the opportunities both now and into the future.

AUTHOR CREDIT STATEMENT

Hengameh Motevasel contributed to investigation, original draft preparation, and data curation; Lana Helms contributed to methodology and manuscript review and editing; George Eckert contributed to formal analysis and manuscript review and editing; Kelton Stewart contributed to conceptualization, methodology, validation, resources, manuscript review and editing, visualization, and funding acquisition; and David Albright contributed to conceptualization, methodology, manuscript review and editing, visualization, supervision, and project administration.

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SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.ajodo.2020.11.040>.

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