Cover Story

Estimating COVID-19 prevalence and infection control practices among US dentists

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Supplemental material is available online.

ABSTRACT

Background. Understanding the risks associated with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission during oral health care delivery and assessing mitigation strategies for dental offices are critical to improving patient safety and access to oral health care.

Methods. The authors invited licensed US dentists practicing primarily in private practice or public health to participate in a web-based survey in June 2020. Dentists from every US state (n = 2,195) answered questions about COVID-19–associated symptoms, SARS-CoV-2 infection, mental and physical health conditions, and infection control procedures used in their primary dental practices.

Results. Most of the dentists (82.2%) were asymptomatic for 1 month before administration of the survey; 16.6% reported being tested for SARS-CoV-2; and 3.7%, 2.7%, and 0% tested positive via respiratory, blood, and salivary samples, respectively. Among those not tested, 0.3% received a probable COVID-19 diagnosis from a physician. In all, 20 of the 2,195 respondents had been infected with SARS-CoV-2; weighted according to age and location to approximate all US dentists, 0.9% (95% confidence interval, 0.5 to 1.5) had confirmed or probable COVID-19. Dentists reported symptoms of depression (8.6%) and anxiety (19.5%). Enhanced infection control procedures were implemented in 99.7% of dentists' primary practices, most commonly disinfection, COVID-19 screening, social distancing, and wearing face masks. Most practicing dentists (72.8%) used personal protective equipment according to interim guidance from the Centers for Disease Control and Prevention.

Conclusions. COVID-19 prevalence and testing positivity rates were low among practicing US dentists. This indicates that the current infection control recommendations may be sufficient to prevent infection in dental settings.

Practical Implications. Dentists have enhanced their infection control practices in response to COVID-19 and may benefit from greater availability of personal protective equipment. ClinicalTrials.gov: NCT04423770.

Key Words. SARS-CoV-2; COVID-19; dentistry.

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The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causative agent for an infectious disease known as COVID-19, which is transmitted primarily through person-to-person contact.[1] The COVID-19 pandemic, with its considerable morbidity and mortality, causes social and economic disruptions and health care delivery problems. The pandemic is of particular concern owing to the airborne transmission dynamics in asymptomatic and presymptomatic people.[2-4] Virus-containing droplets (5-12 micrometers) and aerosols ($\leq$ 5 μm) from infected people are transmitted into the environment through breathing, speaking, coughing, and sneezing.[5] Susceptible people can then become infected if virus-containing respiratory droplets or aerosols settle on mucosal membranes or are inhaled.[5] Respiratory viruses like SARS-CoV-2 can also be spread if a susceptible person touches viral particles on contaminated surfaces and transfers them to their mucus membranes.[5]

As information about SARS-CoV-2 transmission emerged during the early stages of the pandemic, concern regarding the transmission of virus-containing airborne particles in the dental office was also brought to the forefront. It has been suggested that additional potential for SARS-CoV-2 transmission exists in dental settings during the delivery of aerosol-generating dental procedures (AGDPs). These AGDPs might be potential vectors for patient-to-practitioner and patient-to-patient transmission, as the aerosols and droplets produced during such procedures can contain infectious materials.[6] Multiple dental professionals at the School and Hospital of Stomatology, Wuhan University, Wuhan, China, have contracted COVID-19, but it is unclear whether these infections were due to community transmission or transmission associated with oral health care delivery.[7] Developing a fuller understanding of the risks to patients and practitioners related to transmission during oral health care delivery and assessing mitigation strategies within the dental office are key components of improving patient safety and access to ongoing oral health care in this pandemic environment.

With the emergence of this novel virus and the ensuing pandemic, dentists have worked to establish guidance for practices to ensure the safety of practitioners, staff members, and patients. As early as March 2020, *Journal of Dental Research* published the infection control guidelines that dentists at Wuhan University used,[7] and, in April and May 2020, the American Dental Association (ADA) and the Centers for Disease Control and Prevention (CDC), respectively, released interim guidance on infection control protocols and changes to the practice and office environments.[8,9] These guidelines and other local interim guidance documents broadly agree, but the degree to which the US dental profession is aware of and adheres to these recommendations remains unknown. Furthermore, baseline data evaluating infection rates among dentists throughout the US are not widely known because CDC surveillance groups dental professionals with all other health care personnel.[10]

As far as we are aware, this is the first longitudinal study designed to track infection control practices and infection rates among US dentists. In this article, we used the first month of study data to estimate the prevalence of COVID-19 among US dentists and to determine the rate of compliance with CDC and ADA infection prevention and control procedures.[8,9]

METHODS

We administered a web-based survey using Qualtrics survey software (Qualtrics) from June 8 through June 12, 2020. US-based dentists were invited to participate in the survey if they held a license to practice dentistry in the United States, were in private practice or public health, and if, in a May 2020 ADA survey,[11] they reported that they would be willing to participate in a study on symptoms, testing, or diagnosis of COVID-19. In total, 5,479 dentists received an invitation to participate in the survey on June 8, 2020; a reminder invitation e-mail was sent June 11, 2020.

Participating dentists read and signed an electronic informed consent before participating in our study. The 18-question survey was constructed for this research. Demographic survey questions included birth year, race and ethnicity, gender, primary practice location, and dental specialty. SARS-CoV-2 infection was ascertained via self-reported date, type, and positive result of a SARS-CoV-2 test (confirmed case) or, if not tested, the date a health care provider informed the respondent that they had a probable SAR-CoV-2 infection (probable case). On the basis of these questions, and excluding those awaiting test results or with inconclusive results, COVID-19 prevalence was estimated. Consistent with CDC surveillance, the test positivity rate was defined as the numbers of confirmed cases over the total number of tested cases.[12] The survey also asked respondents to identify symptoms experienced in the past month (defined as since May 8, 2020), health conditions associated with COVID-19 severity,[13] and dental and nondental activities in the past month.

Because stressful events such as a pandemic can affect mental well-being, the validated Patient Health Questionnaire-4 screened respondents for depression or anxiety.[14,15] Respondents who reported providing oral health care in the past month were asked about infection prevention or control procedures in their primary dental practice. Respondents indicated which personal protective equipment (PPE) they used when treating patients in the past month and whether they used it sometimes or always. The CDC interim guidance document was used to categorize PPE use,[8] and respondents were categorized as following PPE guidance for AGDP if, in addition to basic clinical PPE of gloves and protective clothing, they "always" wore an N95 or similarly protective respirator (also called an "N95 mask") with eye protection, or the highest level of surgical face mask available with a full-face shield. Dentists who performed no AGDP were categorized as following PPE

ABBREVIATION KEY

ADA: American Dental Association.
AGDP: Aerosol-generating dental procedure.
CDC: Centers for Disease Control and Prevention.
FQHC: Federally qualified health center.
OSHA: Occupational Safety and Health Administration.
PPE: Personal protective equipment.
SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2.

Table 1. Characteristics of the survey sample and comparison with all private practice or public health dentists licensed in the United States.

CHARACTERISTIC	UNWEIGHTED SAMPLE, % (NO.) (N = 2,195)	ADA* MASTERFILE OF US DENTISTS, % (NO.) (N = 185,587)	χ^2 *P* VALUE
Age Group, y	NA†	NA	< .001
27-39	15.6 (343)	26.6 (49,326)	NA
40-49	23.2 (509)	23.4 (43,331)	NA
50-59	26.8 (589)	21.2 (39,253)	NA
60-69	27.4 (601)	20.9 (38,853)	NA
70-84	7.0 (153)	7.7 (14,355)	NA
Race and Ethnicity	NA	NA	< .001
Non-Hispanic white	79.2 (1,739)	71.4 (97,831)	NA
Non-Hispanic Asian	7.2 (159)	15.6 (21,412)	NA
Hispanic or Latino	5.2 (114)	5.6 (7,670)	NA
Non-Hispanic Black	1.1 (24)	4.7 (6,402)	NA
American Indian or Alaska Native	0.2 (5)	0.3 (459)	NA
Native Hawaiian or Pacific Islander	0.2 (4)	0.2 (286)	NA
Other	6.8 (150)	2.1 (2,938)	NA
Gender	NA	NA	< .001
Male	60.0 (1,294)	66.2 (121,125)	NA
Female	39.0 (841)	33.8 (61,847)	NA
Prefer not to say	1.0 (22)	NR‡	NA
Dental Practice Type			NA
Private practice	96.6 (2,077)	NR	NA
FQHC§	2.6 (56)	NR	NA
Non-FQHC health center	0.4 (8)	NR	NA
City or county health department	0.5 (10)	NR	NA
Practice Type	NA	NA	< .001
General dentist	83.6 (1,798)	79.2 (145,557)	NA
Dental anesthesiology	0.1 (2)	0.03 (48)	NA
Endodontics	1.6 (34)	2.7 (5,043)	NA
Oral and maxillofacial pathology	0.05 (1)	0.2 (283)	NA
Oral and maxillofacial surgery	2.6 (58)	3.5 (6,460)	NA
Oral medicine	0.1 (2)	NR	NA
Orofacial pain	0.1 (2)	NR	NA
Orthodontics and dentofacial orthopedics	2.0 (44)	5.4 (9,980)	NA
Pediatric dentistry	6.7 (147)	4.2 (7,751)	NA
Periodontics	2.3 (50)	2.7 (5,004)	NA
Prosthodontics	0.6 (14)	1.6 (3,025)	NA
US Census Bureau Division	NA	NA	< .001
New England	6.2 (136)	5.3 (9,849)	NA
Middle Atlantic	11.9 (262)	14.4 (26,709)	NA
East North Central	18.6 (409)	13.7 (25,439)	NA

* ADA: American Dental Association. † NA: Not applicable. ‡ NR: Not recorded. § FQHC: Federally qualified health center. ¶ Multiple conditions per person allowed.

Table 1. Continued

CHARACTERISTIC	UNWEIGHTED SAMPLE, % (NO.) (N = 2,195)	ADA* MASTERFILE OF US DENTISTS, % (NO.) (N = 185,587)	χ^2 P VALUE
West North Central	9.6 (211)	5.7 (10,644)	NA
South Atlantic	14.9 (327)	17.7 (32,758)	NA
East South Central	4.3 (95)	4.5 (8,253)	NA
West South Central	7.9 (174)	10.5 (19,456)	NA
Mountain	10.1 (221)	7.2 (13,423)	NA
Pacific	15.4 (337)	20.3 (37,606)	NA
Territories	1.0 (23)	0.7 (1,282)	NA
Conditions¶	NA	NA	NA
Asthma	7.3 (160)	NR	NA
Chronic lung disease	0.1 (3)	NR	NA
Diabetes	3.6 (80)	NR	NA
Heart condition	5.3 (116)	NR	NA
Immunocompromised	1.0 (22)	NR	NA
Kidney disease	0.5 (11)	NR	NA
Liver disease	0.3 (6)	NR	NA
Obesity	7.6 (166)	NR	NA
Rheumatologic or autoimmune condition	3.0 (65)	NR	NA
Smoking	1.2 (26)	NR	NA

guidance if they "always" wore gloves, protective clothing, a surgical mask, and eye protection. Occupational Safety and Health Administration guidance was used to categorize the risk of transmitting SARS-CoV-2 to dental providers or patients.[16] Finally, respondents who reported wearing respirators or masks were asked how often they changed them. The ADA Institutional Review Board approved the research protocol and survey, which are registered at ClinicalTrials.gov (NCT04423770).

All statistical analysis was conducted in Stata software, Version 14.0 (StataCorp). For COVID-19 prevalence, statistical weighting was performed using linearization variance estimation so that the sample appropriately represented licensed US dentists in private practice or public health according to age group and US Census Bureau division. The weights and information on age, race or ethnicity, gender, dental specialty, and US Census Bureau division for all licensed US dentists in private practice or public health came from the ADA master file of all dentists (ADA members and nonmembers) in the United States. Dentist records are updated weekly through state licensure databases, death records, ADA surveys of dentists, and other sources. The data used for weighting in our study were extracted from the ADA master file on June 25, 2020. Differences between continuous variables were tested using analysis of variance and between categorical variables using χ^2 tests, with statistical significance set at .05. Single and multivariable logistic regression models were used to test for associations between age category, race or ethnicity, gender, dental practice type, dental specialty, medical conditions, and confirmed or probable SARS-CoV-2 infection. Due to complex survey question skip patterns and because respondents were able to skip any question or stop answering the survey at any time, not all respondents answered all questions. The percentage of missing answers ranged from 2.0% through 3.5% per question.

RESULTS

Participant characteristics

A total of 2,195 US dentists representing all 50 states and Puerto Rico participated in the web-based survey June 8, 2020 through 12, 2020 (response rate, 40.1%). Median age of responding dentists was 54 years (range, 27-84 years) (Table 1). Overall, most respondents identified as male (59.9%), non-

Table 2. Dentists' self-reported symptoms and activities outside of their households in the month before survey administration.

SYMPTOMS/ACTIVITIES	UNWEIGHTED SAMPLE, % (NO.) (N = 2,195)
Symptoms	
Chills	0.9 (19)
Dry cough	2.6 (58)
Fever	0.7 (16)
Headache	9.0 (197)
Muscle pain	4.2 (92)
New loss of taste or smell	0.4 (9)
Repeated shaking with chills	0.1 (3)
Sore throat	3.1 (69)
Shortness of breath or difficulty breathing	1.2 (26)
Fatigue or malaise	4.0 (87)
Other	1.7 (38)
Patient Health Questionnaire-4 Screening	
Likely anxiety	19.5 (414)
Likely depression	8.6 (183)
Activities	
Provided emergency oral health care	91.1 (1,999)
Provided elective oral health care	80.1 (1,758)
Attended a health care visit for myself or a companion	27.3 (599)
Met in person with anyone outside your household	81.6 (1,791)
Met with a group of 10 or more people in a social setting	19.5 (428)
Attended any public event with 50 or more people	4.7 (103)
Traveled via taxi, ride share, or public transportation	2.7 (60)
Had contact with anyone with suspected or confirmed COVID-19	4.6 (100)

Hispanic white (79.2%), in private practice (96.6%), and with a focus on general dentistry (83.6%). Approximately one-fourth of the respondents (24.4%, n = 536) had at least 1 medical condition associated with a higher risk of developing severe illness from COVID-19.[13] The most common conditions were asthma (7.3%) and obesity (7.6%). Compared with all dentists licensed in the United States in private practice or public health, higher proportions of survey respondents were aged 40 through 69 years, and fewer were 39 years or younger and 70 years or older (Table 1). Compared with dentists nationally, survey respondents were more likely to come from certain US Census Bureau divisions, be non-Hispanic white, female, or a general dentist.

Symptoms among dentists

Dentists were asked whether they experienced any symptoms in the month before the survey administration, regardless of whether they thought the symptoms were related to COVID-19; 82.2% (n = 1,805) had no symptoms in the past month. The most commonly experienced symptom was headache (9.0%, n = 197) (Table 2). In the 2 weeks before survey administration, 33.9% experienced at least mild psychological distress, defined as a score of 3 or higher on the Patient Health Questionnaire-4 (mean [standard error], 2.21 [0.06]). Among dentists, 8.6% (n = 183) scored 3 or higher on the depressive symptom questions (mean [standard error], 0.80 [0.03]), indicating potential major depressive disorder, which was a significantly lower proportion than in the US general population (24.3%) measured the same month ($P < .001$).[17] A total of 414 dentists (19.5%) scored 3 or higher on the anxiety symptom questions (mean [standard error], 1.42 [0.04]), indicating potential generalized anxiety disorder, a significantly lower proportion than in the general

Table 3. Self-reported infection prevention and control efforts by dentists who practiced in the month before survey administration.

INFECTION PREVENTION AND CONTROL EFFORTS	UNWEIGHTED SAMPLE, % (NO.) (N = 2,042)
Screen or Interview Patients for Known or Suspected Severe Acute Respiratory Syndrome Coronavrus 2 Infection Before Dental Appointment or Treatment	98.4 (2,010)
Check Patients' Temperatures With a Thermometer Before Dental Treatment	97.2 (1,985)
Check All Dentist and Staff Member Temperatures With a Thermometer at the Beginning of Their Shift	94.4 (1,927)
Disinfect Frequently Touched Surfaces and Materials, Such as Pens or Light Switches	98.9 (2,020)
Disinfect All Equipment in the Operatory Between Patients	99.1 (2,024)
Encourage Distance Between Patients, Such as Scheduling Appointments Farther Apart, Asking Patients to Wait Elsewhere, or Asking Patients Not to Bring Companions	98.9 (2,019)
Physical Protection in the Practice, Such as Erecting Barriers, Opening Windows, or Using Air Filters or Scrubbers	85.2 (1,740)
Provide Face Masks or Coverings to Staff Members	99.1 (2,024)
Provide Face Masks or Coverings to Patients	75.9 (1,550)
Other Efforts	
Preprocedural mouthrinse	12.0 (51)
Extraoral suction device	4.0 (17)

population (25.5%)[17] ($P < .001$). The Patient Health Questionnaire-4 is designed to indicate cause for additional evaluation only, not diagnosis.[14]

Activities outside the household

Dentists were queried about their activities during the period of May 8 through June 12, 2020. Most respondents (81.6%) met in person with someone outside their household in the past month (Table 2). However, few dentists reported gathering in groups, attending public events, or sharing transportation in the past month. Few respondents (4.6%) stated that they believed they had been in contact with someone with suspected or confirmed COVID-19 in the month before the survey. Of the respondents who reported such contact, most (53.0% [n = 53]) reported that the person with suspected or confirmed COVID-19 was a dental patient, another 20.0% thought someone they worked with in the past month had COVID-19.

Dental practice and infection control

During the established period of our study, 91.1% of respondents (n = 1,999) provided emergency oral health care and 80.1% (n = 1,758) provided elective oral health care (Table 2). Among the 2,042 dentists who had provided oral health care in the month before administration of the survey, 92.8% (n = 1,892) performed AGDPs. Enhanced infection prevention and control efforts were common; 99.7% of dentists reported practicing them in the past month (n = 2,189). Almost all practicing dentists reported disinfecting all equipment and surfaces that are commonly touched, checking staff members' and patients' temperatures, screening patients for COVID-19, encouraging distance between patients while waiting, and providing face masks to staff members (Table 3). The most common additional infection control efforts were staff members' masking (99.1%) and disinfecting the operatory between patients (99.1%). The less frequently reported infection control efforts were making physical changes to the practice (85.2%) or providing face masks to patients (75.9%; however, write-in responses indicate this may be due to some practices requiring patients to bring their own masks). Respondents could also describe the infection control efforts in their practices if not already listed. Most of these write-in responses fit into existing categories, except for preprocedural mouthrinses for patients (12.0% [n = 51]) and use of extraoral suction device during dental procedures (4.0% [n = 17]).

PPE

PPE use when treating patients was common; 99.6% of practicing dentists (n = 2,034) reported its use. For dental procedures not expected to produce aerosols, the CDC interim guidance

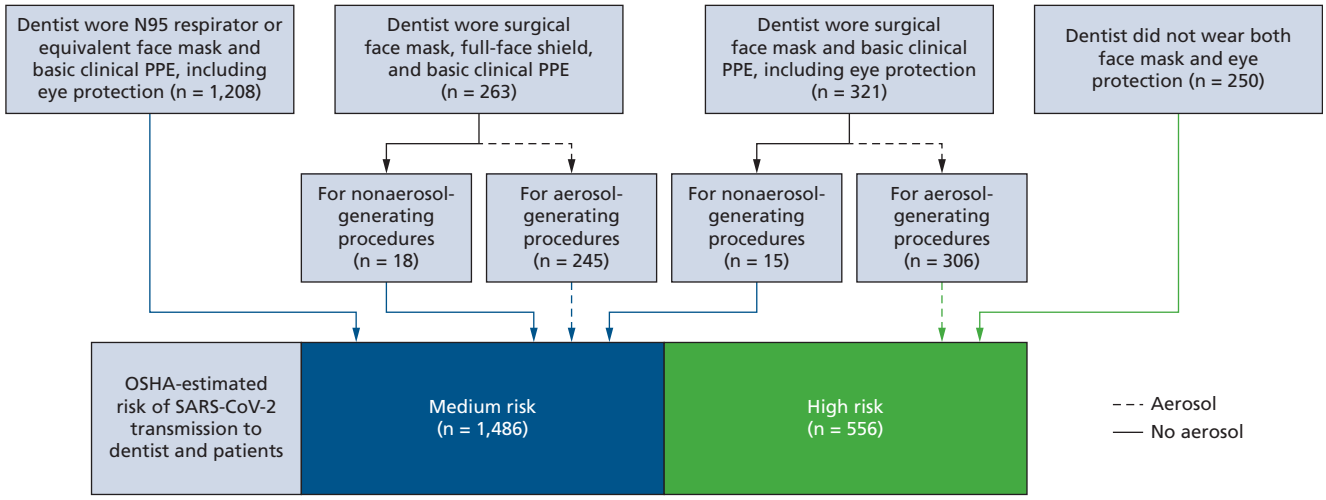

Figure. Personal protective equipment (PPE) always worn in past month, according to dental procedure. OSHA: Occupational Safety and Health Administration. SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2.

recommended surgical masks and basic clinical PPE, including eye protection.[8] Of the 146 dentists who reported performing non-AGDP in the past month, 82.9% (n = 121) always wore masks, basic clinical PPE, and eye protection (Figure). During AGDP with patients assumed to be noncontagious, interim guidance suggests use of a fitted N95 or equivalent mask and basic clinical PPE, including eye protection; 59.0% of dentists (n = 1,117) who reported performing AGDPs in the past month always wore this combination of PPE, and 61.6% (n = 90) dentists reported wearing this during non-AGDP. If N95 or equivalent masks are not available, the CDC interim guidance recommends using both the highest-level surgical face mask available and a full-face shield during AGDPs[8]; 12.9% of dentists (n = 245) performing AGDPs used this combination of PPE, as did 12.3% (n = 18) dentists during non-AGDP. In all, 72.8% (n = 1,486) of dentist respondents used PPE according to CDC interim guidance.[8]

During the time evaluated with this survey, there were limited supplies of PPE, particularly N95 or equivalent masks.[18] Some respondents (17.6%, n = 355) reported changing masks in between patients. More commonly, dentists changed masks between multiple patients (20.2%; n = 407), daily (34.2% , n = 689), weekly (7.7%, n = 155), or only if soiled or damaged (20.2%, n = 407). Respondents also wrote in to report that they used multiple masks simultaneously, with surgical masks worn over N95 or equivalent masks, and replaced the surgical masks more often.

Confirmed or probable COVID-19 among dentists

Among respondents, 16.6% (n = 355) reported that they had been tested for SARS-CoV-2 with at least 1 testing type. Fifty-one respondents (2.3%) were tested with 2 testing types—50 (2.3%) with both blood and nasal or throat swab tests and 1 (0.05%) with saliva and nasal or throat swab tests. A total of 244 respondents (11.1%) were tested with a nasal or throat swab, of which 9 (3.7%) tested positive. One hundred and fifty-six respondents (7.1%) were tested with a blood sample, and 4 (2.7%) had a positive result. Six respondents (0.3%) were tested for SARS-CoV-2 using a saliva sample and 0 had a positive result. Because testing was not widely available during this time, respondents were also asked whether they had received a diagnosis of probable COVID-19 infection and 7 (0.3%) had. Twenty dentists (0.9%) in this sample had either confirmed or probable COVID-19 cases. Weighted to approximate the age and location of licensed private practice and public health dentists nationally, the estimated prevalence of confirmed or probable COVID-19 among dentists was 0.9% (95% confidence interval, 0.5 to 1.5). The likely source of SARS-CoV-2 transmission was identified via contact tracing through a health agency or clinic in only 5 cases, and in none of those cases was the source of transmission the dental practice.

Association between COVID-19 and personal characteristics

Although respondents were tested for SARS-CoV-2 on dates ranging from March 6 through June 11, 2020, all but 1 positive test result came before the period the survey covered. The survey

questions about symptoms, activities outside the household, dental procedures, and infection prevention or control efforts in their primary dental practice covered the past month only. This misalignment in timing precludes using these survey data to investigate modifiable and behavioral risk factors for COVID-19 among dentists. When we compared those with and without confirmed or probable COVID-19, there were no statistically significant differences in age, gender, race or ethnicity, underlying medical condition, dental practice type, dental specialty, or US Census Bureau division (all χ^2 $P > .2$). Given the limitations of antibody tests currently available in the United States,[19] a sensitivity analysis was conducted that excluded COVID-19 cases confirmed with antibody tests only. This analysis similarly found no statistically significant associations with age, gender, race or ethnicity, dental practice type, dental specialty, or US Census Bureau division (all χ^2 $P > .2$). However, there was a statistically significant association between antigen or viral confirmed or health care provider—suspected COVID-19 cases and patient-reported immunocompromised status. Specifically, 0.9% (n = 17) of COVID-19 negative dentists were immunocompromised compared with 6.3% (n = 1) of COVID-19 positive dentists (χ^2 $P = .02$).

DISCUSSION

Our study is the first to our knowledge to estimate SARS-CoV-2 infections in the US dental community and to assess the dental-related infection prevention and control efforts of dentists. In addition, this description of US dentists' dental practices and PPE use at 1 point can be useful to future understanding of the dental response to the pandemic and to assessing the results of future surveillance for COVID-19 prevalence. We estimated the infection rate of SARS-CoV-2 in US dentists. As of June 2020, an estimated 0.9% (95% confidence interval, 0.5 to 1.5) of US dentists have or have had COVID-19. This is similar to infection rates reported in health care workers in the Netherlands (0.9%)[20] and China (1.1%),[21] but lower than the rate in Seattle, Washington (5.3%).[22] Furthermore, in our sample, 3.7% of nasal or throat swabs tested positive, which is lower than the 10.3% positivity in respiratory specimens from the broader US population from March 1, 2020 through June 13, 2020.[23] This might reflect the higher socioeconomic status of many dentists and their subsequent ability to use social distancing and mitigate viral exposure.

The responses to our survey indicated that 99.7% of dental offices were using enhanced infection protection and control practices and many had also adopted advanced PPE. The reports from dentists of mask reuse or combined use of surgical masks and respirators might reflect the current CDC guidance regarding optimization of PPE due to supply issues.[8] As of June 29, 2020, patient volume in dental practices nationwide was estimated to be 70% of pre—COVID-19 levels, and it has been increasing steadily.[11] Use of disposable products for PPE and infection control might increase if patient volume increases, which could result in scarcity or alteration of practices within dental offices based on availability. In addition, changes in local and regional ordinances and infection rates might also alter practices within dental offices moving forward, particularly as COVID-19 cases resurge in many states.[24]

Although there were no significant demographic differences between COVID-19—negative and confirmed or probable cases, the COVID-19—positive group included more immunocompromised people. This relationship might reflect greater susceptibility in those people, a higher level of surveillance due to concern about underlying immune dysfunction, or the underlying mechanisms of viral binding and entry into host cells via angiotensin-converting enzyme 2.[25] Angiotensin-converting enzyme 2 is upregulated in the presence of certain systemic diseases.

To our knowledge, this is the first large-scale report of data surveilling rates of COVID-19 and concomitant infection protection and control practices among US dentists. The sample was generally representative of US dentists and large enough to allow for analysis of subgroups of interest. There are, however, limitations to these findings. The survey response rate of 40.1% was higher than the mean e-mail survey response rate of 24.0%,[26] but nonrespondents might differ from respondents, which can reduce the validity and generalizability of these results. The survey sample might also be subject to selection bias, leading to an underestimation of COVID-19 prevalence or severity because dentists who have died or been hospitalized with COVID-19, for example, cannot or might be less likely to participate. Due to the limited availability of COVID-19 tests in the United States,[27] it is possible respondents had

limited access to COVID-19 testing and might have had undiagnosed infections. Furthermore, these findings are only as accurate as the COVID-19 tests and diagnoses themselves, which can be subject to false-negative and false-positive results.[28] There might be recall bias in the questions that asked about activities and symptoms in the past month. It is likely that respondents reported higher levels of social distancing and infection prevention and control compliance due to social desirability bias and unrecognized lapses in PPE usage. These cross-sectional data were also limited in that the timing of known SARS-CoV-2 infections in this survey sample precluded testing for associations with symptoms, activities, or infection prevention and control efforts.

Given that there is known community transmission of COVID-19, dentists might acquire COVID-19 in the community and outside of the delivery of oral health care. We attempted to use reports of contact tracing and infection timing to ascertain whether dentists were at increased infection risk owing to dental practice activities. The probable source of infection was not identified for most dentists in this sample (75.0% [n = 15]); for the remainder, contact tracing indicated community transmission. It should also be noted that disease spread during nonclinical activities within the dental office is also a potential transmission route and should be probed. In response to the COVID-19 pandemic, in March 2020 the CDC and ADA recommended that dentists postpone elective procedures.[8,29] Subsequently, the number of dental patients seen and procedures conducted in the United States dropped.[11] In this survey sample, 75.0% (n = 15) of dentists with presumed or confirmed COVID-19 tested positive in March or April, when 95% of US dental practices were closed or provided only emergency oral health care.[11] Subsequent surveys sent to the cohort described in our study will continue to collect COVID-19 test results, symptoms, activities, and infection prevention and control efforts in dental practices. Future research in this cohort might therefore be able to estimate COVID-19 incidence, as well as associations with dental activities and infection prevention or control efforts.

CONCLUSIONS

This survey was conducted to initiate surveillance of licensed, practicing dentists and public health dentists to determine the prevalence of COVID-19 before June 12, 2020, as well as the behavioral and infection control and prevention practices of dentists from May 8, 2020 through June 12, 2020. To our knowledge, this is the first study to estimate the prevalence of COVID-19 among US dentists. For this sample of dentists, the weighted prevalence of COVID-19 was 0.9%. Among the tested respiratory samples, 3.7% had positive results. These rates support that use of the CDC's currently recommended infection prevention and control procedures in dental offices will contribute to the reduced risk of developing infection during the delivery of oral health care, and risks associated with nonclinical activities and community spread might pose the most substantial risks for the exposure of dentists to COVID-19. Future investigations will assess ongoing rates of COVID-19 for US dentists and can assess modifiable risk factors for SARS-CoV-2 transmission and development of COVID-19 disease, in addition to defining incidence rates of disease. ■

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at https://doi.org/10.1016/j.adaj.2020.09.005.

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