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Veterinarian COVID-19 vaccine uptake was widespread, but safety and efficacy concerns held some back: descriptive results from a survey of AVMA members' perceptions of COVID-19

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OBJECTIVE
Assess COVID-19 vaccine uptake among veterinarians and describe unvaccinated veterinarians' perceptions of COVID-19 disease and vaccines.

SAMPLE
2,721 (14%) of 19,654 randomly sampled AVMA members.

PROCEDURES
A survey of AVMA members was conducted between June 8 and June 18, 2021. Information was collected on COVID-19 experience, vaccination intention, and perceptions of COVID-19 disease and vaccines.

RESULTS
A total of 2,721 AVMA members completed the survey. Most respondents reported receiving a COVID-19 vaccine (89% [2,428/2,721]). Most unvaccinated respondents disagreed with concerns about contracting (67% [196/292]) or being harmed by (65% [187/287]) COVID-19 but agreed with concerns about short- (79% [228/290]) and long-term (89% [258/289]) side effects of COVID-19 vaccines. Over 91% (268/292) did not agree that COVID-19 vaccine benefits outweigh the risk. Although 83% (244/293) of unvaccinated respondents reported being unlikely to get a COVID-19 vaccine, 47% (137/291) agreed they would be more likely if they knew people vaccinated without serious side effects. Perceptions of COVID-19 disease severity and susceptibility, beliefs about COVID-19 vaccine benefits, and barriers and facilitators to COVID-19 vaccination varied with vaccination intention.

CLINICAL RELEVANCE
Results of the AVMA survey suggested that COVID-19 vaccination was widespread among veterinarians in June 2021. Understanding unvaccinated respondents' health beliefs about COVID-19 and COVID-19 vaccines may facilitate veterinarian vaccination participation. Veterinarians who abstained from COVID-19 vaccination cited concerns about the safety, efficacy, and necessity of COVID-19 vaccines. Our results suggested that demonstrating vaccine safety and a favorable risk-to-benefit ratio of vaccination may help reduce vaccine hesitancy and increase uptake of COVID-19 vaccines among veterinarians.

On March 11, 2020, the WHO declared a pandemic because of the international transmission of SARS-CoV-2, the virus that causes COVID-19. On March 13, 2020, the US declared COVID-19 a national emergency. Since veterinarians provide essential services, veterinary practices were able to continue to operate at the beginning of the pandemic despite stay-at-home orders issued in many states,[1] but COVID-19 drastically changed how veterinary practices provided services to the public. In addition to adopting masking, social distancing, and isolation and quarantine recommendations in the spring of 2020, most veterinary practices transitioned to curbside care, cohorted staff, and increased sanitization procedures and use of personal protective equipment as methods for controlling the spread of SARS-CoV-2.[2,3] Despite these COVID-19 safety protocols, veterinary practices still experienced veterinary team member shortages because of COVID-19 exposures and illnesses, which further impacted the availability and efficiency of services veterinary practices could deliver.

Emerging infectious diseases have significant economic and public health impacts,[4] and approximately 75% of emerging infectious diseases are zoo-

notic.[5] Veterinarians work to prevent and control infectious and zoonotic diseases using multiple tools, including vaccines. Veterinary vaccines not only protect animal health and improve animal welfare, but also protect human health at the animal-human interface where infectious diseases are at high risk of transmission between animal and human populations.[6] In addition to protecting their patients from infectious and zoonotic diseases, including SARS-CoV-2, veterinarians need to remember to protect themselves by wearing personal protective equipment, such as gloves and respirators, and practicing good hand hygiene.[7] For some zoonotic diseases (eg, rabies, influenza), human vaccines are available and recommended for veterinarians. COVID-19 prevention and control also leverage the following tools for humans: social distancing, frequent handwashing, wearing a mask, and being up-to-date on COVID-19 vaccines. These prevention steps not only protect individuals from disease—including, in the case of vaccines, reducing disease severity—but also reduce the spread of SARS-CoV-2 within human communities and are helping the country recover from the pandemic.[8,9]

In partnership with the US Government, 3 pharmaceutical companies focused on developing, manufacturing, and distributing COVID-19 vaccines.[10] In December 2020, the Pfizer-BioNTech COVID-19 vaccine and Moderna COVID-19 vaccine were the first vaccines to receive an emergency use authorization from the FDA.[11,12] By May 2021, COVID-19 vaccines became widely available for individuals 18 and older throughout the US, yet public response to these novel vaccines was varied. Some individuals rushed to obtain a COVID-19 vaccine, whereas others were more hesitant. Since individual attitudes toward and beliefs about COVID-19 disease and vaccines can influence vaccine uptake, it is important to assess what perceptions may be contributing to COVID-19 vaccine hesitancy. Assessing how beliefs may impact a decision to seek vaccination can inform strategies aimed at addressing vaccine hesitancy. Individuals' engagement in health-promoting behaviors (such as COVID-19 vaccination) is a product of their beliefs about the health problem, perceptions of the benefits of actions to prevent or reduce the health problem, perceived barriers to taking action, and assessment of their own ability to successfully take action. In other words, the likelihood an individual will adopt a specific health behavior is determined by their belief that they are at personal risk for disease or injury (eg, severe COVID-19 illness) coupled with the perception that a particular action or intervention (eg, COVID-19 vaccines, social distancing, masking) will protect them.[13,14]

Furthermore, several studies highlight how veterinarians are important leaders in their community and suggest their attitudes about SARS-CoV-2 and COVID-19 vaccines might substantively impact related perceptions, beliefs, and behaviors in their practices and surrounding communities. US surveys have indicated veterinarians are among the most respected professionals, especially by US residents who own animals.[15,16] In a 2006 study,[14] veterinarians ranked higher than physicians with regard to compassion, honesty, and trustworthiness. A 2019 survey[15] that compared the US public's perception of physicians with their perception veterinarians indicated the public believed veterinarians were more approachable, sympathetic, sensitive, respectful, and competent than physicians.[15] Results of the same survey revealed the public perceived veterinarians to be as scientific as physicians. Therefore, the objective of this study was to assess COVID-19 vaccine uptake among veterinarians and describe unvaccinated veterinarians' perceptions of COVID-19 disease and vaccine. Understanding veterinarians' perceptions of COVID-19 will help those working in public health address concerns around COVID-19 vaccines and, potentially, improve community COVID-19 vaccination rates. Because approximately 75% of veterinarians in the US are members of the AVMA, we surveyed AVMA members about their perceptions of SARS-CoV-2 and COVID-19 vaccines.

Materials and Methods

Study design and procedure

The AVMA leads the veterinary profession by advocating for its members and advancing the science and practice of veterinary medicine to improve animal and human health.[17] A cross-sectional, confidential, web-based survey was administered to understand veterinarians' perceptions of COVID-19 disease and COVID-19 vaccines. Survey software (Qualtrics version June 2021; Qualtrics International Inc) was used to collect data between June 8 and June 18, 2021. The 2020–2021 AVMA president sent an email with a survey link and a recruitment letter to 20,000 randomly selected AVMA members who live in the US. The survey was successfully delivered to 19,654 recipients. The survey consisted of questions that assessed informants' COVID-19 experience and vaccination intention, perceptions of COVID-19 disease and COVID-19 vaccines, perceptions of coworkers' behaviors and workplace practices, and individual demographics. Participation in the survey was completely voluntary; respondents could choose to exit the survey at any time. Only finished surveys were included in the analysis, but respondents were not required to answer all questions, and some items were skipped by some participants. All respondents received questions about COVID-19 experience, vaccination intention, and demographics. To minimize time demands and survey fatigue, veterinarians vaccinated for COVID-19 (*vaccinated veterinarians*) were not presented with questions regarding perceptions of COVID-19 disease or vaccines. Only veterinarians who had not received a COVID-19 vaccine injection at the time of the survey (*unvaccinated veterinarians*) were presented with these items.

Instruments

The survey instrument was developed and distributed collaboratively by the CDC and the AVMA **(Supplementary Appendix S1)**.

COVID-19 experience and vaccination intent—*COVID-19 experience* was measured with the item "Have you ever had COVID-19?" Response options included "yes," "no," and "uncertain or maybe."

COVID-19 vaccination status was measured with the item "Have you received a COVID-19 vaccine?" Response options included "yes" and "no." Respondents who indicated "yes" were immediately directed to the demographic questions. Respondents who answered "no" received additional questions regarding their vaccination intentions and perceptions of COVID-19 disease and vaccines before being directed to the demographic questions.

COVID-19 vaccination intent was measured with the item "How likely are you to get a COVID-19 vaccine?" Response options followed a 5-point Likert scale that ranged from "highly unlikely" to "highly likely."

Health beliefs: perceptions of COVID-19 disease and vaccines—The health belief model was used to frame questions to unvaccinated survey respondents about their perceptions of COVID-19 and available vaccines. The health belief model is one of the most widely recognized social psychological health behavior change models. It is commonly used to assess variance between individual perceptions and explain and predict engagement in health-related behaviors, such as vaccine participation.[13,14] In alignment with the model, the following health beliefs were measured with a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Assessing variance in respondents' health beliefs (ie, perceptions) about COVID-19 disease and vaccines in this way facilitates clearer understanding of the intricacies of the factors that may motivate or demotivate COVID-19 vaccine uptake.

Perceived severity is an individual's assessment of the seriousness of infection or injury and negative effects of becoming injured or ill. Perceived severity of COVID-19 was measured with the item "I am concerned COVID-19 would harm me."

Perceived susceptibility refers to beliefs that one is vulnerable to infection or injury. Perceived susceptibility to COVID-19 was measured with the items "I am concerned about catching COVID-19" and "I am concerned that my job or workplace puts me at risk for getting COVID-19."

Perceived benefits are one's beliefs that a health behavior (eg, getting a COVID-19 vaccine) will confer positive outcomes for preventing or reducing severity of illness or injury. Perceived benefits of COVID-19 vaccines were measured with 5 items. An example item is "Vaccination will protect me against getting COVID-19."

Perceived barriers refer to beliefs that a health behavior is restricted due to psychosocial, physical, or financial constraints. Perceived barriers to receiving a COVID-19 vaccine were measured with 7 Likert-style items (eg, "I am concerned about missing work after getting a COVID-19 vaccine" and "I am concerned about short-term negative COVID-19 vaccine side effects"). An additional free response item invited respondents to explain any other factors that would prevent or make it difficult for them to be vaccinated against COVID-19.

Cues to action include the motivating factors, such as people or events, that prompt an individual to adopt a particular health behavior or intervention. Six cues to action selected by the survey developers were measured. An example is "I would be more likely to get the COVID-19 vaccine if I could get paid time off to get the COVID-19 vaccine."

Workplace practices—*Employer encouragement of vaccination* was measured with the item "How is your practice/office encouraging COVID-19 vaccination?" Select-all-that-apply response options included "Making vaccination mandatory to return to work," "Giving paid time off to get the vaccine," "Sharing information about how and where to get the vaccine locally," "Helping staff book appointments," "Other: please specify," "I don't know," and "They aren't encouraging COVID-19 vaccination."

Perceptions of coworker behavior were measured with 2 items: "How many of your colleagues have received the vaccine or have scheduled an appointment to get the vaccine?" and "Why do you think some of your coworkers have not been vaccinated?" Select-all-that-apply response options included "inconvenience of scheduling a vaccine appointment," "inconvenience of vaccine site locations," "concerns about getting or taking time off to get the vaccine," "worries about taking time off due to bad short-term side effects," "concerns about long-term side effects," "uncertainty about how the COVID-19 vaccine works to induce immunity," "moral, religious, or ethical objections to vaccination," "other," and "not applicable."

Demographics—Individual demographic variables included age, race/ethnicity, gender, and employment type or status. For employment information, AVMA survey participants were asked to select from a list of employment types, which included academia, clinical practice, government, industry/commercial, nonprofit, other, nonveterinary employment, retired, not employed, and rather not say. Organizational demographic variables included size (ie, number of veterinarians and nonveterinarians working in the clinic), geographic area (rural, suburban, urban), and primary species-type served.

Statistical analysis

A minimum sample size of 150 respondents was determined a priori to be representative of the overall population of AVMA members. This estimate was calculated with a 95% confidence level, 5% SE, and 11% population proportion based on the mean response rate of previous AVMA membership surveys.

Descriptive statistics for demographic and COVID-19 perception items were analyzed survey software (Qualtrics version June 2021; Qualtrics International Inc). To simplify presentation of results, participant responses were compressed from the original 5-point scale to 3 response categories: (1) disagree (an aggregate of "disagree" and "strongly disagree" response options), (2) neutral, and (3) agree (an aggregate of "agree" and "strongly agree" response options). Cross-tabulation of results was used to help identify trends among region, employment type,

species category, age, and sex demographics. This activity was reviewed by the CDC and was consistent with applicable federal law and CDC policy.[18–22]

Results

Study demographics

A total of 2,721 AVMA members submitted survey responses, rendering a response rate of 14% (2,721/19,654). Demographic data were collected from all survey participants **(Table 1)**. Of the respondents, 73% (1,998/2,721) reported being female and 27% (721/2,721) reported being male. The majority of respondents were white (88% [2,385/2,717]). The median age of respondents was 47 years.

The majority of AVMA survey respondents worked in clinical practice (83% [2,248/2,721]), most often with companion animals (80% [2,109/2,633]; Table 1). More than half of the AVMA survey respondents worked in a place of employment with 2 to 5 other veterinarians (54% [1,403/2,590]), and almost half worked in a place of employment with 11 to 50 other nonveterinarian employees (49% [1,256/2,562]). Most survey respondents practiced in suburban communities (55% [1,487/2,716]), followed by rural (23% [632/2,716]) and urban (22% [597/2,716]) areas. The majority of the respondents were in the South (37% [1,003/2,721]) region of the US.

COVID-19 experience and vaccination intent

Of the AVMA survey respondents, 22% (588/2,719) reported a confirmed or possible infection with SARs-CoV-2. Most respondents (89% [2,428/2,721]) reported receiving an available COVID-19 vaccine **(Table 2)**. Of the 293 (11% [293/2,721]) AVMA survey respondents who reported not receiving a COVID-19 vaccine (*unvaccinated respondents*), 83% (244/293) indicated they were unlikely or highly unlikely to seek vaccination.

Unvaccinated AVMA survey respondents' perceptions of COVID-19 severity and susceptibility

Of the AVMA survey respondents who reported not receiving a COVID-19 vaccine, 67% (196/292) reported they disagreed or strongly disagreed with the statement "I am concerned about catching COVID-19" **(Table 3)**. Similarly, 64% (187/292) of

Table 1—Results of demographic variables reported by 2,721 AVMA members in a confidential online survey to gather veterinarian perceptions of COVID-19 vaccines during June 8 through June 18, 2021.

Demographic characteristics	Vaccinated N (%)	Unvaccinated N (%)	Total N (%)
Age (y)	2,402 (89)	292 (11)	**2,694 (100)**
< 30	166 (90)	19 (10)	**185 (7)**
30–39	614 (90)	71 (10)	**685 (25)**
40–49	565 (89)	71 (11)	**636 (24)**
50–59	536 (87)	79 (13)	**615 (23)**
60+	521 (91)	52 (9)	**573 (21)**
Race/ethnicity	2,425 (89)	292 (11)	**2,717 (100)**
White/Caucasian	2,159 (91)	226 (9)	**2,385 (88)**
Black/African American	26 (96)	1 (4)	**27 (1)**
Hispanic/Latino/Spanish	71 (96)	3 (4)	**74 (3)**
Asian	47 (98)	1 (2)	**48 (2)**
Multiracial/ethnic	41 (89)	5 (11)	**46 (2)**
Prefer not to answer	72 (58)	53 (42)	**125 (5)**
Employment type	2,428 (89)	293 (11)	**2,721 (100)**
Clinical practice	1,978 (88)	270 (12)	**2,248 (83)**
Academia	156 (98)	4 (3)	**160 (6)**
Government	60 (95)	3 (5)	**63 (2)**
Industry/commercial	79 (96)	3 (4)	**82 (3)**
Nonprofit organization	63 (97)	2 (3)	**65 (2)**
Other*	32 (94)	2 (6)	**34 (1)**
Retired	57 (92)	5 (8)	**62 (2)**
Prefer not to answer	3 (43)	4 (57)	**7 (0)**
Species category	2,349 (89)	284 (11)	**2,633 (100)**
Companion animals	1,906 (90)	203 (10)	**2,109 (80)**
Equine	73 (85)	13 (15)	**86 (3)**
Food animal	76 (84)	14 (16)	**90 (3)**
Mixed animal	152 (76)	48 (24)	**200 (8)**
Lab animal	57 (98)	1 (2)	**58 (2)**
Zoo or wildlife	24 (96)	1 (4)	**25 (1)**
Other	26 (100)	0 (0)	**26 (1)**
No species contact	34 (97)	1 (3)	**35 (1)**
Prefer not to answer	1 (25)	3 (75)	**4 (0)**
US regions	2,428 (89)	293 (11)	**2,721 (100)**
Northeast	369 (15)	27 (9)	**396 (14)**
Midwest	615 (25)	91 (31)	**706 (26)**
South	872 (36)	131 (45)	**1,003 (37)**
West	572 (24)	44 (15)	**616 (23)**

*Includes veterinarians in nonveterinary employment and those not employed.

Table 2—Distribution of COVID-19 infection history by COVID-19 vaccination status and vaccination intent for 2,719 AVMA respondents from the survey described in Table 1.

	COVID-19 history			
Variables	**Uninfected N (%)**	**Infected N (%)**	**Uncertain N (%)**	**Total N (%)**
Vaccination status	2,131 (78)	311 (11)	277 (10)	**2,719 (100)**
Vaccinated	2,013 (83)	218 (9)	196 (8)	**2,427 (89)**
Unvaccinated	118 (40)	93 (32)	81 (28)	**292 (11)**
Vaccination intent	118 (40)	93 (32)	81 (28)	**292 (100)**
Likely to vaccinate	17 (46)	15 (41)	5 (14)	**37 (13)**
Uncertain	5 (42)	4 (33)	3 (25)	**12 (4)**
Unlikely to vaccinate	96 (40)	74 (30)	73 (30)	**243 (83)**

Table 3—Results of health belief questions for perceived COVID-19 susceptibility and severity in unvaccinated AVMA respondents from the survey described in Table 1

Perceived susceptibility and severity	**Disagree N (%)**	**Agree N (%)**	**Uncertain N (%)**	**Total N (%)**
I am concerned about catching COVID-19.	196 (67)	42 (14)	54 (18)	**292 (100)**
Intent				
Likely to vaccinate	19 (53)	14 (39)	3 (8)	**36 (12)**
Uncertain	4 (33)	4 (33)	4 (33)	**12 (4)**
Unlikely to vaccinate	173 (71)	24 (10)	47 (19)	**244 (84)**
I am concerned that my job or workplace puts me at risk for getting COVID-19.	187 (64)	53 (18)	52 (18)	**292 (100)**
Intent				
Likely to vaccinate	10 (28)	19 (53)	7 (19)	**36 (12)**
Uncertain	2 (17)	3 (25)	7 (58)	**12 (4)**
Unlikely to vaccinate	175 (72)	31 (13)	38 (16)	**244 (84)**
I am concerned that COVID-19 would harm me.	187 (65)	35 (12)	65 (23)	**287 (100)**
Intent				
Likely to vaccinate	17 (49)	13 (37)	5 (14)	**35 (12)**
Uncertain	5 (42)	0 (0)	7 (58)	**12 (4)**
Unlikely to vaccinate	165 (69)	22 (9)	53 (22)	**240 (84)**

unvaccinated respondents reported they disagreed or strongly disagreed that their workplace puts them at risk for becoming infected with COVID-19. Nearly two-thirds of unvaccinated respondents (65% [187/287]) indicated they disagreed or strongly disagreed with the statement "I am concerned that COVID-19 would harm me."

Unvaccinated AVMA survey respondents' perceptions of COVID-19 vaccine benefits

Unvaccinated respondents generally disagreed or strongly disagreed with 5 potential benefits of COVID-19 vaccines **(Table 4)**. Most unvaccinated respondents disagreed or strongly disagreed that vaccination is necessary to do their job safely (90% [263/293]) and that they would feel safer at work if everyone in their workplace was vaccinated against COVID-19 (82% [238/291]). Most unvaccinated respondents disagreed or strongly disagreed that the benefits of the COVID-19 vaccine outweighed its risks (73% [214/292]). These beliefs were especially prevalent among respondents who reported being unlikely or extremely unlikely to become vaccinated. For example, 81% (198/243) of respondents who were unlikely to become vaccinated disagreed or strongly disagreed that the benefits of the COVID-19 vaccine outweigh the risk, whereas only 22% (8/37) of respondents who were likely to obtain a COVID-19 vaccine disagreed or strongly disagreed with this statement. Instead, 41% (15/37) of respondents who were likely to get vaccinated agreed or strongly agreed that the benefits of vaccination outweigh the risks.

Compared with other vaccination benefits, agreement with and uncertainty about the protective quality of COVID-19 vaccines were higher among unvaccinated respondents (Table 4). Although most unvaccinated respondents disagreed or strongly disagreed that vaccination would protect them from contracting or spreading COVID-19, approximately one-third were uncertain, and approximately one fifth agreed or strongly agreed with these concerns. Specifically, 31% (90/292) and 33% (95/290) of unvaccinated respondents reported being uncertain that vaccines would protect against contracting or spreading COVID-19, respectively. Furthermore, 24% (71/292) and 18% (52/290) of respondents agreed that vaccines would protect against contracting and spreading COVID-19, respectively. These general trends were observed regardless of vaccination intent.

Table 4—Results of health belief questions for perceived benefits to COVID-19 vaccine in unvaccinated AVMA respondents from the survey described in Table 1.

Perceived benefits of COVID-19 vaccine	Disagree N (%)	Agree N (%)	Uncertain N (%)	Total N (%)
Vaccination will protect me against getting COVID-19.	131 (45)	71 (24)	90 (31)	**292 (100)**
Intent				
Likely to vaccinate	5 (14)	25 (68)	7 (19)	**37 (13)**
Uncertain	1 (8)	4 (33)	7 (58)	**12 (4)**
Unlikely to vaccinate	125 (51)	42 (17)	76 (31)	**243 (83)**
Vaccination will prevent me from spreading COVID-19 to others.	143 (49)	52 (18)	95 (33)	**290 (100)**
Intent				
Likely to vaccinate	9 (24)	20 (54)	8 (22)	**37 (13)**
Uncertain	1 (8)	6 (50)	5 (42)	**12 (4)**
Unlikely to vaccinate	133 (55)	26 (11)	82 (34)	**241 (83)**
It is necessary for me to be vaccinated against COVID-19 in order to do my job safely.	263 (90)	13 (4)	17 (6)	**293 (100)**
Intent				
Likely to vaccinate	18 (49)	11 (30)	8 (22)	**37 (13)**
Uncertain	11 (92)	0 (0)	1 (8)	**12 (4)**
Unlikely to vaccinate	234 (96)	2 (1)	8 (3)	**244 (83)**
I would feel safer if everyone in my workplace was vaccinated against COVID-19.	238 (82)	23 (8)	30 (10)	**291 (100)**
Intent				
Likely to vaccinate	14 (38)	16 (43)	7 (19)	**37 (13)**
Uncertain	9 (75)	0 (0)	3 (25)	**12 (4)**
Unlikely to vaccinate	215 (89)	7 (3)	20 (8)	**242 (83)**
I believe the benefits of the COVID-19 vaccine outweigh the risks.	214 (73)	24 (8)	54 (19)	**292 (100)**
Intent				
Likely to vaccinate	8 (22)	15 (41)	14 (38)	**37 (13)**
Uncertain	8 (67)	1 (8)	3 (25)	**12 (4)**
Unlikely to vaccinate	198 (81)	8 (3)	37 (15)	**243 (83)**

Unvaccinated AVMA survey respondents' perceptions of barriers to COVID-19 vaccination

Risk concerns were the largest barriers to COVID-19 vaccination **(Table 5)**. Most unvaccinated respondents agreed or strongly agreed that they were concerned about the potential short-term (79% [228/290]) and long-term (89% [258/289]) adverse effects of COVID-19 vaccines. Moreover, 42% (120/283) agreed or strongly agreed that they were concerned about getting the COVID-19 vaccine while pregnant, breast feeding, or trying to get pregnant. These trends were similar regardless of vaccination intent.

Unvaccinated respondents generally did not perceive convenience factors to be barriers to vaccination (Table 5). More than half (67% [195/290]) agreed or strongly agreed that it would be convenient to travel to a COVID-19 vaccination site. Most (75% [217/288]) unvaccinated respondents disagreed or strongly disagreed with being concerned about being able to take time off work to get the COVID-19 vaccine. However, only 44% (127/288) disagreed or strongly disagreed with being concerned about missing work after getting a COVID-19 vaccine.

Written comments indicated that barriers to COVID-19 vaccination included (1) concerns about how the vaccine may interfere with pregnancy, breast feeding, and fetal and infant health; (2) a desire for more safety evidence of the vaccines; (3) a sense of antibody protection from previous COVID-19 exposure; (4) a belief of being at low risk for becoming severely ill from COVID-19 disease; and (5) underlying health conditions that prevent vaccination.

Unvaccinated AVMA survey respondents' perceptions of COVID-19 vaccination cues to action

The 2 most motivating cues to action measured in the AVMA COVID-19 vaccination survey involved personal connections: knowing vaccinated individuals and health-care provider recommendations **(Table 6)**. Regardless of vaccination intent, the most powerful motivating factor was knowing safely vaccinated individuals. Forty-seven percent (47% [137/291]) of unvaccinated respondents agreed or strongly agreed that they would be more likely to get a COVID-19 vaccine if they personally knew people who were vaccinated without serious side effects. Though agreement with this statement was strongest among respondents who were likely to get vaccinated (76% [28/37]), 42% (102/242) of respondents who were unlikely to get vaccinated also agreed or strongly agreed.

Forty-nine percent (141/289) of unvaccinated respondents disagreed or strongly disagreed that they would be more likely to get a COVID-19 vaccine

Table 5—Results of health belief questions for perceived barriers to COVID-19 vaccine in unvaccinated AVMA respondents from the survey described in Table 1.

Perceived barriers to COVID-19 vaccine	Disagree N (%)	Agree N (%)	Uncertain N (%)	Total N (%)
It is convenient for me to get to a COVID-19 vaccine site.	29 (10)	195 (67)	66 (23)	**290 (100)**
Intent				
Likely to vaccinate	6 (16)	23 (62)	8 (22)	**37 (13)**
Uncertain	1 (8)	9 (75)	2 (17)	**12 (4)**
Unlikely to vaccinate	22 (9)	163 (68)	56 (23)	**241 (83)**
I am concerned about being able to take time off work to get the COVID-19 vaccine.	217 (75)	37 (13)	34 (12)	**288 (100)**
Intent				
Likely to vaccinate	20 (56)	11 (31)	5 (14)	**36 (13)**
Uncertain	8 (73)	3 (27)	0 (0)	**11 (4)**
Unlikely to vaccinate	189 (78)	23 (10)	29 (12)	**241 (84)**
I am concerned about missing work after getting a COVID-19 vaccine.	127 (44)	116 (40)	45 (16)	**288 (100)**
Intent				
Likely to vaccinate	9 (24)	22 (59)	6 (16)	**37 (13)**
Uncertain	2 (17)	7 (58)	3 (25)	**12 (4)**
Unlikely to vaccinate	116 (49)	87 (36)	36 (15)	**239 (83)**
I am concerned about short-term negative COVID-19 vaccine side effects.	35 (12)	228 (79)	27 (9)	**290 (100)**
Intent				
Likely to vaccinate	3 (8)	28 (76)	6 (16)	**37 (13)**
Uncertain	2 (17)	7 (58)	3 (25)	**12 (4)**
Unlikely to vaccinate	30 (12)	193 (80)	18 (7)	**241 (83)**
I am concerned about long-term negative COVID-19 vaccine side effects.	17 (6)	258 (89)	14 (5)	**289 (100)**
Intent				
Likely to vaccinate	5 (14)	29 (78)	3 (8)	**37 (13)**
Uncertain	1 (8)	9 (75)	2 (17)	**12 (4)**
Unlikely to vaccinate	11 (5)	220 (92)	9 (4)	**240 (83)**
I have ethical, moral, and/or religious concerns about vaccinations.	145 (50)	78 (27)	67 (23)	**290 (100)**
Intent				
Likely to vaccinate	29 (78)	8 (22)	0 (0)	**37 (13)**
Uncertain	8 (67)	2 (17)	2 (17)	**12 (4)**
Unlikely to vaccinate	108 (45)	68 (28)	65 (27)	**241 (83)**
I am concerned about getting a COVID-19 vaccine while pregnant, breast feeding, or trying to get pregnant.	53 (19)	120 (42)	110 (39)	**283 (100)**
Intent				
Likely to vaccinate	8 (23)	16 (46)	11 (31)	**35 (12)**
Uncertain	1 (8)	5 (42)	6 (50)	**12 (4)**
Unlikely to vaccinate	44 (19)	99 (42)	93 (39)	**236 (83)**

if their health-care provider recommended one. The majority (55% [133/240]) of respondents who were unlikely to get vaccinated disagreed or strongly disagreed that they would be swayed by their health-care provider's recommendation, but 35% (85/240) indicated they were uncertain how a recommendation from their health-care provider would motivate them to get vaccinated. Of the respondents who were uncertain about getting vaccinated, 42% (5/12) agreed or strongly agreed that a health-care provider's recommendation would increase the likelihood they would get vaccinated (Table 6).

Unvaccinated respondents largely disagreed or strongly disagreed that employer cues to action such as paid time off (79% [230/291]) or employment requirements to be vaccinated (86% [249/291]) would motivate them to obtain a COVID-19 vaccination. Over 50% of unvaccinated respondents disagreed or strongly disagreed that their practice was encouraging employee vaccination against COVID-19 (54% [153/284]), and 61% (176/290) disagreed or strongly disagreed that being able to keep their practice open would increase the likelihood they would get a COVID-19 vaccine.

AVMA survey respondents' perceptions of coworkers' vaccination behavior

Approximately 59% (1,530/2,598) of AVMA survey respondents reported their coworkers had received or scheduled an appointment to receive a COVID-19 vaccine. Respondents most frequently reported believing that coworkers had not received the vaccine due to concerns about serious long-term side effects (59% [1,516/2,581]) and uncertainty about how the COVID-19 vaccine induces immunity (29% [751/2,581]).

Table 6—Results of health belief questions for cues to action or motivations to obtain a COVID-19 vaccine in unvaccinated AVMA respondents from the survey described in Table 1.

Cues to action or motivations to obtain a COVID-19 vaccine	Disagree N (%)	Agree N (%)	Uncertain N (%)	Total N (%)
I will be more likely to get a COVID-19 vaccine if I could get paid time if to get a vaccine.	230 (79)	27 (9)	34 (12)	**291 (100)**
Intent				
Likely to vaccinate	17 (46)	11 (30)	9 (24)	**37 (13)**
Uncertain	6 (50)	3 (25)	3 (25)	**12 (4)**
Unlikely to vaccinate	207 (86)	13 (5)	22 (9)	**242 (83)**
My practice/office could remain open for the time I get a vaccine.	176 (61)	58 (20)	56 (19)	**290 (100)**
Intent				
Likely to vaccinate	10 (27)	20 (54)	7 (19)	**37 (13)**
Uncertain	4 (33)	1 (8)	7 (58)	**12 (4)**
Unlikely to vaccinate	162 (67)	37 (15)	42 (17)	**241 (83)**
I personally know people who are vaccinated without serious side effects.	102 (35)	137 (47)	52 (18)	**291 (100)**
Intent				
Likely to vaccinate	5 (14)	28 (76)	4 (11)	**37 (13)**
Uncertain	0 (0)	7 (58)	5 (42)	**12 (4)**
Unlikely to vaccinate	97 (40)	102 (42)	43 (18)	**242 (83)**
My health-care provider recommends I get the vaccine.	141 (49)	45 (16)	103 (36)	**289 (100)**
Intent				
Likely to vaccinate	7 (19)	18 (49)	12 (32)	**37 (13)**
Uncertain	1 (8)	5 (42)	6 (50)	**12 (4)**
Unlikely to vaccinate	133 (55)	22 (9)	85 (35)	**240 (83)**
I know the vaccine will protect me for 1 year or more.	182 (63)	44 (15)	65 (22)	**291 (100)**
Intent				
Likely to vaccinate	7 (19)	19 (51)	11 (30)	**37 (13)**
Uncertain	1 (8)	6 (50)	5 (42)	**12 (4)**
Unlikely to vaccinate	174 (72)	19 (8)	49 (20)	**242 (83)**
My employer requires me to get vaccinated to be allowed to work.	249 (86)	17 (6)	25 (9)	**291 (100)**
Intent				
Likely to vaccinate	29 (78)	6 (16)	2 (5)	**37 (13)**
Uncertain	10 (83)	1 (8)	1 (8)	**12 (4)**
Unlikely to vaccinate	210 (87)	10 (4)	22 (9)	**242 (83)**

Discussion

Results indicated that 89% (2,428/2,721) of veterinarians who participated in the AVMA survey had received a COVID-19 vaccination at the time of the survey. This exceeded the rate of the general US population, which was 53% on June 18, 2021.[23] Most (83% [244/293]) unvaccinated AVMA survey respondents reported they were unlikely to get a COVID-19 vaccine in the future. Survey results suggested that concerns regarding the safety, efficacy, and necessity of receiving a COVID-19 vaccine may be among the primary factors influencing some veterinarians' decision not to seek vaccination against COVID-19.

Of the veterinarians who had not received a COVID-19 vaccine, the majority reported concerns related to short- and long-term safety. Almost 74% of unvaccinated AVMA survey respondents did not believe the benefits of COVID-19 vaccines outweighed the risks. However, 47% (137/291) of unvaccinated AVMA survey respondents agreed or strongly agreed that they would be more likely to be vaccinated against COVID-19 if they personally knew people who had been vaccinated without adverse side effects. Taken together, these findings suggested that unvaccinated veterinarians had concerns about the safety of COVID-19 vaccines, but for many, those concerns might be assuaged with more safety evidence. Additionally, many unvaccinated veterinarians were uncertain, disagreed, or strongly disagreed with the statements that COVID-19 vaccines will protect them from contracting or spreading the disease. Given this doubt, unvaccinated veterinarians may be unlikely to want to receive a vaccine that they perceive to be both ineffective and potentially unsafe. In free-response comments, some unvaccinated respondents cited preexisting or anticipated conditions (eg, pregnancy, breastfeeding, allergies to vaccine components) as reasons they were not vaccinated at the time of completing the survey. Others indicated they wanted more evidence supporting the safety and effectiveness of COVID-19 vaccines. Thus, the AVMA survey results suggested vaccine uptake might be improved among veterinarians by increasing vaccine confidence, specifically through hearing testaments from veterinarians who have already re-

ceived their COVID-19 vaccine. Vaccinated veterinarians could share their reason for getting vaccinated and their experience with doing so, and help address COVID-19 vaccine misinformation.

Perceived necessity was another barrier to vaccination against COVID-19 among veterinarians. Most (65% [187/287]) unvaccinated AVMA survey respondents did not believe that COVID-19 would seriously harm them should they become infected with the disease. Additionally, nearly 90% (263/293) of unvaccinated veterinarians did not view COVID-19 vaccines as necessary for them to practice safely, nor did most (82% [238/291]) indicate they would feel safer if everyone in their workplace were vaccinated. In written responses, some unvaccinated AVMA survey respondents commented about effectiveness of other COVID-19 precautions (eg, masking, social distancing) or previous infection with COVID-19; therefore, unvaccinated AVMA survey respondents may trust that other precautions or previous infection with COVID-19 were just as or even more effective in keeping them safe in the workplace. Their beliefs that COVID-19 vaccines were not needed, either because COVID-19 was unlikely to significantly harm them or because other precautions were effective at protecting against the spread of the disease, help to explain why 73% (214/292) of unvaccinated AVMA survey respondents did not believe the benefits of COVID-19 vaccines outweighed the risks.

Convenience and accessibility did not appear to be a significant barrier to COVID-19 vaccination among AVMA survey respondents. More than 67% (195/290) of unvaccinated veterinarians reported that it would be convenient for them to travel to a COVID-19 vaccination site. Unvaccinated survey respondents were split on concerns about missing work after receiving a COVID-19 vaccine; however, incentives such as paid time off and a guarantee that one's practice could remain open were not significant motivators for most. Even an employer's requirement that their employees be vaccinated was not a significant motivator, although the possibility that some unvaccinated veterinarians may be self-employed may help explain this finding.

This study had several limitations. First, completion was voluntary, which adds to the possibility of selection bias. We do not know why an AVMA member may have chosen to participate in our survey or not. With many surveys, those who take the time to respond are likely to have strong opinions; in this case, those opinions could be either for or against COVID-19 vaccination, which could result in overestimation or underestimation of the true prevalence of COVID-19 vaccine participation. Second, our survey results relied on self-reporting of COVID-19 vaccination status; therefore, we do not know if our survey results represent the true vaccination status of veterinarians in the US. However, the confidential and voluntary nature of the survey should limit social desirability bias, and lack of participation incentives would discourage disingenuous responses. Furthermore, our sample was sufficiently large to be representative of the overall population of AVMA members, and our results are consistent with those obtained when US primary health-care personnel and US dentists were surveyed about their COVID-19 vaccination status.[24,25] This suggests that our results should provide reliable information regarding the true vaccination status of veterinarians in the US. Third, the phrasing of our vaccination status question did not distinguish between whether veterinarians received a full or partial course of vaccine dosage. At the time of the survey, COVID-19 vaccines had only recently been made widely available to all US citizens, and it was possible that many respondents may have not yet had the opportunity to complete a full course of vaccination. The pressing objective was to identify barriers to COVID-19 vaccination participation and effective motivating factors. Fourth, we did not directly ask participants what factors were most influential in their decision to vaccinate. However, our measurement strategy affords a more nuanced understanding of the strength of respondents' perceptions of selected health beliefs; such an understanding facilitates better, more empathetic conversations about COVID-19 and more effective strategies for encouraging vaccine participation. Future research should therefore explore how selected health beliefs relate to vaccination intent and vaccine uptake. Fifth, we compressed our 5-point scale into 3 agreement categories. Although compressed scales reduce variance and statistical power in inferential statistical analysis, they facilitate digestibility of our descriptive results. Last, our survey was cross-sectional. Therefore, we are unable to evaluate causation or how health beliefs shift with changes in guidelines, vaccine booster recommendations, and new SARS-CoV-2 variants. It is possible that some respondents may have opted not to receive the vaccine after becoming infected with SARS-CoV-2; however, our data do not permit us to infer whether or how that impacted the decision to receive a COVID-19 vaccine.

In summary, as community leaders, veterinarians' beliefs and behaviors surrounding public health concerns such as COVID-19 may transfer to clients and veterinary staff. The results of this survey indicated that most AVMA survey respondents had received at least 1 dose of a COVID-19 vaccine, exceeding the vaccination rate for the general US population. Vaccine hesitancy among unvaccinated veterinarians may be largely driven by a lack of confidence in COVID-19 vaccine efficacy and safety. Surveys among human US health-care workers identified similar concerns among a small percentage of workers who were hesitant or unwilling to get the COVID-19 vaccine.[26,27] Insight from these findings can help set the direction for successfully responding to questions motivating vaccine participation among veterinarians. Doing so begins with recognizing that veterinarians have the medical knowledge and training to weigh the collective body of evidence surrounding COVID-19 vaccine safety and efficacy, and to express autonomy in choosing the risks they are willing to accept for themselves. Educational materials are needed to focus on the long-term safety of

COVID-19 vaccines, evidence underscoring the contrast in severe health consequences experienced by vaccinated and unvaccinated individuals who contract COVID-19, and the increased likelihood of contracting COVID-19 as new, more highly transmissible variants spread. These educational materials might help to reduce vaccine hesitancy among the small proportion of veterinarians who are not vaccinated.

Despite limitations, our survey results suggested that COVID-19 vaccination is widespread among US veterinarians. Veterinarians who have abstained from COVID-19 vaccination cite concerns regarding the short-and long-term safety and efficacy of COVID-19 vaccines. These individuals may be hesitant to participate in COVID-19 vaccination in the future unless they begin to perceive that vaccination benefits outweigh risks. Diminishing COVID-19 hesitancy and fostering additional uptake of COVID-19 vaccines among veterinarians will require demonstration of short- and long-term safety of these vaccines.

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Supplementary Materials

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