

Evaluating Use of Personal Protective Equipment by Veterinary Professionals Before and During  
the COVID-19 Pandemic

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**Abstract**

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**Introduction:** Infection control is important in the veterinary care setting due to the risk of zoonotic illness<sup>1-4</sup>, however research has consistently shown that veterinary workers tend to underestimate their risk and have lower rates of proper personal protective equipment (PPE) use<sup>5-9</sup>. The primary aim of this research was to investigate if the impacts of the COVID-19 pandemic changed PPE use in the veterinary industry, and investigate if other areas related to clinical veterinary work have been impacted.

**Methods:** Quantitative analysis of cross-sectional data from two separate studies recruiting veterinary workers in Washington state from 2019 (N=97) and 2021 (N=66), including a paired data set of 27 participants responding to both questionnaires was conducted using simple and paired T-testing and linear regression modeling.

**Results:** Findings suggest a broad trend toward a small increase in PPE use for most activities that present a risk for occupational zoonosis exposure, however results were generally not statistically significant. Other findings of interest include high rates of COVID-19 vaccination among veterinary workers (98.5% fully or partially vaccinated at time of questionnaire), high levels of difficulty in obtaining PPE (>56%) and re-use of masks and other PPE (40% and 26%, respectively) since March 2020, and high levels of reported career burnout (>70%) and poor mental health (17.5%).

Conclusion: Further research to understand the predictors of PPE use, impacts of PPE supply chain issues, and implications of psychosocial stress and burnout on occupational health and safety are needed in this population.

## Introduction

Veterinary professionals are at risk for a variety of occupational health and safety hazards. These include musculoskeletal injuries<sup>10,11</sup>, toxic exposures<sup>12</sup>, radiation exposures<sup>13-15</sup>, mental health stresses<sup>16-20</sup>, and exposure to infectious disease<sup>1-4</sup>. During routine work veterinarians are exposed to zoonotic pathogens, which are microbes that are transmissible between vertebrate animals and humans<sup>21</sup>. Fewer occupational health cases of infection compared to cases of musculoskeletal injury are reported in the veterinary industry, however many of these zoonotic diseases can have serious or even life-long impacts<sup>22,23</sup>. Commonly reported zoonotic infections include dermatophytosis, as well as pathogens with fecal-oral transmission such as *Salmonella* spp and *Campylobacter* spp<sup>11</sup>.

Infection prevention and control (IPC) protocols are instrumental in preventing hospital-acquired infections in patients and health care providers in both the human and veterinary medical fields. Human medicine has developed rigorously researched standards for IPCs with the aim to prevent illness in healthcare settings<sup>18</sup>. Numerous studies have shown that awareness of zoonotic risks among veterinary professionals is poor and compliance with recommendations for IPCs is low<sup>5-9</sup>. Research has indicated that factors affecting compliance with occupational safety programs are varied and complex, including gender differences<sup>6,24</sup>, personality traits<sup>25</sup>, workplace culture<sup>26</sup>, mental health and well-being<sup>27-29</sup>, and insufficient knowledge and training<sup>6</sup>.

Research investigating the use of personal protective equipment (PPE) among veterinary professionals has shown that historically correct usage has been limited and inconsistent<sup>6,7,9,15</sup>. Use of PPE is an important component of IPCs and a key factor for prevention of zoonotic disease transmission as well as protection from injury. It is important to gain a better understanding of the barriers and facilitators around PPE use in the veterinary industry, and how the COVID-19 pandemic might have introduced changes in perspective, hospital policies, and availability of PPE.

A cross-sectional survey was administered in September 2019 to a group of approximately 100 veterinarians in attendance at a Washington State Veterinary Medical

Association (WSVMA) Conference. This survey was a supplement to a study being conducted by the University of Washington Center for One Health Research and investigated occupational health behaviors among veterinarians and other veterinary staff. As this survey was conducted just a few months prior to the start of the COVID-19 pandemic and collected responses regarding PPE use and other occupational health concerns it provides a unique opportunity for comparison of perceptions and practices regarding occupational health risks prior to and after the impact of the COVID-19 pandemic.

Since the start of the COVID-19 pandemic PPE practices have changed dramatically among the general population and within the healthcare industry. The goal of this research is to use an expanded version of the 2019 survey to learn more about PPE usage for veterinarians and how it may have changed related to COVID-19 supply constraints and public perception shifts. Members of the 2019 group who responded to the previous survey were invited to respond to the current version, and an effort was also made to recruit from the larger WSVMA member audience as well.

The primary research aim was to investigate if the impacts of the COVID-19 pandemic changed PPE use in the veterinary industry, and investigate if other areas related to clinical veterinary work have been impacted. Quantitative analysis of survey information on PPE usage, knowledge of potential zoonotic and occupational health threats, and workplace policies relating to COVID-19 were performed. We provide a descriptive analysis of the results among all the survey responses, as well as comparative analysis of the subgroup that responded in both 2019 and 2022. This information can be used to develop improved protocols to reduce occupational risks, as well as to learn specific facilitators and barriers for PPE usage in the veterinary profession.

## **Methods**

### Study Design and Data Collection

A cross-sectional online survey was administered to veterinarians and other veterinary professionals in Washington State from December 2021 through March of 2022. Respondents for the survey were recruited from two different sources. First, the individuals who had participated

in the 2019 survey administered by the University of Washington Center for One Health Research at the September 2019 WSVMA Conference were contacted and asked to participate in this survey. Second, additional participants for the 2021 survey were recruited from the WSVMA membership via an embedded URL link in the December 2021 and January 2022 editions of the organization's e-newsletter. This study was approved by the Institutional Review Board (IRB) with a modification to the 2019 survey approval. People were incentivized to participate through a give-away of Amazon gift cards.

A total of 67 people responded to the 2021 survey (Figure 1). Of the 97 people who participated in the 2019 survey, two were lost to follow up without current contact information, and 27 out of the remaining 95 participants responded with a response rate of 28.4%. The WSVMA has a membership pool of approximately 1,900 individuals<sup>30</sup>. Therefore the 39 respondents for the 2021 survey who did not also participate in the 2019 survey represent a response rate of approximately 2% from this larger secondary recruitment source. The 2021 survey was primarily based on questions taken directly from the 2019 survey to allow for direct comparison of reported PPE use and handwashing. Additional questions related to workplace policies and stress related to the COVID-19 pandemic were also included.

### Data Analysis

Data analysis was performed using the R program open source statistical software (R Foundation for Statistical Computing, Vienna, Austria). Descriptive analysis regarding both the total 2019 survey population, the 2021 survey population, and the subgroup of participants who responded to both surveys was performed. Likert-scale questions regarding frequency of PPE usage for each activity were averaged for each individual with a scale from 1 to 5. The Likert-scale assigned a score of 1 for each activity that the individual answered they “always” use the stated type of PPE, and a score of 5 for “never” using that type of PPE for the given activity. Answers indicating “often”, “sometimes”, and “rarely” were scored as 2, 3, and 4, respectively. These average PPE scores were then used as the outcome for assessment of change over time (between Sept 2019 when the first survey was administered and Dec 2021-Mar 2022 when the second survey was given) by two-sided T-tests and assessment of general trends. The subgroup of 27 individuals with identified answers in both the 2019 and the 2021 survey allowed

for a pairwise analysis of this sample as well. Due to the small size of this sample the normality of each PPE use score distribution was assessed using the Shapiro-Wilk test. Normal distributions for each type of PPE recommended by the National Association for Public Health Veterinarians (NASPHV)<sup>31</sup> were assessed for differences in means using a paired T-test, while non-normal distributions were assessed with a Wilcoxon rank sum test.

Univariate and multivariate linear regression analysis were also performed. The outcome assessed in regression models were the mean PPE use scores for each type of PPE (gloves, masks, and eye protection). These mean PPE scores were calculated by averaging the Likert scores for each type of PPE within each survey group for individuals indicating they worked in a clinical setting (2019 N=97; 2021 N=63). The independent variable assessed in the regression models was a binary variable indicating pre- vs post-pandemic. The 2019 responses were categorized as “pre-pandemic” and 2021 survey responses were “post-pandemic”. For the purposes of this thesis “post-pandemic” refers to the time period well after the beginning of the pandemic, and is not meant to indicate the conclusion of the global COVID-19 pandemic. Further adjustment for covariates was performed using multivariate linear regression. Covariates were chosen apriori to assess for confounding. Covariates included in all adjusted models include participant age, race (coded as a factor variable), presence of employer provided occupational health training program, and reported PPE availability (with 2019 data set as reference level for no difficulties in obtaining PPE).

Linear regression models were also used for inferential analysis of selected variables. Nine additional models were included to assess the effect of the number of years employed at current workplace, the average number of hours worked per week, the type of practice (small animal, large animal, mixed animal, or other) on the adjusted estimates for each type of PPE. These variables for inferential statistics were chosen apriori based on previous literature indicating differences in PPE use for veterinarians working in different practice settings<sup>6,7</sup>, and literature indicating the importance of workplace culture on occupational safety behaviors<sup>25,26,32,33</sup>.

## **Results**

## Descriptive Analysis

This study used data from three study groups; participants of the first veterinary occupational health survey administered in 2019 (N = 97), participants of the second veterinary occupational health survey administered starting in 2021 (N = 66), and a subgroup of participants who responded to both questionnaires (N = 27) (Figure 1.). Descriptive statistics for the study population are presented in Table 1. The 2019 study population was 85.6% white, 83.5% non-Hispanic, 84.5% female and the median age was 48 years old (range: 23 - 71). The majority of the 2019 group were employed as veterinarians (78.4%), worked in small animal medicine (73.2%), and the mean number of years employed at their current workplace was 9.9 (SD: 10.5) at the time of the survey. The descriptive statistics for the 2021 group and the subset population that took both surveys followed similar patterns, however, it was noteworthy that the 2021 group was over 92% female and white, and over 98% non-Hispanic. The 2021 group had more variation in job titles with only 59% employed as veterinarians, however a larger proportion practiced in a small animal exclusive setting (80.3%).

The majority of respondents to the 2021 survey (93.9%) indicated that they had been fully vaccinated for COVID-19 at the time of response, and 45.5% and 27.3% indicated that they felt moderately safe and very safe from COVID-19 risks at work, respectively. At the time of the 2021 survey (Dec 2021 - Mar 2022), 40.9% respondents indicated employee vaccination was required, 92% that employees were required to wear face-masks, 15.2% indicated that their workplace required clients to show proof of COVID-19 vaccination, and 89.4% that clients were required to wear face-masks (Table 2.).

Regarding PPE availability during the pandemic nine respondents (13.85%) indicated that they often had difficulty in obtaining PPE since March 2020, and 28 respondents (43.08%) indicated that they sometimes had difficulty. When asked about workplace policies for PPE re-use and conservation 26 respondents (40%) indicated that their workplace had a policy in place for mask re-use at some point since March 2020, and 17 (26.15%) indicated there was a policy for re-use of another type of PPE. Examples of other types of PPE that were conserved include: gloves, gowns, KN95 respirators, face shields, and bouffant caps (Table 3). When 2021 respondents were asked to rate their overall physical and mental health 3.2% and 17.5% rated it

as poor, respectively. In the 2019 survey respondents were asked to rate their general health (not specifically physical and mental aspects), but no respondents gave a rating of poor. The 2021 survey also asked if respondents were experiencing burnout or compassion fatigue at work, and 33.3% and 38.1% indicated that they “strongly agree” and “somewhat agree”, respectively. Respondents to the 2021 survey were also asked to indicate their top three sources of stress over the past year from a list of provided choices. The most chosen sources of stress were staffing shortages (65.1%), working excessive overtime (52.4%), and abusive behavior from clients while at work (46%) (Table 3).

#### Differences in Mean PPE Use Analysis

In the 2021 survey glove use during preparation and administration of chemotherapeutics and necropsy both had average PPE use scores of 1. Urinary catheterization (1.22), dentistry (1.39), and reproductive procedures (1.43) all had the next lowest average glove PPE use scores (indicating frequent use of gloves for those procedures). The National Association of State Public Health Veterinarians recommended routine usage of disposable face-masks and eye protection PPE during dentistry, reproductive, and necropsy procedures in 2015 Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel<sup>31</sup>. The average mask and eye protection PPE use scores for dentistry procedures in the 2021 survey was 2.03 and 2.5, for reproductive procedures was 3.43 and 3.93, and for necropsy was 2.4 and 3.5; indicating moderate usage of this equipment during these procedures. Further information about average PPE use scores in 2021 can be found in Table 3.

Changes over time in mean PPE scores between 2019 and 2021 are presented in Table 4. Generally the changes in PPE use scores were small, but there was a clear pattern of scores decreasing in 2021 as compared to 2019 (meaning a trend of overall more PPE usage). The largest differences were generally seen in the mask PPE category as compared to using gloves or eye protection for the same activity. Paired T-test analysis found most of the scores for the selected procedures and PPE decreased slightly, however most of the paired data analysis failed to reject the null hypothesis that the difference in mean PPE scores was zero (Table 5). Only the analysis of the difference in mean glove use during cytological sample preparation or examination had a borderline statistically significant estimated change. It was estimated that

between 2019 and 2021 the mean glove use score for cytologic sample handling increased by 2.12 points (P= 0.0493, 95% CI: 0.0025, 1.442).

### Regression Analysis

Regression analysis produced estimates for lower mean scores of glove and mask use in 2021 (meaning increased use of these types of PPE), and a higher mean score for eye protection in 2021. The adjusted model produced very similar estimates to the unadjusted model, however the Global F statistic for the adjusted glove model did have a p-value of <0.05 indicating that this adjusted model may have provided a better estimate of the difference in glove score means. None of the adjusted models produced p-values <0.05, therefore we failed to reject the null hypothesis that the difference in mean PPE use scores was statistically different from zero. The unadjusted model for mask use however did have a statistically significant p-value of 0.005 and estimated an approximately 0.5 point drop in the mean mask use score between 2019 and 2021 (95% CI: -0.811, -0.152) (Table 6).

Inferential multiple regression analysis on three variables of interest produced estimates presented in Table 7. No findings in these models were determined to be statistically significant and were very similar to the estimates in the adjusted model. Interestingly the estimates for mean eye protection use did change from a positive relationship to a negative one when controlling for average hours worked per week (p-value = 0.994, 95% confidence interval -0.45, 0.45).

## **Discussion**

This thesis project analyzed cross-sectional survey data of veterinarians and other veterinary professionals on knowledge, attitudes, and practices regarding the use of PPE in clinical settings and other occupational health behaviors and risks. Analysis of two groups of respondents from prior to the start of the COVID-19 pandemic and almost two years into the pandemic, including paired data from individuals who completed both surveys, indicated that there was overall a trend of increasing PPE usage with respect to gloves, masks, and eye protection. While there was a clear trend towards a change in the direction of increasing use, the change noted was very small and the majority of analysis did not find the change to be statistically significantly different from zero. Only the score for gloves being used during

cytologic sample handling showed a significant increase in the mean PPE use score. This would represent less frequent use of gloves during this procedure in 2021 than in 2019. This could potentially be related to decreases in PPE availability in 2021, as 56% of respondents in 2021 answered that they often or sometimes had difficulties in obtaining PPE since March of 2020. However, other indicators for glove use in differences in mean PPE score and in regression modeling tended to indicate more frequent glove use.

The adjusted regression analysis indicated a general increase in glove and mask use and lower eye protection use in 2021 compared to 2019, however none of these findings were statistically significant. The unadjusted regression produced statistically significant results showing an increase in mask use, but that is also not unexpected given the high proportion of workplaces that required employees to wear masks in 2021 (92.4%). Inferential multiple regression analysis on three variables of interest produced estimates that were very similar to the estimates in the adjusted model. Minor changes in the estimates and confidence intervals with addition of the 3 variables of interest is interpreted as the years of employment at their current workplace, average hours worked per week, and type of clinical practice, is likely to account for only small differences in overall PPE use behaviors. Of note in this analysis is that the estimates for mean eye protection use did change from a positive relationship to a negative one in the model controlling for average hours worked per week. However, all the estimates related to change in use of eye protection were very close to zero, and not statistically significant, so it is unclear if the change in the relationship is practically meaningful.

#### Comparison With Veterinary PPE Use Reported in Literature

Average rates of PPE use in this study are consistent with previous studies examining PPE in the veterinary field<sup>7,9</sup>. Highest rates of consistent PPE use were seen with necropsy and surgical procedures (e.g. dentistry) with significantly lower rates of PPE use for procedures involving handling of bodily fluids (e.g. urine free catch collection, cystocentesis, cytology, etc). It is important to note that mask and eye protection use was reported much less often than glove use for dentistry and reproductive procedures, though all three levels of PPE protection are recommended for those activities by NASPHV<sup>31</sup>.

This thesis project investigated PPE use among veterinary professionals pre and post onset of the COVID-19 pandemic with the hypothesis that the scale and prevalence of a pandemic zoonotic illness would increase awareness and perceived risk of infectious occupational health hazards in the study population, resulting in a generalized increase use of PPE. It was unexpected to find that generally only small changes in the frequency of use were noted, and that the majority of those changes were not statistically significant. At the time of writing, to the author's knowledge there has been no other published work examining changes in veterinary occupational health behaviors related to the COVID-19 pandemic.

### Implications for PPE Use Predictors and Future Research

One possible explanation for the only minor changes in PPE use seen could be due to a strong desire for PPE conservation. The COVID-19 pandemic caused unprecedented disruptions in the global supply chain, and severely impacted PPE availability. Over half of the respondents reported difficulties in obtaining PPE since March 2020, with 40% indicating their workplace had instituted a policy for re-use of disposable face masks and more than 25% indicating their workplace had instituted policies for re-use of other disposable PPE (Table 7.). Studies examining the experiences of UK and U.S. healthcare workers found that both actual and perceived PPE shortages were a significant source of stress that was often compounded by a lack of training and clear guidance on PPE best practices<sup>34-36</sup>. Given the high proportions of veterinary staff reporting lack of PPE access and re-use policies it is likely that this population had similar stress. A pre-print paper from Dalton et.al. examining COVID-19 risk perception and response preparedness in veterinary workers found that an increased perceived threat of COVID-19 infection or a decreased confidence in workplace safety protocols for COVID-19 were not associated with a decrease in reported willingness, ableness, or readiness to respond during the pandemic<sup>37</sup>.

The authors theorized that this unexpected outcome may be due to the veterinary workforce's unique risks for zoonotic disease exposures and acclimation to high risk work environments<sup>37-39</sup>. When participants were asked about perceived risk of contracting a zoonotic illness at work in the 2019 survey 33% of respondents indicated they were not concerned, while in the 2021 survey 60% were not concerned. Taken together this information suggests that

veterinary professionals likely underestimate their risks of occupational exposure to zoonotic illness, and that during the pandemic PPE supply shortages this in addition to a desire to conserve supply for hospitals and physicians as a part of pandemic response might have resulted in overall less PPE use.

This investigation also found that 17.5% of respondents reported having poor mental health at the time of the survey, and greater than 70% of respondents answered “strongly agree” or “somewhat agree” when asked if they felt they were experiencing burnout at work. This finding may suggest another possible explanation for the lack of significant PPE use change. A recent study investigating associations between major depressive disorder and face-mask use among the general public in Hong Kong found that people reporting symptoms consistent with depression were also more likely to report higher levels of unsafe face mask use<sup>40</sup>. Due to the cross-sectional design of the study, similar to this investigation, temporal and causal inferences cannot be evaluated. However, it has been well established that individuals experiencing depression often exhibit poor ability to execute self-care tasks and other health behaviors<sup>41,42</sup>. The authors theorized that the COVID-19 pandemic and lack of PPE availability may have resulted in bidirectional impacts on PPE use and other safety behaviors, such that the lack of PPE caused stress and depression<sup>34–36,43</sup> and the associated cognitive disruptions and symptoms of depression may have in-turn resulted in decreased PPE use. Prior research examining the effects of mental health as an individual level factor affecting occupational safety behaviors are sparse, but there is evidence that U.S. farm workers with depressive symptoms may be more likely to engage in high risk occupational behaviors and have lower level of safety knowledge with a corresponding higher risk of injury<sup>27,28</sup>. A more recent study among oil and gas workers in Kuwait indicated that poor mental health may modify the relationship between occupational stressors and safety behaviors by increasing the adverse influence of occupational stress on safety<sup>29</sup>. The extreme risks of depression and poor mental health status in the veterinary profession have been well documented<sup>16–19,44</sup>. The results of this study indicated that the COVID-19 pandemic may have exacerbated these occupational risks, and there is evidence to suggest that these mental health outcomes may also impact other occupational health behaviors like PPE use.

## One Health's Role in Veterinary Worker Occupational Health and Safety

The findings of this research support the advantages of a Total Worker Health model<sup>45</sup>. Total Worker Health is a holistic approach to designing and implementing occupational health and safety programs, and is defined by the CDC as “ policies, programs, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness-prevention efforts to advance worker well-being”. This research and other research on health worker occupational health and safety during the COVID-19 pandemic highlight the importance of considering all aspects of a worker's health profile and work-related stress when developing or improving methods to protect worker safety and well-being.

In particular, when considering occupational health programs for workers at the human-animal interface, such as veterinary workers, a One Health approach is optimal. One Health is an interdisciplinary and collaborative approach to investigating and responding to public health issues<sup>46</sup>. Workers in fields that involve interacting with humans and animals benefit from a One Health occupational health model that considers human, animal, and environmental factors and risks in the workplace. A 2018 qualitative research study by Fowler et.al. found that taking the veterinary-client relationship into consideration when assessing occupational health could benefit both veterinary worker safety and client safety and understanding. The authors proposed a One Health Occupational Safety and Health (OHOSH) model to aid in assessment and development of occupational health programs for animal health workers<sup>47</sup>. Findings from our survey indicate that veterinary workers experience a variety of occupational stresses. Results suggested that increased stress likely related to the COVID-19 pandemic such as staffing shortages, excessive overtime, and abusive behavior from clients, may have contributed to increases in self-reported poor physical and mental health, as well as career burnout (Table 4). Utilizing these more holistic models in future occupational health research for veterinary and other animal health workers could potentially better elucidate important factors that could be leveraged to improve safety behaviors and overall worker health.

## Limitations

The cross-sectional study design is a limitation of this and many other studies attempting to assess predictors of PPE use and occupational safety behaviors. Although this design allowed

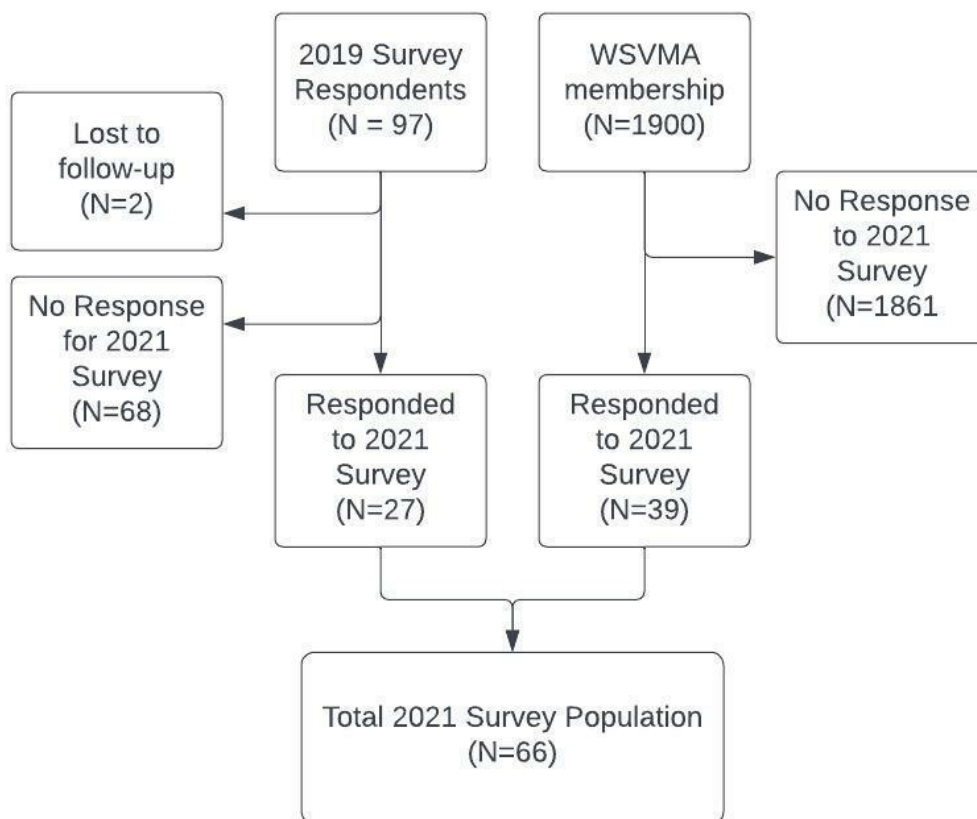
for a faster data collection and analysis of the effects of the COVID-19 pandemic, it also by definition makes it impossible to assess temporal relationships between factors. However the nested longitudinal study of 27 people can help with assessing temporality and provides several important insights into the overall trends of PPE use and the changes in perceived risks of zoonotic disease. A linear regression analysis was chosen to provide for more concise modeling and presentation of findings, but limitations of this type of analysis is the assumption of consistency of magnitude between each step in the Likert scale. An alternative analysis that could be considered to correct for this assumption would be multinomial regression modeling. Another limitation of this study is the small sample size and low response rate to the survey. Although individuals were encouraged to participate with incentives and ease of online format, unfortunately it remains difficult to recruit participants for surveys of this nature. As this analysis was based on self-report of practices it is also vulnerable to social desirability bias<sup>48</sup>, as well as a self-selection bias of participant recruitment. Furthermore, due to unforeseen errors in the creation of the online survey there were several important questions that were not presented to respondents (e.g. PPE use for urinalysis and blood work activities).

## **Conclusion**

In conclusion, this analysis suggested that general PPE use may have increased slightly for veterinary professionals after the start of the COVID-19 pandemic. This trend was much less significant than anticipated however, which indicates further research is needed. Veterinary workers provide an important first line of defense for zoonotic diseases, and as such their work positions them in a higher risk category for these illnesses than the general public or many other professions. Further research to understand the predictors of PPE use, impacts of PPE supply chain issues, and implications of psychosocial stress and burnout on occupational health and safety are needed in this population.

## Appendix

**Figure 1. Survey Recruitment Flow Diagram**



**Table 1. Descriptive Characteristics of Study Populations**

	Subset participating in both 2019 and 2021 (N= 27)	Population only participating in 2021 survey (N=39)	Total 2021 survey population (N=66)	Total 2019 survey population (N=97)
<b>Gender (%)</b>				
Female	22 (81.5)	39 (100)	61 (92.4)	82 (84.5)
Male	5 (18.5)	0 (0)	5 (7.6)	12 (12.4)
Declined	0	0	0	2 (2.1)
Missing	0	0	0	1 (1.0)

<b>Age</b>				
Mean Age (SD)	49.3 (14.6)	42 (12.2)	44.9 (13.6)	48.2 (13.5)
Declined (%)	1 (3.7%)	0	1 (1.5%)	4 (4.1)
<b>Career Type (%)</b>				
Veterinarian	20 (74.1)	19 (48.7)	39 (59.1)	76 (78.4)
Vet Tech	2 (7.4)	8 (20.5)	10 (15.2)	9 (9.3)
Vet Assistant	0	3 (7.7)	3 (4.5)	0
Vet Student/Vet Tech Student	0	1 (2.6)	1 (1.5)	0
Owner	5 (18.5)	2 (5.1)	7 (10.6)	6 (6.2)
Practice Manager	0	5 (12.8)	5 (7.6)	0
Other	0	1 (2.6)	1 (1.5)	4 (4.1)
Missing	0	0	0	1 (1.0)
<b>Type of Practice (%)</b>				
Small Animal	21 (77.8)	32 (82.1))	53 (80.3)	71 (73.2)
Large Animal	1 (3.7)	0	1 (1.5)	1 (1.0)
Mixed Animal	4 (14.8)	4 (10.3)	8 (12.1)	13 (13.4)
Other	1 (3.7)	0	1 (1.5)	10 (10.3)
Missing	0	3 (7.7)	3 (4.5)	2 (2.1)
<b>Years at Current Workplace</b>				
Mean years (SD)	11.0 (10.3)	7.30 (6.30)	8.81 (8.30)	9.89 (10.5)
<b>Race (%)</b>				
White	25 (92.6)	36 (92.3)	61 (92.4)	83 (85.6)
Black	0	0	0	0
Asian	0	0	0	3 (3.1)
Native American/ Alaska Native	0	0	0	0
Native Hawaiian/ Pacific Islander	0	0	0	1 (1.0)
Multiracial	2 (7.4)	2 (5.1)	4 (6.1)	3 (3.1)
Declined	0	0	0	6 (6.2)

Missing	0	1 (2.6)	1 (1.5)	1 (1.0)
<b>Ethnicity</b>				
Hispanic	0	1 (2.6)	1 (1.5)	2 (2.1)
Non-Hispanic	27 (100)	38 (97.4)	65 (98.5)	81 (83.5)

<b>Table 2. COVID-19 Vaccination Responses for 2021 Survey Population</b>			
	Subset participating in both 2019 and 2021 (N= 27)	Population only participating in 2021 survey (N=39)	Total 2021 survey population (N=66)
<b>COVID-19 Vaccination (%)</b>			
Fully Vaccinated <sup>^</sup>	26 (96.3)	36 (92.3)	62 (93.9)
Partially Vaccinated <sup>^^</sup>	1 (3.7)	2 (5.1)	3 (4.5)
Exemption	0	1 (2.6)	1 (1.5)

Footnote: (^) - Full vaccination series is complete, either single dose + 2 weeks for Johnson and Johnson vaccine, or Initial dose, booster dose + 2 weeks for Moderna or Pfizer vaccines. (^^) <2 weeks since final vaccination, or only received first dose of Moderna or Pfizer vaccine.

<b>Table 3. PPE Availability and Clinical Workplace Policies During the COVID-19 Pandemic (N=66)</b>					
<b>PPE Availability</b>					
	<b>Often</b>	<b>Sometimes</b>	<b>Rarely</b>	<b>Never</b>	<b>Unsure</b>
Difficulty Obtaining PPE since March 2020	9 (13.85%)	28 (43.08%)	16 (24.62%)	2 (3.08%)	10 (15.39%)
<b>Since March 2020 policy for re-use of disposable PPE to conserve supply</b>	<b>Yes (%)</b>	<b>No (%)</b>	<b>Unsure or Declined to Answer (%)</b>	<b>Average length of time policy was in place (months)</b>	
Mask re-use	26 (40%)	32 (49.23%)	7 (10.77%)	3.75 (range: 0-22)	
Other type of PPE re-use	17 (26.15%)	38 (58.46%)	10 (15.39%)	3.15 (range: 0-22)	
Types of PPE specified	gloves, gowns, face shields, KN95's, bouffant caps				
<b>Institution of specific workplace policies due to COVID-19</b>					

	Yes (%)	No or Not Yet Instituted (%)	Unsure or Declined to Answer (%)
Mandatory employee COVID-19 vaccination policy	27 (40.9%)	33 (50.1%)	6 (9.09%)
Proof of vaccination or negative COVID-19 test required for clients	10 (15.15%)	49 (74.24%)	7 (10.6%)
Mandatory employee masking policy	61 (92.42%)	3 (4.55%)	2 (3.03%)
Mandatory client or visitor masking policy	59 (89.39%)	5 (7.58%)	2 (3.03%)

<b>Table 4. Descriptive Statistics of Self-Reported Health Scores, Burnout, and Stress</b>					
<b>2019 survey respondents overall health rating (N=96)</b>					
	Excellent	Good	Fair	Poor	
Overall Health Rating	35 (36.5%)	55 (57.3%)	6 (6.25%)	0	
<b>2021 survey respondents health ratings, burnout, and causes of stress (N=63)<sup>^^</sup></b>					
	Excellent	Good	Fair	Poor	
Overall Physical Health Rating	12 (19%)	15 (23.8%)	34 (54%)	2 (3.2%)	
Overall Mental Health Rating	4 (6.3%)	24 (38.1%)	24 (38.1%)	11 (17.5%)	
	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
Are you experiencing burnout at work?	21 (33.3%)	24 (38.1%)	8 (12.7%)	5 (7.9%)	5 (7.9%)
	Short Staffed	Overtime	Client Abuse	Covid Risk	Physical Demands
Most reported causes of stress in past year	41 (65.1%)	33 (52.4%)	29 (46%)	24 (38.1%)	17 (27%)
Footnotes: (^) Missing one respondent from 2019. (^^) only responses of 2021 respondents indicated they worked in a clinical field					

<b>Table 5. Descriptive Statistics of Perceived Zoonosis Risk</b>		
	<b>Total 2019 survey population (N=97)</b>	<b>Total 2021 survey population (N=63)</b>
<b>Are you concerned about getting diseases from the animals you work with at your clinic?</b>		
Yes	62 (65.6%)	25 (39.7%)
No	32 (33.3%)	38 (60.3%)
Unsure	1 (1%)	0
<b>Are you concerned about giving diseases to the animals you work with at your clinic?</b>		
Yes	33 (34.4%)	12 (19%)
No	62 (64.6%)	50 (79.4%)
Unsure	1 (1%)	1 (1.6%)

<b>Table 6. Mean PPE use in 2021 survey for participants working in clinical field (N=63)</b>				
<b>Procedure</b>	<b>Respondents regularly performing the activity at work (%)</b>	<b>Reported PPE Use Average Score (1 = always uses when performing the task, 5=never uses)</b>		
		<b>Gloves</b>	<b>Surgical Mask</b>	<b>Eye Shield</b>
Fecal Floatation	18.0 (28.6%)	1.71*	3.58	4.29
Free catch urine collection	37.0 (58.7%)	2.59*	4.16	4.59
Cystocentesis	55.0 (87.3%)	3.55*	4.04	4.51
Urethral catheterization	32.0 (50.8%)	1.22*	3.47	4.53
Venipuncture/ Blood collection	59.0 (93.7%)	3.66	3.9	4.59
IV Catheterization	59.0 (93.7%)	3.49	3.98	4.47
Cytology	49.0 (77.8%)	3.06*	4	4.55
Animal restraint	59.0 (93.7%)	3.54	3.88	4.54
Cleaning with chemical disinfectants	49.0 (77.8%)	2.51*	3.96	4.61
Surgical Cleaning	--	2.84*	3.9	4.65
Dentistry	36.0 (57.1%)	1.39*	2.03*	2.5*

Reproductive procedures	14.0 (22.2%)	1.43*	3.43*	3.93*
Preparation or administration of chemotherapeutics	5.00 (7.9%)	1	1.6	2.4
Radiology	47.0 (74.6%)	3.21	3.94	4.51
Necropsy	20.0 (31.7%)	1*	2.4*	3.5*
Monitoring anesthetized patients	51.0 (81.0%)	3.63	2.73	4.49
Footnote: (*) - minimum routine PPE recommended in NASPHV 2015 Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Professionals <sup>30</sup>				

<b>Table 7. Difference in mean PPE use scores between 2019 and 2021 surveys</b>			
<b>Procedure</b>	<b>Average Change in PPE Score between 2019 - 2021</b>		
	<b>Gloves</b>	<b>Masks</b>	<b>Eye Protection</b>
Fecal Floatation	-0.726*	-1	-0.3
Free catch urine collection	-0.451*	-0.638	-0.194
Cystocentesis	-0.114*	-0.712	-0.261
Venipuncture/ Blood collection	-0.263	-0.915	-0.187
IV Catheterization	-0.131	-0.824	-0.355
Cytology	-0.642*	-0.867	-0.269
Animal restraint	-0.189	-0.89	-0.273
General cleaning/ Cleaning kennels	-0.513*	-0.679	-0.111
Surgical Cleaning	-0.754*	-0.892	-0.186
Dentistry	-0.157*	-0.006*	-0.167*
Monitoring anesthetized patients	0.15	-0.297	0.019
Footnote: (*) - minimum routine PPE recommended in NASPHV 2015 Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Professionals			

**Table 8. Paired T Tests of selected PPE recommended by NASPHV guidance (N=27)**

	<b>Estimated Difference in Means</b>	<b>P-value</b>	<b>95% Confidence Interval</b>
Gloves during fecal floatation <sup>^</sup>	5.49E-05	0.3041	-2.08e-6, 1.002
Gloves during free catch urine collection	-0.125	0.763	-0.992, 0.742
Gloves during cystocentesis	-0.381	0.337	-1.189, 0.427
Gloves during cytology prep/examination	0.722	0.0493*	0.002, 1.442
Gloves during general cleaning/cleaning kennels	0.353	0.287	-0.326, 1.032
Gloves during surgical cleaning	-0.059	0.868	-0.797, 0.679
Gloves during dentistry <sup>^</sup>	-3.32E-05	0.57	-0.999, 1.683e-6
Masks during dentistry	-0.333	0.394	-1.161, 0.494
Eye protection during dentistry <sup>^</sup>		0.58	--

Footnote: This table presents all selected NASPHV recommended PPE data available for both 2019 and 2021 in this subset population. (^) = Wilcoxon rank sum test performed due to non-parametric data indicators. (\*) - p = <0.05

**Table 9. Regression Analysis of Participant Mean PPE Use Scores of Each PPE Type Across All Procedures**

	Unadjusted		Adjusted <sup>^</sup>		Adjusted Model Global F Statistic	
	Estimate Mean Score Difference	P-Value (95% CI)	Estimate Mean Score Difference	P-Value (95% CI)	Statistic	P-Value
Gloves	-0.31	0.073 (-0.64, 0.02)	-0.26	0.286 (-0.77, 0.24)	2.8	0.006*
Masks	-0.65	0.0009* (-0.97, -0.33)	-0.38	0.156 (-0.9, 0.15)	1.4	0.244
Eye Protection	-0.23	0.1 (-0.51, 0.04)	0.03	0.908 (-0.41, 0.46)	0.57	0.802

Footnotes: CI: Confidence Interval, (^) model adjusted for age, years employed in current workplace, average handwashing score, occupational health training program provided by employer, and availability of PPE. (\*) - p <0.05

**Table 10. Inferential Regression Analysis of Participant Mean PPE Use Scores of Each PPE Type Across All Procedures**

	Inference Model <sup>^^</sup> 1 (years at current workplace)		Inference Model <sup>^^^</sup> 2 (hours worked per week)		Inference Model <sup>^^^^</sup> 3 (type of practice)	
	Estimate	P-Value (95% CI)	Estimate	P-Value (95% CI)	Estimate	P-Value (95% CI)
Gloves	-0.23	0.352 (-0.72, 0.26)	-0.27	0.302 (-0.77, 0.24)	-0.33	0.180 (-0.82, 0.15)
Masks	-0.39	0.128 (-0.90, 0.11)	-0.35	0.198 (-0.89, 0.19)	-0.37	0.168 (-0.90, 0.16)
Eye Protection	0.03	0.899 (-0.41, 0.47)	-0.002	0.994 (-0.45, 0.45)	0.02	0.462 (-0.26, 0.58)

Footnotes: CI: Confidence Interval, (^) model adjusted for age, race, occupational health training program provided by employer, and availability of PPE. (^^) model adjusted for age, race, occupational health training program provided by employer, availability of PPE, and years at current workplace. (^^^ )model adjusted for age, race, occupational health training program provided by employer, availability of PPE, and average hours worked per week. (^^^^)model adjusted for age, race, occupational health training program provided by employer, availability of PPE, and type of practice. (\*) p <0.05

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