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COVID-19 Pandemic Response Preparedness and Risk Perceptions Among Peruvian Veterinarians and Animal Care Workers

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Peruvian veterinarians and animal care workers (VACW) are primary responders in the event of disasters or emergencies, yet they face unique concerns that could impede or block their essential functions in public health preparedness in comparison with VACWs in other countries. In this study, we used the Ready, Willing, and Able model via electronic survey to evaluate the perception of risks and barriers that Peruvian VACWs faced when deciding whether to continue working during the COVID-19 pandemic between July and December 2020. We used logistic regression models to evaluate associations between demographic characteristics, perceived role, and contact scores with 8 outcomes: knowledge of COVID-19; confidence in safety protocols; perceived threat; perceived job efficacy; perceived barriers; and readiness, willingness, and ability to respond to the COVID-19 pandemic. Less than 50% of respondents reported barriers to report to work during the pandemic. Respondents who reported higher contact with coworkers had an increased confidence in safety protocols (OR 5.16; 95% CI, 1.36 to 19.61) and willingness (OR 3.76; 95% CI, 1.14 to 12.47) to respond to the pandemic. Close contacts with essential workers and higher economic income were associated with higher reported knowledge of COVID-19. Respondents with higher perceived job efficacy had higher odds of reporting being ready, willing, and able to respond to COVID-19, while those who identified more barriers to report to work had lower odds of being ready, willing, and able to respond. The findings from this study, which showed differences from VACWs in the United States, can be used by individuals designing programs to improve pandemic and disaster preparedness in this essential, yet understudied and vulnerable, workforce.

Keywords: COVID-19, SARS-CoV-2, Pandemic preparedness, Disaster planning, "Ready, Willing, and Able" model, Veterinary and animal care occupation

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Introduction

The COVID-19 outbreak was declared a pandemic by the World Health Organization in March 2020.[1] By mid-2021, Peru had the highest worldwide recorded death rate, with almost 200,000 deaths (6,200 deaths per million).[2] The impact of COVID-19 has been highest among individuals and communities living in poverty with limited access to healthcare.[3,4] Economic consequences of the pandemic in Peru included a drastic increase in unemployment (average increase of 20% from April to December 2020) and an increase in the total number of individuals living in poverty by 2 million people (as of January 2022).[5] The physical and mental health of healthcare workers was also severely impacted by the pandemic. The shortage of personal protective equipment and the low numbers of healthcare professionals in some regions of the country have led to high work burden among physicians, nurses, and other healthcare professionals.[6,7] As of March 2021, 20.9% (13,073) of physicians had been infected with SARS-CoV-2, and 0.7% (406) had died from COVID-19.[7] However, limited data have been reported on the impacts from COVID-19 on other healthcare professionals, including veterinarians and animal care workers (VACWs).

VACWs play essential roles in the control of zoonotic diseases. They are considered part of the healthcare workforce and are primary responders in the event of disasters and mass casualties including human biological threats, livestock emergencies, and natural disasters.[8,9] Their role as primary responders is increasingly recognized internationally, and the American Veterinary Medical Association has taken a lead role in promoting the integration of the workforce into the nation's disaster management response.[8-11] In Peru, veterinarians were not considered healthcare professionals until March 2021, after the enactment of Law 31151, which recognized veterinarians as health and medical sciences professionals.[12] The law acknowledged that the role of veterinarians is to protect human and animal health by identifying, notifying, preventing, and controlling the spread of diseases that affect humans and animals, as well as participating in the preparedness and response to epidemics, emergencies, and disasters.[12] In 2020, 12,442 professionals were registered under the Peruvian College of Veterinary Medicine, yet many more animal healthcare workers, including animal production and management professionals, perform essential functions but are not enumerated by the Peruvian authorities. During a high-risk event, such as a pandemic or natural disaster, adverse working conditions and limited resources may cause VACWs to be reluctant to work and respond if they perceive a high risk to themselves, their patients, or their relatives, as has been reported for other professionals.[13-16] Given the unique composition of emerging and reemerging infectious disease of epidemic potential in Peru and the Americas[17,18] and the distinct composition of the overall veterinary workforce in the region, in comparison with the United States and other high-income nations, it is vital to explore the role of the Peruvian veterinary workforce within the overall national pandemic and disaster response.

The overall likelihood of responding to emergencies has been assessed using the Ready, Willing, and Able model, in which a worker's readiness, willingness, and ability to respond are evaluated through a multicomponent survey.[19] *Readiness* relates to the available external infrastructure and material resources necessary to perform a task, *willingness* refers to an individual's predilection and desire to perform a task, and *ability* refers to the knowledge and the skills a worker needs to perform a task.[20] Studies have shown that workers' willingness and ability to respond to an emergency, including both natural or biological threats of pandemic potential, are affected by the individual's perception of their risk and role within the disaster response.[21] Research using the Ready, Willing, and Able model has been conducted in public health workers, healthcare employees, first responders, and other vital occupations,[19,20,22-24] yet few studies have evaluated the likelihood of response within the important veterinary workforce. An example of the latter is a US-based study, which evaluated for the first time the emergency preparedness and response of US VACWs during the COVID-19 pandemic.[25] Despite the essential roles that VACWs play to protect public health, no studies have been conducted that evaluate the perception of risk and the barriers that VACWs face during a national emergency, such as the COVID-19 pandemic, in a Latin American country where workers may face different stressors than their US counterparts.[26]

The overall objective of this study was to evaluate the perceptions of risk and barriers among Peruvian VACWs to continue working during the COVID-19 pandemic using the Ready, Willing, and Able model. This is the first study, to our knowledge, that evaluates a Latin American veterinary healthcare workforce in the unique context of a pandemic and one of few to address their role in any emergency response effort.[27,28] The findings from this work are essential to characterize risk factors for decreased disaster response from VACWs in this region of the world, and to aid in the design of interventions to ensure safe working conditions and enhance training and support systems for this vulnerable yet critical worker population.

Methods

Study Population and Survey Deployment

The study population consisted of VACWs working throughout Peru. Individuals were classified according to the type of veterinary practice, and their specific role within it, or their employment in industry, government, or other. Individuals working with dogs and cats were classified as

"small animal medicine." Due to limited response rates among individuals working with equines, farm animals, exotic animals, laboratory animals, and those working in small animal shelters and zoos, these groups of practitioners were combined into a single category defined as "other animal medicine." Each larger category was subdivided into veterinarians and other veterinary support staff. Support staff included veterinary assistants and administrative personnel. Respondents working for a government agency or an animal-related industry were included in a separate category defined as "industry or government," and finally, individuals indicating other lines of work were classified as "other" (eg, individuals in academia).

Respondents were recruited through social media, professional organizations, regional veterinary accreditation organizations (eg, Colegios Médico Veterinarios Departamentales), and the researchers' existing contacts. Data were collected between July and December 2020, using an anonymous online survey administered through the REDCap platform of Universidad Peruana Cayetano Heredia.[29] The study was approved by the Institutional Review Board of Universidad Peruana Cayetano Heredia, Lima, Peru (IRB number 202186). Data collected were unidentifiable. Before starting the survey, respondents signed an electronic disclosure statement assuring that they had read and understood the study information and that they were participating voluntarily.

Survey Data Collected

The survey was divided into 6 main sections: (1) demographic and professional information, including job role, number of years performing the indicated job role, age, gender, if the district of residence was still under quarantine, residing with an essential worker, household crowding, location of work, salary, and coworker and public contact levels; (2) attitudes, beliefs, and perceptions regarding their risk of exposure to COVID-19; (3) attitudes, beliefs, and perceptions about the individual's role in the organization; (4) attitudes, beliefs, and perceptions about the individual's ability and disposition to respond to the pandemic; (5) attitudes, beliefs, and perceptions about preparedness support and training; and (6) perceived consequences of the COVID-19 pandemic. Questions in sections 2 through 5 were presented as a 5-point Likert scale. The survey included questions about access to training before and during the pandemic, as well as the importance of pandemic preparedness training. Training was divided into 3 categories: specific training for the COVID-19 pandemic, training for general biological risks, and training for other risks including natural disasters such as earthquakes (Supplemental Table 1, available at www.liebertpub.com/doi/suppl/10.1089/hs.2022.0047). The survey was originally designed for use in the United States and was translated to Spanish and tailored to Peru's VACW conditions.[25]

Data Analysis

Responses from individuals who completed the entire survey were included in the analysis. This decision was made because the anonymous nature of the survey did not allow researchers to determine whether an individual started the survey more than once. Statistical analysis was performed according to Dalton et al[25] to ensure the comparability of results with the US-based study, and was done in Stata version 15.0 (StataCorp, College Station, TX).

Age and time (in years) in the current job were treated as binary variables, with time in job dichotomized at the median value (4 years) and age dichotomized as under 40 years and 40 years or older (median value). Due to limited responses from respondents working outside the capital city, Lima, the workplace location was dichotomized as Lima and outside of Lima. Finally, the respondent's monthly income in Peruvian nuevo soles (S/) was categorized as: less than or equal to S/.2,000 or less, S/.2,001 to S/.5,000, S/.5,001 to S/.10,000, and more than S/.10,000 (equivalent to approximately: less than or equal to US$540, US$541 to US$1,350, US$1,351 to US$2,700, and more than US$2,700), and prefer not to answer.

Contact scores were developed for both contact with coworkers and the public (eg, clients, visitors). These were developed by asking questions related to the average daily contact in terms of percentage of time spent during a workday, and the total number of people contacted daily. These scores were created by summing the responses to the questions and dividing the overall sum into quartiles (Q1 to Q4), representing minimal, low, moderate, and high contact.

A total of 8 outcome variables were created from the survey data, clustered into 3 outcome groups. The first group was defined as *risk* outcomes and included knowledge of COVID-19, confidence in safety protocols, and perceived threat; the second group was defined as the *role* outcomes and included perceived efficacy and perceived barriers to report to work; and finally, the third group was defined as *response* outcomes, and this included the readiness, willingness, and ability of VACWs to respond to the COVID-19 pandemic. These outcomes were selected because previous studies have shown their importance on preparedness in other occupational groups.[19,20,22-24] Five-point Likert scale questions about each of these outcomes were included in the survey. The Likert score obtained in all the questions for each outcome were aggregated and then dichotomized at the median to produce low and high categories of each of the 8 outcomes (Supplementary Table 2, available at www.liebertpub.com/doi/suppl/10.1089/hs.2022.0047).

Odds ratios for the associations between covariates, including job role, job experience, leadership role, sociodemographic characteristics, contact scores, living within a quarantine district, living with an essential worker, and work location, and the 8 defined outcomes were modeled using multivariate logistic regression models fitted with

generalized linear models. Lastly, odds ratios for the association between the VACWs' knowledge, confidence, threat, efficacy, and barriers to the COVID-19 pandemic and their readiness, willingness, and ability to respond were modeled using multivariate logistic regression models fitted with generalized linear models. For the job role variable, odds were calculated (not odds ratios) since we considered there was not an intuitive reference category.

Results

Overall, 789 people opened the survey. Of these, 740 (93.8%) consented to participate in the study, 6 (0.76%) did not consent, and 43 (5.5%) closed the survey before responding to the consent form. Of those who consented, 266 completed the survey, yielding a participation rate of 33.7% (n = 266). The differences between respondents who completed the survey and those who did not are shown in Supplementary Table 3 (www.liebertpub.com/doi/suppl/10.1089/hs.2022.0047). Respondents' job and demographic characteristics are summarized in Table 1. The majority of the 266 respondents worked with small animals (n = 163, 61.3%). Within this group, most were veterinarians (n = 124, 76.1%), followed by veterinary assistants and other veterinary support staff (n = 39, 23.9%). Of the total study population, 22.6% (n = 60) worked with other animals, 7.9% (n = 21) worked in industry or government, and 8.3% (n = 22) of respondents specified they worked in other areas, such as academia. The median job experience was 4 years, with a range of 0 to 40 years. Within the study population, 83.5% (n = 222) considered themselves to be in a leadership role, 22.2% (n = 59) were aged 40 years old or older, and 62.0% (n = 165) identified as female. Finally, 73.3% (n = 195) worked in Lima, the capital city of Peru.

Table 2 shows respondents' self-reported contact level with coworkers and the public. Respondents reported having longer contact time with coworkers than with the public. In fact, 15.4% (n = 41) of the respondents reported they had contact with coworkers for almost the entire day, while only 10.2% (n = 27) reported having contact with the public all day long. Most respondents indicated they had contact with 3 to 5 people per day (n = 82, 30.8% with coworkers; n = 52, 19.6% with the public), but some reported having contact with more than 25 people per day (n = 17, 6.4% for coworkers; n = 23, 8.7% for public). Overall, the contact aggregated scores were evenly distributed across quartiles within coworkers and the public (range from 14.3% to 26.7%), with 19.2% and 16.9% in the highest contact score (Q4) for coworkers and the public, respectively.

COVID-19 Perception

Most respondents considered clients and visitors as the most likely source of SARS-CoV-2 exposure (n = 141, 53.0%), followed by the general public outside their job (n = 79, 29.7%) and coworkers (n = 31, 11.7%) (Table 3). Only 5.6% (n = 15) considered their family/friends at home to be a source of SARS-CoV-2. A majority (n = 244,

Table 1. Demographic and Employment Characteristics (N = 266)

Characteristics	*n (%)*
Job role	
Small animal medicine – veterinarian	124 (46.6)
Small animal medicine – support staff	39 (14.7)
Veterinary medicine other – veterinarian	36 (13.5)
Veterinary medicine other – support staff	24 (9.0)
Industry or government	21 (7.9)
Other	22 (8.3)
Job time, years	
Minimum	0
Median (IQR)	4 (2-7)
Maximum	40
Leadership role	
Yes	222 (83.5)
Age, years	
Under 40	207 (77.8)
40 and older	59 (22.2)
Gender	
Female	165 (62.0)
Other/prefer not to say	1 (0.4)
Location	
Lima	195 (73.3)
Outside Lima	69 (25.9)

Table 2. Self-Reported Contact Level With Coworkers and the Public (N = 266)

	Coworkers n (%)	*Public n (%)*
Average daily contact		
No contact	51 (19.2)	59 (22.2)
Rarely (1% to 15%)	45 (16.9)	58 (21.8)
Intermittent (16% to 50%)	66 (24.8)	72 (27.1)
Most of the workday (50% to 85%)	63 (23.7)	50 (18.8)
Almost the entire workday (85% to 100%)	41 (15.4)	27 (10.2)
Total number of people contacted daily[a]		
1 to 2	31 (11.7)	45 (16.9)
3 to 5	82 (30.8)	52 (19.6)
6 to 10	54 (20.3)	50 (18.8)
11 to 24	29 (10.9)	34 (12.8)
25 or more	17 (6.4)	23 (8.7)
Contact aggregated score quartile[a]		
Minimal contact (Q1)	71 (26.7)	53 (19.9)
Low contact (Q2)	38 (14.3)	62 (23.3)
Moderate contact (Q3)	51 (19.2)	43 (16.2)
High contact (Q4)	51 (19.2)	45 (16.9)

[a]Not all respondents provided answers to this question. Percentages were calculated using the total respondent population (N = 266) as the denominator.

Table 3. Perceived Source of SARS-CoV-2 Exposure and Secondary Concerns Associated With the COVID-19 Pandemic (N = 266)

	n (%)
Perceived most likely source for SARS-CoV-2 exposure	
The public as part of my job (clients/visitors)	141 (53.0)
The general public outside of my job	79 (29.7)
Coworkers	31 (11.7)
Family/friends at home	15 (5.6)
Perceived secondary concerns as a result of the COVID-19 pandemic[a]	
Any secondary concerns	226 (85.0)
Animal health and welfare during and after the pandemic	182 (68.4)
Support of human healthcare professionals during and after the pandemic	178 (66.9)
Economic resilience of the veterinary and animal care fields as a whole	171 (64.3)
Economic resilience of your personal profession	150 (56.4)
Mental health implications of the veterinary and animal care fields	131 (49.3)

[a]Not all respondents provided answers to this question. Percentages were calculated using the total respondent population (N = 266) as the denominator.

85.0%) of the study population reported having at least 1 secondary concern as a result of the COVID-19 pandemic. The most frequently reported secondary concern was regarding animal health and welfare during the pandemic (n = 182, 68.4%); however, a majority of respondents also reported concerns about the support of human healthcare professionals during the pandemic, the economic resilience of the veterinary and animal care field as a result of the pandemic, and the mental health implications within the VACW profession.

Table 4. Self-Reported Personal and Professional Barriers to Report to Work (N = 266)

Types of Barriers	*n (%)*
Personal barriers[a]	
None	155 (58.3)
Family/dependents needs	54 (20.3)
Transportation	52 (19.6)
Health (physical)	41 (15.4)
Health (mental)	16 (6.0)
Other	4 (1.5)
Professional barriers[b,c]	
None	224 (84.2)
Lack of management support	21 (7.9)
Lack of communication channels	10 (3.8)
Lack of peer support	4 (1.5)
Other	6 (2.3)

[a]Respondents were able to select more than 1 barrier. [b]One of the 42 individuals who reported professional barriers did not indicate the type of barrier. [c]Not all respondents provided answers to this question. Percentages were calculated using the total respondent population (N = 266) as the denominator.

Table 4 shows the professional and personal barriers to report to work identified by respondents. Respondents were able to select more than 1 barrier. Personal barriers to report to work were reported by 41.7% (n = 111) of respondents, while only 15.8% (n = 42) reported a professional barrier. The most commonly reported personal barriers were the need to attend to family members or other dependents (20.3%), and the ability to get to work or transportation (19.6%). Lack of support from managerial staff was the most common professional barrier (7.9%), with only 1.5% reporting a lack of peer support as a professional barrier to report to work.

Training and Support for Disaster Response

Of the respondents who completed the survey, 59.8% and 52.1% indicated that they did not receive any training or support before and during the pandemic, respectively. At the same time, more than 80% of respondents indicated that it was very important or extremely important to be trained to respond to this pandemic. Before the COVID-19 pandemic, only 15.8% had received training for pandemic preparedness and response, and during the pandemic, only 39.5% of respondents received training on how to respond during the health emergency. Respondents indicated having been trained for biological risks (20.3%) or other risks, such as natural disasters (14.3%), before the pandemic, while only 6.9% and 1.5% were trained against these 2 risks during the pandemic. While 69.6% of the respondents indicated that they would like to be part of public health response activities, only 13% of them had done so. Detailed results of training for disaster response of VACWs is shown in Supplementary Tables 1 and 4 (www.liebertpub.com/doi/suppl/10.1089/hs.2022.0047).

Job and Demographic Characteristics on 8 Outcomes

The associations between covariates (eg, job role, job experience, leadership role, sociodemographic characteristics, contact scores, living within a quarantine district, living with an essential worker, work location) and (1) knowledge, confidence, and threat; (2) job efficacy and barriers; (3) readiness, willingness, and ability, are presented in Tables 5, 6, and 7, respectively. Respondents living with an essential worker had higher odds of reporting high knowledge compared with respondents not living with an essential worker (OR 3.86; 95% CI, 1.58 to 9.47). Respondents living with 5 or more people in the same household (median population size in the dataset) had lower odds of reporting high knowledge compared with those living with fewer than 5 people (OR 0.43; 95% CI, 0.19 to 0.99). Finally, as the salary increased, the odds of

Table 5. Association Between Job, Demographic, and Contact Level and the Risk Outcomes in the Ready, Willing, and Able Model (N = 266)

Characteristics	*Knowledge OR (95% CI)*	*Confidence OR (95% CI)*	*Threat OR (95% CI)*
Job role			
Small animal medicine – veterinarian	1.38 (0.97-1.98)	1.32 (0.92-1.88)	1.34 (0.94-1.91)
Small animal medicine – other	1.29 (0.69-2.44)	1.24 (0.65-2.34)	0.77 (0.41-1.46)
Other medicine – veterinarian	1.40 (0.72-2.72)	0.94 (0.49-1.83)	0.71 (0.37-1.39)
Other medicine – other	1.40 (0.62-3.15)	1.18 (0.53-2.64)	0.71 (0.37-1.39)
Industry or government	0.75 (0.32-1.78)	0.54 (0.21-1.35)	1.10 (0.47-2.59)
Other	2.67 (1.04-6.81)	3.40 (1.25-9.21)	0.47 (0.19-1.14)
Job experience, years			
More than median	1.05 (0.41-2.69)	3.26[a] (1.25-8.51)	0.50 (0.20-1.24)
Less than median	1 reference	1 reference	1 reference
Leadership			
Leadership role	3.72 (0.98-14.03)	3.23 (0.78-13.37)	0.51 (0.15-1.71)
No leadership role	1 reference	1 reference	1 reference
Age, years			
Under 40	1.05 (0.34-3.31)	2.55 (0.82-7.90)	2.97 (0.98-9.07)
40 and older	1 reference	1 reference	1 reference
Gender			
Female	1.01 (0.39-2.61)	1.06 (0.42-2.67)	0.94 (0.39-2.27)
Male	1 reference	1 reference	1 reference
Quarantine			
District still in quarantine	2.95 (1.11-7.86)	1.80 (0.71-4.56)	0.72 (0.30-1.72)
District without restrictions	1 reference	1 reference	1 reference
Living with an essential worker			
Yes	3.86[a] (1.58-9.47)	1.18 (0.52-2.67)	1.19 (0.54-2.61)
No	1 reference	1 reference	1 reference
Household crowding			
5 or more people living in a house	0.43[a] (0.19-0.99)	0.93 (0.41-2.13)	0.55 (0.25-1.20)
Less than 5 people living in a house	1 reference	1 reference	1 reference
Work location			
Lima	1.35 (0.48-3.81)	1.48 (0.55-4.0)	0.62 (0.23-1.64)
Other than Lima	1 reference	1 reference	1 reference
Salary			
Less than S/.2,000	1 reference	1 reference	1 reference
S/.2,000-S/.5,000	3.78[a] (1.15-12.42)	0.98 (0.32-3.03)	2.91 (0.97-8.75)
S/.5,000 to S/.10,000	3.88[a] (1.08-13.90)	0.75 (0.22-2.61)	2.56 (0.78-8.39)
More than S/.10,000	8.92[b] (1.92-41.47)	2.24 (0.57-8.75)	1.55 (0.43-5.58)
Contact level			
Coworker contact Q1	1 reference	1 reference	1 reference
Coworker contact Q2	3.16 (0.88-11.33)	5.16[a] (1.36-19.61)	1.86 (0.60-5.80)
Coworker contact Q3	0.74 (0.26-2.14)	0.46 (0.16-1.31)	1.77 (0.66-4.74)
Coworker contact Q4	1.90 (0.58-6.16)	1.69 (0.53-5.38)	2.65 (0.89-7.86)
Public contact Q1	1 reference	1 reference	1 reference
Public contact Q2	0.35 (0.11-1.09)	0.68 (0.22-2.08)	2.31 (0.81-6.64)
Public contact Q3	1.52 (0.41-5.68)	0.56 (0.16-2.03)	2.09 (0.65-6.74)
Public contact Q4	1.33 (0.36-4.90)	1.07 (0.29-3.98)	5.05[a] (1.45-17.56)

[a]$P < .05$. [b]$P < .01$. Abbreviation: S/, nuevo sol (Peruvian currency).

reporting a higher knowledge also increased. Respondents with more than 4 years working in their current job had higher odds of reporting high confidence in safety protocols (OR 3.26; 95% CI, 1.25 to 8.51) and higher perceived job efficacy (OR 2.85; 95% CI, 1.16 to 6.99), compared with respondents who had worked for under 4 years.

With regard to VACW contact with coworkers, respondents who had a contact aggregate score classified in the second contact quartile (Q2) had higher odds of reporting high confidence (OR 5.16; 95% CI, 1.36 to 19.61) and high willingness (OR 3.76; 95% CI, 1.14 to 12.47) compared with those in the first quartile. Respondents classified in the highest

Table 6. Association Between Job, Demographic, and Contact Level and the Role Outcomes in the Ready, Willing, and Able Model (N = 266)

	Efficacy OR (95% CI)	*Barriers OR (95% CI)*
Job role		
Small animal medicine – veterinarian	1.48 (1.03-2.12)	2.02 (1.39-2.94)
Small animal medicine – other	0.77 (0.41-1.46)	5.5 (2.30-13.13)
Other medicine – veterinarian	1 (0.52-1.92)	4.14 (1.81-9.46)
Other medicine – other	0.71 (0.32-1.61)	3 (1.19-7.56)
Industry or government	0.91 (0.39-2.14)	4.25 (1.43-12.63)
Other	1 (0.43-2.31)	2.5 (0.97-6.44)
Job experience, years		
More than median	2.85[a] (1.16-6.99)	0.50 (0.19-1.34)
Less than median	1 reference	1 reference
Leadership		
Leadership role	1.25 (0.39-3.99)	0.66 (0.16-2.80)
No leadership role	1 reference	1 reference
Age, years		
40 and older	1.50 (0.50-4.52)	0.61 (0.21-1.79)
Under 40	1 reference	1 reference
Gender		
Female	0.46 (0.18-1.15)	0.82 (0.32-2.13)
Male	1 reference	1 reference
Quarantine		
District still in quarantine	1.82 (0.72-4.60)	1.13 (0.44-2.93)
District without restrictions	1 reference	1 reference
Living with an essential worker		
Yes	1.39 (0.62-3.37)	0.97 (0.42-2.24)
No	1 reference	1 reference
Household crowding		
5 or more people living in a house	1.20 (0.54-2.66)	1.09 (0.47-2.54)
Less than 5 people living in a house	1 reference	1 reference
Work location		
Lima	1.68 (0.61-4.61)	1.24 (0.43-3.57)
Other than Lima	1 reference	1 reference
Salary		
Less than S/.2,000	1 reference	1 reference
S/.2,000 to S/.5,000	2.23 (0.74-6.71)	1.62 (0.49-5.33)
S/.5,000 to S/.10,000	0.98 (0.30-3.26)	1.38 (0.38-5.05)
More than S/.10,000	1.16 (0.32-4.23)	0.48 (0.13-1.82)
Contact level		
Coworker contact Q1	1 reference	1 reference
Coworker contact Q2	2.53 (0.76-8.45)	1.06 (0.30-3.76)
Coworker contact Q3	1.73 (0.64-4.71)	1.81 (0.62-5.22)
Coworker contact Q4	1.84 (0.59-5.69)	0.80 (0.26-2.47)
Public contact Q1	1 reference	1 reference
Public contact Q2	0.84 (0.30-2.44)	0.70 (0.22-2.22)
Public contact Q3	1.19 (0.35-4.04)	0.91 (0.25-3.30)
Public contact Q4	1.90 (0.55-6.62)	1.66 (0.44-6.31)

[a]$P < .05$. Abbreviation: S/, nuevo sol (Peruvian currency).

contact quartile (Q4) also had higher odds of reporting higher willingness (OR 5.04; 95% CI, 1.60 to 15.88) compared with those classified in the lowest quartile (Q1). On the other hand, with regard to VACW contact with the public, those who were classified in the highest contact quartile (Q4) had 5.05 (95% CI 1.45 to 17.56) times the odds of reporting a higher perceived threat compared with those who were classified in Q1.

Perceived Risk and Role on Response Outcomes

As shown in Table 8, individuals who reported high perceived job efficacy had higher odds of being ready (OR 2.51; 95% CI, 1.45 to 4.36), willing (OR 2.24; 95% CI, 1.30 to 3.87), and able (OR 2.88; 95% CI, 1.64 to 5.03)

Table 7. Association Between Job, Demographic, and Contact Level and the Response Outcomes in the Ready, Willing, and Able Model (N = 266)

	Ready OR (95% CI)	*Willing OR (95% CI)*	*Able OR (95% CI)*
Job role			
Small animal medicine – veterinarian	0.89 (0.63-1.27)	0.79 (0.56-1.14)	0.89 (0.63-1.27)
Small animal medicine – other	0.63 (0.33-1.19)	0.56 (0.29-1.08)	0.58 (0.30-1.13)
Other medicine – veterinarian	0.67 (0.34-1.31)	0.80 (0.41-1.54)	0.64 (0.33-1.24)
Other medicine – other	0.85 (0.38-1.89)	0.71 (0.32-1.61)	0.60 (0.26-1.37)
Industry or government	0.50 (0.20-1.24)	0.40 (0.16-1.03)	0.40 (0.16-1.03)
Other	0.38 (0.15-0.96)	0.38 (0.15-0.96)	0.22 (0.08-0.66)
Job experience, years			
More than median	0.96 (0.40-2.29)	1.29 (0.53-3.14)	1.31 (0.54-3.15)
Less than median	1 reference	1 reference	1 reference
Leadership			
Leadership role	1.81 (0.55-5.95)	2.51 (0.68-9.25)	1.54 (0.46-5.18)
No leadership role	1 reference	1 reference	1 reference
Age, years			
40 and older	1.52 (0.56-4.17)	1.70 (0.60-4.86)	1.44 (0.52-4.03)
Under 40	1 reference	1 reference	1 reference
Gender			
Female	0.53 (0.23-1.26)	0.72 (0.30-1.73)	0.84 (0.36-1.97)
Male	1 reference	1 reference	1 reference
Quarantine			
District still in quarantine	0.77 (0.33-1.80)	0.53 (0.22-1.28)	0.71 (0.30-1.67)
District without restrictions	1 reference	1 reference	1 reference
Living with an essential worker			
Yes	1.10 (0.52-2.34)	1.56 (0.72-3.38)	1.06 (0.50-2.27)
No	1 reference	1 reference	1 reference
Household crowding			
5 or more people living in a house	1.76 (0.83-3.72)	1.74 (0.80-3.77)	2.05 (0.96-4.35)
Less than 5 people living in a house	1 reference	1 reference	1 reference
Work location			
Lima	0.87 (0.34-2.21)	0.91 (0.34-2.39)	0.90 (0.35-2.32)
Other than Lima	1 reference	1 reference	1 reference
Salary			
Less than S/.2,000	1 reference	1 reference	1 reference
S/.2,000 to S/.5,000	2.41 (0.83-7.03)	1.85 (0.62-5.58)	1.81 (0.62-5.27)
S/.5,000 to S/.10,000	1.47 (0.46-4.64)	1.68 (0.51-5.49)	1.22 (0.39-3.84)
More than S/.10,000	2.02 (0.59-7.00)	1.89 (0.53-6.80)	1.53 (0.44-5.30)
Contact level			
Coworker contact Q1	1 reference	1 reference	1 reference
Coworker contact Q2	2.36 (0.76-7.34)	3.76[a] (1.14-12.47)	2.31 (0.73-7.30)
Coworker contact Q3	1.61 (0.60-4.33)	2.74 (0.96-7.80)	1.76 (0.64-4.83)
Coworker contact Q4	2.50 (0.84-7.44)	5.04[b] (1.60-15.88)	3.65[a] (1.20-11.11)
Public contact Q1	1 reference	1 reference	1 reference
Public contact Q2	0.88 (0.31-2.54)	1.12 (0.37-3.33)	0.69 (0.24-2.03)
Public contact Q3	1.13 (0.36-3.60)	1.65 (0.50-5.43)	1.25 (0.39-3.99)
Public contact Q4	1.22 (0.37-4.08)	0.79 (0.30-2.69)	0.65 (0.19-2.18)

[a]$P < .05$. [b]$P < .01$. Abbreviation: S/, nuevo sol (Peruvian currency).

to respond to the COVID-19 pandemic. However, individuals who reported high barriers had lower odds of being ready (OR 0.34; 95% CI, 0.19 to 0.62), willing (OR 0.36; 95% CI, 0.20 to 0.66), and able (OR 0.34; 95% CI, 0.18 to 0.61) to respond to the COVID-19 pandemic. Perceived knowledge, confidence, and threat were not significantly associated with any of the 3 response outcomes.

Discussion

In this study, we characterized the risk factors and barriers to pandemic preparedness response among Peruvian VACWs during the first year of the COVID-19 pandemic. Despite the severe impact of the COVID-19 pandemic in

Table 8. Association Between Knowledge, Confidence, Threat, Efficacy, and Barriers and Readiness, Willingness, and Ability to Respond to the COVID-19 Pandemic (N = 266)

	Ready OR (95% CI)	*Willing OR (95% CI)*	*Able OR (95% CI)*
Knowledge	1.84 (1.04-3.28)	1.74 (0.98-3.09)	1.42 (0.79-2.54)
Confidence	1.48 (0.83-2.63)	1.04 (0.59-1.85)	1.20 (0.68-2.14)
Threat	1.16 (0.67-2.03)	1.01 (0.59-1.75)	1.15 (0.66-2.01)
Efficacy	2.51[a] (1.45-4.36)	2.24[b] (1.30-3.87)	2.88[b] (1.64-5.03)
Barriers	0.34[b] (0.19-0.62)	0.36[b] (0.20-0.66)	0.34[b] (0.18-0.61)

[a]$P < .01$. [b]$P < .005$.

Peru during 2020, the majority of VACWs did not report professional barriers. Personal barriers such as inadequate transportation and the need to care for family members and dependents were the most prevalent, yet were reported by only a fifth of respondents. A similar percentage of Peruvian (20.3%) and US-based (25.0%) VACWs indicated that taking care of family or dependent needs was a barrier to report to work.[25] In contrast, 19.3% of Peruvian VACWs indicated that transportation to or from work was a major barrier to report to work, while only 2.0% of US-based VACWs did.[25] This reflects the fact that in Peru, the majority of the people do not have a privately owned vehicle, and therefore most individuals rely on public transportation.[30] A previous study reported that public transportation in Lima (where the majority of our survey respondents live) is highly deficient.[31] Problems include long travel times and high density within vehicles, which may be perceived as high risk for COVID-19 transmission. Designing interventions that enable safe transportation mechanisms for primary responders such as VACWs during country emergencies may increase their readiness, willingness, and ability to respond to disasters.

Peruvian VACWs considered clients and visitors as the most likely source of SARS-CoV-2. These results are similar to those found among US veterinary professionals.[25] The survey was conducted during the first year of the pandemic, when household transmission dynamics of SARS-CoV-2 were not fully elucidated; although household transmission is now recognized as a likely source of infection, gaps in understanding at the time of the survey may have contributed to the findings.[32] Moreover, among Peruvian VACWs, increased coworker contact was associated with decreased perception of risk and increased willingness and ability to respond to the health crisis. This differs from the US-based study where increased contact with coworkers was associated with increased risk perception and it was not associated with changes among the main response outcomes (ie, readiness, willingness, and ability to respond). We hypothesize that this interesting finding could suggest that peer support and the interconnectedness of Peruvian VACW networks enable them to respond to health emergencies.[33] Another hypothesis that could explain this is the potential for larger clinics with higher coworker contact to provide more resources for employees in comparison with smaller veterinary practices. This means that the association between coworker contact and perceived risk, as well as willingness and ability to respond, could be confounded by the number of resources and safety practices within the workplace.[34,35] Finally, strict testing protocols for all open businesses (including veterinary clinics) during the first year of the pandemic could have contributed to VACW confidence among peers.[36]

A previous national crisis, namely the 2007 earthquake on the coast of Peru, mobilized the veterinary community to support animal health needs in the aftermath of the disaster.[27] Although this event occurred more than a decade ago, it could serve as potential evidence that veterinarians in the region are physically and emotionally ready to respond to emergencies and that they should be considered by national authorities in future events. The question remains as to whether response preparedness to natural disasters (commonly experienced in Peru) could have translated to readiness to respond to the COVID-19 pandemic in a similar way as previous experiences dealing with epidemics have successfully prepared the African continent to respond to the COVID-19 crisis.[37] Future studies should evaluate readiness, willingness, and ability of VACWs in other Latin American countries to determine if there are differences in the response to health emergencies and biological risks in comparison with other events such as natural disasters, and if preparedness protocols and training used frequently for natural disasters could be adapted to pandemic preparedness.

Regarding the unintended consequences of the COVID-19 pandemic, 64.3% of respondents indicated that they were concerned about economic resilience of the veterinary and animal care fields. This might be related to the fact that the majority of VACWs in Peru work in small animal veterinary practices that are highly dependent on nonessential (ie, elective and aesthetic) veterinary procedures, which were restricted at the beginning of the pandemic.[38] Additionally, the pandemic reduced the number of clients visiting the clinic and as a result, decreased nonmedical sales, which is a common source of income for small animal veterinarians.[39,40] Small practices, as other small business, have a reduced financial flexibility, and therefore were severely impacted by the increase in cost of medical supplies.[41] Other veterinary professionals, including large animal and equine medical professionals, could have been

affected by nationwide lockdowns and the inability to mobilize. Finally, VACWs from shelters perceived a drastic decrease in donations and lower numbers of volunteers, affecting their everyday activities.[42] Interestingly, only 49.3% of Peruvian VACWs were concerned about mental health implications in veterinary and animal care fields. This was the first attempt at quantifying and reporting mental health concerns among Peruvian VACWs, showing alarmingly high response rates. Even though the percentage reported among US-based VACWs was higher (89.0%), the mental health status of Peruvian VACWs should not be neglected.[25] Although further studies are required to characterize perceived mental healthcare issues, it can be hypothesized that they are related to informal labor, low recognition, and financial instability. These results could also indicate that US-based VACWs could be more aware of mental health issues among veterinarians, or that mental health conditions could be neglected or stigmatized in Peru and other Latin American countries in comparison with the United States.[43,44]

In the study cohort, increased contact with the public (eg, clients, visitors) was positively associated with high perceived threat from COVID-19, but was not associated with respondents' readiness, willingness, and ability to respond to the pandemic. This suggests that Peruvian VACWs may perceive a higher risk associated with dealing with the public, yet this does not preclude them from responding to an emergency situation. Similar trends were observed among US VACWs.[25] That said, occupational exposures should be a target amenable for intervention at the workplace in future health emergency situations. This is especially important among veterinary professionals who are constantly at an increased risk of exposure and infection with zoonotic diseases.[45] It could also be possible that avoiding going to work is not possible among this group of professionals whose economic income depends on onsite work and interaction with colleagues, the public, and animals. Nonetheless, it is not possible to compare VACWs with other professionals because no studies, to our knowledge, have evaluated the response preparedness and risk perception among other professions in Peru.

Job experience (in years) and salary level were associated with increased job efficacy and confidence in safety protocols during the COVID-19 pandemic. This is expected as more experienced workers have improved self-assurance in their job role.[46] Our analysis shows that efficacy was significantly associated with readiness, willingness, and ability of VACWs to respond to the COVID-19 pandemic, as has been shown in other biological risks preparedness response studies.[21,24,47] These findings highlight that interventions should target workers with less work experience to improve overall professional pandemic response. Leadership roles were not associated with the VACWs' response to the COVID-19 pandemic, as they were among US-based VACWs.[25] However, more than 80% of our respondents identified as having a leadership role, while only 57% of those in the United States did. This could be a result of the nature of the veterinary practice in Peru, which is largely composed of small veterinary clinics owned by the attending veterinarian, and differs from the trends in the United States toward larger, multidoctor veterinary practices and corporate medicine (N. Falcón, personal communication, February 8, 2022). Finally, the limited number of respondents in the older age categories and respondents in nonleadership roles could limit the power to properly assess this association within this population, and as such is a limitation of this study.

While this is the first study to evaluate pandemic response and risk factors among VACWs in Peru, it has several important limitations. Most respondents were VACWs working in small animal medicine in Lima (the capital city) and more than 70% were younger than 40 years. Because we have only a few observations from VACWs in different regions of Peru other than the capital, we dichotomized the location as Lima vs outside of Lima. Although we recognize this as a limitation of the study, it is important to mention that 44% of all Peruvian veterinarians are registered in Lima. We are not able to determine the percentage of the total veterinary support staff who were enrolled in the study because there is no official census of this professional population. Better enumeration of the allied professionals within the veterinary workforce will be important to future efforts for workforce preparedness activities and training in Peru. Additionally, this study represents a snapshot in time during the first year of the pandemic, and risk perceptions may have evolved since then. Some biases, commonly present in studies that use surveys, could have impacted our results, such as self-selection bias as evidenced by more than 80% of the study population considering themselves in a leadership role. Finally, the survey could have better categorized training by differentiating training in general biological risks and training in biological risks associated with the COVID-19 pandemic.

Conclusion

This is the first study to evaluate pandemic preparedness and response readiness among first responders in Peru, and the first of its kind among veterinarians in Latin America. Our findings indicate that, despite some professional and personal barriers to respond to the pandemic, Peruvian VACWs were willing and able to respond to the COVID-19 health emergency. Results indicated that high contact with peers increased their willingness and ability to respond to the pandemic, suggesting that the veterinary community in Peru could consist of a group of professionals with a social and professional support network that enables them to respond to emergency and disaster situations, and could prove an important and underutilized resource in

community response efforts. Government authorities should acknowledge VACWs as professionals who are capable of responding during a national emergency and willing to do so. However, to do so, VACWs should be—and deserve to be—trained and prepared to respond effectively and appropriately, a gap noted by respondents in our study. These results will help tailor future interventions that prepare and protect VACWs who will likely face future biological and natural disasters.

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