Knowledge, Perception and Attitude of Veterinarians about Q Fever from South Spain

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Article

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Abstract

Q Fever is a zoonosis caused by *Coxiella burnetii* that affects domestic and wild ruminants, leading to reproductive disorders. In humans, the disease can manifest with respiratory and cardiac symptoms. Veterinarians, as healthcare professionals in close contact with animals, serve both as the first line of defence in preventing infection at the animal-human interfaz and as an important sentinel group for the rapid detection of outbreaks. The aim of this study was to assess the knowledge, perception, and attitude of veterinarians in Southern Spain regarding Q Fever. To this end, an online survey was designed, validated, and conducted among veterinarians in the province of Malaga, with a final participation of 97 individuals, predominantly from the private sector (clinic, livestock, agri-food, etc.). The data obtained reflected a general lack of knowledge about the disease, particularly concerning its epidemiology and infection prevention. Regarding perception and attitude, a significant percentage of respondents stated they did not use protective equipment when handling susceptible animals and only sought information about the disease in response to outbreak declarations. The study emphasized the significance of promoting training in zoonotic diseases during and after graduation, the relevance of official channels in occupational risk prevention, and the utility of epidemiological surveys as a tool to identify and address potential gaps in knowledge related to this disease.

Keywords: zoonoses; Q Fever; one health; survey; biosafety

1. Introduction

Q Fever, also known as Coxiellosis, is a zoonotic infectious disease caused by the bacterium *Coxiella burnetii* [1], with a global distribution, excluding New Zealand and Antarctica [2]. In Europe, the number of reported cases has significantly increased in recent decades, with Spain standing out as the European Union country with the highest notification rate [3]. Regarding the study area for this work, between 2018 and 2023, 52 cases of Q Fever were detected in the province of Malaga (Illustrious Official College of Veterinarians of Malaga), representing a zoonosis with moderate-to-high prevalence in this location.

Epidemiologically, Q Fever presents two main cycles: a wild cycle, involving ruminants (primarily cervids) and migratory birds, and a domestic cycle, where sheep are the most susceptible species, followed by goats and cattle, although dogs and cats can also contract the infection and act as a source of transmission to humans [4–6]. Both cycles are interconnected through ticks, which serve as reservoir vectors [7]. In Southern Spain, the seroprevalence of Q Fever is estimated at 13.88% in

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sheep and 13.4% in Iberian wild goats [8,9]. The main route of infection and transmission is indirect, through the inhalation of contaminated aerosols or particles. Infected females release large quantities of *C. burnetii* during birth or abortion. Additionally, excretion can occur through faeces, vaginal mucus, urine, and milk. This last form of excretion could lead to foodborne transmission; however, heat treatments applied to milk and the lack of conclusive evidence mean it is not considered a foodborne risk [10]. Diagnosis is based on polymerase chain reaction (PCR) and serological tests, such as enzyme-linked immunosorbent assays (ELISA) [11]. The Coxevac® vaccine is used in ruminants to reduce abortions and bacterial excretion, with tetracyclines used as treatment [12].

This disease has a significant impact on public health due to its ability to infect humans, mainly through contact with animals, classifying it as an occupational zoonosis. Although rarely fatal in humans, acute infections can cause fever, fatigue, pneumonia, and hepatitis, while chronic forms may result in endocarditis and other serious complications, especially in immunocompromised individuals or those with valvular heart diseases [13]. Furthermore, Q Fever is included on the list of notifiable diseases by the World Health Organization (WHO) and the World Organization for Animal Health (WOAH).

The aim of this study was to conduct a cross-sectional survey among veterinarians in the province of Malaga to assess their knowledge, perceptions, and attitudes toward Q Fever.

2. Material and Methods

Due to the nature of the information collected, prior approval from the Bioethics Committee of the Junta de Andalucia was required (Reference: SICEIA-2024-002752). To comply with the Organic Law on Data Protection and Guarantee of Digital Rights (LODPGDR) 2018 and the General Data Protection Regulation (GDPR) 2022, data anonymization was maintained throughout the entire research process.

4.1. Study Population and Sampling

Between October and December 2024, a cross-sectional survey was conducted among licensed veterinarians in the province of Malaga (covering 27.6% of the total registered veterinarians in Andalusia), remaining open to all professional fields: clinical practice, public health, agriculture, public administrations, laboratories, food companies, and education. This encompassed a study population of 1.187 veterinarians. Regarding the study design, as well as the analysis and presentation of results, they were carried out following the STROBE checklist (Strengthening the Reporting of Observational Studies in Epidemiology).

4.2. Study Questionnaire

To calculate the sample size, it was estimated that, for a confidence level of 95%, a maximum acceptable error of 10%, a standard deviation in the responses of 0.5 (50%), and a study population of 1.187 veterinarians (Official College of Veterinarians of Malaga as of September 30, 2024), the sample should consist of 89 participants. This implies that, for an expected response rate of 20%, it was necessary to send the survey to at least 445 individuals.

The questionnaire was designed using the online program EUSurvey, developed by the European Commission's Department for Digital Services. This program enables the creation of a link to facilitate anonymous distribution and participation among the study population. The link was sent to the Veterinary College of Malaga for dissemination via newsletters, the website, and social media, indicating the possibility of forwarding the link to non-member colleagues to expand the sampling framework ("snowball sampling").

The questionnaire's development referenced information about Q Fever published on the websites of the WHO, ECDC, WOAH, and Spain's Ministry of Health. It included single-option and multiple-choice questions. To minimize random correct answers or partial knowledge, questions

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with more than one correct answer were presented as independent options, allowing participants to select more than one.

Prior to dissemination, the questionnaire underwent validation in two phases. Firstly, it was sent to researchers and professors from the Faculty of Veterinary Medicine in Cordoba, who provided suggestions regarding adequacy, conciseness, and relevance. After revisions, a pilot study was conducted with 20 conveniently available veterinarians in Cordoba. Participants were asked to provide feedback on any difficulties in understanding the survey, and items were revised if at least 15% of respondents reported difficulty with them. Two questions were modified based on this feedback. The final version of the questionnaire consisted of five sections:

- Demographic data (10 items): personal details of the respondent (gender, age, highest level of education, current employment status, professional field, and work location).
- General knowledge of the disease (14 items): etiology, epidemiology, clinical features, diagnosis, and prophylaxis.
- Specific knowledge about the disease in Spain (3 items): aimed at assessing respondents' understanding of presentation forms, seasonal presentation, and the mandatory reporting of cases.

In both cases, items were scored with '1' point for each correct answer and '0' points if all selected answers were incorrect or the respondent marked "don't know/no response."

- Perception of Q Fever (4 items): multiple-choice, single-choice, and numerical rating scale (NRS from 0 to 5 points) questions, designed to evaluate participants' opinions on their training, the quality of information sources, and the occupational zoonotic risk posed by this disease.
- Attitude toward Q Fever (7 items): single-choice and multiple-choice questions, aimed at evaluating attitudes toward the use of protective equipment and preventive measures, vaccination, early diagnosis, and continued training about the disease.

The estimated average time to complete the questionnaire was 15 minutes.

4.3. Statistical Analysis

Performed with the IBM SPSS Statistics version 28 program. Based on demographic data, the study population was characterized by calculating the percentages and frequency distributions of the responses obtained for each variable. To assess general and specific knowledge about Q Fever, the following were determined for each item: 1) the percentage of respondents who answered correctly (scores from 1 to 7, depending on the item), 2) the percentage who answered partially, and 3) those who did not answer or answered incorrectly (score of 0). The data obtained were statistically compared based on the demographic variable using the non-parametric Kruskal-Walli's test ($P \leq 0.05$). Subsequently, the total achievable score in each section was divided into quartiles, and it was considered that an individual had poor knowledge if their score was below the 50th percentile; good knowledge if it was between the 50th-75th percentiles; and very good knowledge if it exceeded the 75th percentile. The scores of individuals in the different categories were contrasted using the Kruskal-Walli's rank test ($P \leq 0.05$) to assess significant differences based on the demographic characteristics of the respondents.

Finally, the frequency distributions and percentages obtained in the perception and attitude questions were determined and compared based on the demographic characteristics of the respondents, using non-parametric tests (Chi-square, Kruskal-Wallis, and Mann-Whitney U, depending on the nature of the variable) ($P \leq 0.05$), applying the Bonferroni correction in the case of pairwise multiple comparisons. The data obtained were graphically represented using the EUSurvey program.

3. Results

A total of 97 veterinarians participated, of whom 69% were between 31 and 50 years old, 55.7% were male, and 97.9% held a degree in Veterinary Medicine. Of the participants, 72.2% worked in urban areas and 83.5% were employed in the private sector, primarily in small and large animal

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clinics. In the public sector (14.4%), 92.9% worked in departments related to Agriculture, Fisheries, and Health (Table 1).

Table 1. Demographic characterization.

Total participants (N=97)	n (Percentage %)	CI95%
Gender		
Male	54 (55.7%)	45.8–65.6%
Female	42 (43.3%)	33.4–53.2%
Other	1 (1%)	0-3%
Age (years)		
22 - 30	10 (10.3%)	4.3–16.4%
31 - 40	32 (33%)	23.6–42.4%
41 - 50	35 (36.1%)	26.5–45.6%
Over 50	20 (20.6%)	12.6–28.7%
Higher level of studies		
Bachelor's degree in veterinary medicine	95 (97.9%)	95.1–100%
PhD in Veterinary Medicine	2 (2.1%)	0–4.9%
Another higher level of studies		
Yes	8 (8.3%)	2.8–7.13%
No	89 (91.7%)	86.3–97.2%
Usual work area		
Rural and semi-urban (< 10,000 inhabitants)	27(27.8%)	18.9–36.8%
Urban (> 10,000 inhabitants)	70 (72.2%)	63.3–81.1%
Work area		
Public sector	14 (14.4%)	7.4–21.4%
Private sector	81 (83.5%)	76.1–90.9%
Unoccupied	2 (2.1%)	0–4.9%
Public sector (n=14)		
Ministry of Agriculture and Fisheries	6 (42.9%)	16.9–68.8%
Ministry of Health	7 (50%)	23.8–76.2%
City Hall	1 (7.1%)	0–20.6%
Private sector (n=81)		
Small animal clinic only	39 (48.2%)	37.3-59%
Large Clinic and Animal Production	37 (45.7%)	34.8–56.5%
Food or environmental company	4 (4.9%)	0.2–9.7%
Technology centres and laboratories	1 (1.2%)	0–3.6%

Most of the participants (96.9%) were aware of the zoonotic nature of the disease, and 82.47% recognized its bacterial origin (Table 3). However, 10.3% mistakenly identified the vector as the etiological agent. Regarding endemic distribution, only 10.3% answered all options correctly, while 78.4% provided partially correct responses. As for reservoirs, 92.8% identified domestic ruminants, but only 9.3% recognized birds and deer as wild reservoirs.

Table 3. General knowledge of the disease.

Total participants (N=97)				
Question	**Correct % (CI95%)**	**Partially correct % (CI95%)**	**Incorrect or I do not know % (CI95%)**	P Value
Is Q Fever a zoonosis?	**96.9% (93.5-100)**	**-**	**3.1% (0-6.5)**	
Work area				
Rural-semi-urban (n=27)	96.3% (89.2-100)	-	3.7% (0-10.8)	1.00
Urban (n=70)	97.1% (93.2-100)	-	2.9% (0-6.8)	
Work area				
Public sector (n=14)	100% (100-100)	-	0% (0-0)	
Private sector (n=81)	96.3% (92.2-100)	-	3.7% (0-7.8)	0.73
Unoccupied (n=2)	100% (100-100)	-	0% (0-0)	

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Private sector				
Small animals (n=39)	97.4% (92.5-100)	-	2.6% (0-7.5)	
Large animals (n=37)	97.3% (92.1-100)	-	2.7% (0-7.9)	0.14
Company (n=4)	75% (32.6-100)	-	25% (0-67.4)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
What causes Q Fever?	**82.47% (75-90)**	**-**	**17.53% (10-25)**	
Work area				
Rural-semi-urban (n=27)	85.2% (71.8-98.6)	-	14.8% (1.4-28.2)	0.77
Urban (n=70)	81.4% (72.3-90.5)	-	18.6% (9.5-27.7)	
Work area				
Public sector (n=14)	78.6% (57-100)	-	21.4% (0-43)	
Private sector (n=81)	84% (76-92)	-	16% (8-24)	0.42
Unoccupied (n=2)	50% (0-100)	-	50% (0-100)	
Private sector				
Small animals (n=39)	84.6% (73.3-96)	-	15.4% (4.1-26.7)	
Large animals (n=37)	83.8% (71.9-95.6)	-	16.2% (4.3-28.1)	0.93
Company (n=4)	75% (32.6-100)	-	25% (0-67.4)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
In which areas is the disease endemic?	**10.3% (4.2-16.3)**	**78.4% (70.1-86.6)**	**11.3% (5.1-17.7)**	
Work area				
Rural-semi-urban (n=27)	14.5% (1.4-28.2)	74.1% (57.5-90.6)	11.4% (0-22.9)	0.91
Urban (n=70)	8.6% (2-15.1)	80% (70.6-89.4)	11.4% (3.9-18.9)	
Work area				
Public sector (n=14)	0% (0-0)	78.6% (57.1-100)	21.4% (0-42.9)	
Private sector (n=81)	12.4% (5.1-19.5)	77.8% (68.7-86.8)	9.8% (3.4-16.3)	0.51
Unoccupied (n=2)	0% (0-0)	100% (100-100)	0% (0-0)	
Private sector				
Small animals (n=39)	10.3% (0.8-19.8)	79.4% (66.8-92.1)	10.3% (0.8-19.8)	
Large animals (n=37)	16.2% (4.3-28.1)	78.4% (65.1-91.7)	5.4% (0-12.7)	0.51
Company (n=4)	0% (0-0)	50% (1-99)	50% (1-99)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0 (0-0)	
Which domestic species are most susceptible?	**92.8% (87.6-97.9)**	**-**	**7.2% (2.1-12.4)**	
Work area				
Rural-semi-urban (n=27)	96.3% (89.1-100)	-	3.7% (0-10.8)	0.66
Urban (n=70)	91.4% (84.9-98)	-	8.6% (2-15.1)	
Work area				
Public sector (n=14)	100% (100-100)	-	0% (0-0)	
Private sector (n=81)	92.6% (86.9-98.3)	-	7.4% (1.7-13.1)	**0.038**
Unoccupied (n=2)	50% (1-99)	-	50% (1-99)	
Private sector				
Small animals (n=39)	92.3% (84-100)	-	7.7% (0-16.1)	
Large animals (n=37)	94.6% (87.3-100)	-	5.4% (0-12.7)	0.55
Company (n=4)	75% (32.6-100)	-	25% (0-67.4)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
What are its wild reservoirs?	**9.3% (3.5-15.1)**	**62.3% (53.3-72.5)**	**28.4% (19-36.8)**	
Work area				
Rural-semi-urban (n=27)	11.1% (0-23)	59.3% (40.7-77.8)	29.6% (12.4-46.9)	0.87
Urban (n=70)	8.6% (2-15.1)	64.3% (53.1-75.5)	27.1% (16.7-37.6)	
Work area				
Public sector (n=14)	0%	64.3% (39.1-89.4)	35.7% (10.6-60.8)	
Private sector (n=81)	11.1% (4.3-18)	63% (52.5-73.5)	25.9% (16.4-35.5)	0.62
Unoccupied (n=2)	0%	50% (1-99)	50% (1-99)	
Private sector				
Small animals (n=39)	7.7% (0-16.1)	64.1% (49.1-79.2)	28.2% (14.1-42.3)	0.85
Large animals (n=37)	16.2% (4.3-28.1)	59.5% (43.6-75.3)	24.3% (10.5-38.1)	

 doi:10.20944/preprints202506.1903.v1

Company (n=4)	0% (0-0)	75% (32.6-100)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	
How does infection occur in animals?	**10.3% (4.3-16.4)**	**82.5% (75-90)**	**7.2% (2.1-12.4)**	
Work area				
Rural-semi-urban (n=27)	3.7% (0-10.9)	92.6% (82.7-100)	3.7% (0-10.9)	0.57
Urban (n=70)	12.9% (5-20.7)	78.6% (69-88.2)	8.5% (2-15.1)	
Work area				
Public sector (n=14)	0% (0-0)	92.9% (79.4-100)	7.1% (0-20.7)	
Private sector (n=81)	11.1% (4.3-18)	81.5% (73-90)	7.4% (1.7-13.1)	0.15
Unoccupied (n=2)	50% (1-99)	50% (1-99)	0% (0-0)	
Private sector				
Small animals (n=39)	15.4% (4.1-16.7)	77% (63.7-90.1)	7.4% (0-16.1)	
Large animals (n=37)	8.1% (0-16.9)	86.5% (75.5-97.5)	5.4% (0-12.7)	0.81
Company (n=4)	0% (0-0)	75% (32.6-100)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	
How does infection occur in humans?	**1% (0-3)**	**91.8% (86.3-97.2)**	**7.2% (2.1-12.4)**	
Work area				
Rural-semi-urban (n=27)	0% (0-0)	96.3% (89.2-100)	3.7% (0-10.9)	0.86
Urban (n=70)	1.4% (0-4.2)	90% (83-97)	8.6% (2-15.1)	
Work area				
Public sector (n=14)	0% (0-0)	92.9% (79.4-100)	7.1% (0-20.7)	
Private sector (n=81)	1.2% (0-3.6)	91.4% (85.2-97.5)	7.4% (1.7-13.1)	0.81
Unoccupied (n=2)	0% (0-0)	100% (100-100)	0% (0-0)	
Private sector				
Small animals (n=39)	2.6% (0-7.5)	89.7% (80.2-99.3)	7.7% (0-16.1)	
Large animals (n=37)	0% (0-0)	97.3% (92.1-100)	2.7% (0-8)	**0.04**
Company (n=4)	0% (0-0)	75% (32.6-100)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	0% (0-0)	100% (100-100)	
What is the most common form of presentation in animals?	**53.6% (43.7-63.5)**	**-**	**46.4% (36.5-56.3)**	
Work area				
Rural-semi-urban (n=27)	48.2% (29.3-67)	-	51.8% (33-70.7)	0.65
Urban (n=70)	55.7% (44.1-67.3)	-	44.3% (32.7-56)	
Work area				
Public sector (n=14)	64.3% (39.2-89.4)	-	35.7% (10.6-60.8)	
Private sector (n=81)	53.1% (42.2-64)	-	46.9% (36-57.8)	0.22
Unoccupied (n=2)	0% (0-0)	-	100% (100-100)	
Private sector				
Small animals (n=39)	51.3% (35.6-67)	-	48.7% (33-64.4)	
Large animals (n=37)	56.8% (40.8-72.7)	-	43.2% (27.3-59.2)	0.49
Company (n=4)	25% (0-67.4)	-	75% (32.6-100)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
What are the most common clinical signs in sick animals?	**41.2% (31.4-51)**	**-**	**58.8% (49-68.6)**	
Work area				
Rural-semi-urban (n=27)	29.6% (12.4-46.9)	-	70.4% (53.1-57.6)	0.14
Urban (n=70)	45.7% (34-57.4)	-	54.3% (42.6-66)	
Work area				
Public sector (n=14)	35.7% (10.6-60.8)	-	64.3% (39.2-89.4)	
Private sector (n=81)	42% (31.2-52.7)	-	58% (47.3-67.8)	0.87
Unoccupied (n=2)	50% (0-100)	-	50% (0-100)	
Private sector				
Small animals (n=39)	43.6% (28-59.2)	-	56.4% (40.9-72)	0.5

 doi:10.20944/preprints202506.1903.v1

Large animals (n=37)	40.5% (24.7-56.4)	-	59.5% (43.7-75.3)	
Company (n=4)	25% (0-67.4)	-	75% (32.6-100)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
What is the most common form of presentation in humans?	**83.5% (76.1-90.9)**	**-**	**16.5% (9.1-23.9)**	
Work area				
Rural-semi-urban (n=27)	81.5% (66.9-96.1)	-	18.5% (3.9-33.1)	0.76
Urban (n=70)	84.3% (75.8-92.8)	-	15.7% (7.2-24.2)	
Work area				
Public sector (n=14)	71.4% (47.8-95.1)	-	28.6% (4.9-52.2)	
Private sector (n=81)	86.4% (79-93.9)	-	13.6% (6.1-21.1)	0.16
Unoccupied (n=2)	50% (1-99)	-	50% (1-99)	
Private sector				
Small animals (n=39)	89.7% (80.2-99.3)	-	10.3% (0.7-19.8)	
Large animals (n=37)	83.8% (71.9-95.7)	-	16.2% (4.3-28.1)	0.75
Company (n=4)	75% (32.6-100)	-	25% (0-67.4)	
Technology centre (n=1)	100% (100-100)	-	0% (0-0)	
What are the most common clinical signs in sick people?	**10.3% (4.3-16.4)**	**79.4% (71.3-87.4)**	**10.3% (4.3-16.4)**	
Work area				
Rural-semi-urban (n=27)	3.7% (0-10.8)	88.9% (77-100)	7.4% (0-17.3)	0.53
Urban (n=70)	12.9% (5-20.7)	75.7% (65.7-85.8)	11.4% (4-18.9)	
Work area				
Public sector (n=14)	7.1% (0-20.6)	85.8% (67.4-100)	7.1% (0-20.6)	
Private sector (n=81)	11.1% (4.3-18)	79% (70.1-87.9)	9.9% (3.4-16.4)	0.23
Unoccupied (n=2)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector				
Small animals (n=39)	12.8% (2.3-23.3)	76.9% (63.7-90.1)	10.3% (0.7-19.8)	
Large animals (n=37)	10.8% (0.8-20.8)	83.8% (71.9-95.7)	5.4% (0-12.7)	0.25
Company (n=4)	0% (0-0)	75% (32.6-100)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	0% (0-0)	100% (100-100)	
Recommended diagnostic techniques in animals	**30.9% (21.7-40.1)**	**57.7% (47.9-67.6)**	**11.4% (5-17.7)**	
Work area				
Rural-semi-urban (n=27)	18.5% (3.9-33.1)	66.7% (48.9-84.5)	14.8% (1.4-28.2)	0.25
Urban (n=70)	35.7% (24.5-47)	54.3% (42.6-66)	10% (3-17)	
Work area				
Public sector (n=14)	28.6% (4.9-52.2)	57.1% (31.2-83.1)	14.3% (0-32.6)	
Private sector (n=81)	30.9% (20.8-40.9)	59.3% (48.6-70)	9.8% (3.4-16.4)	0.36
Unoccupied (n=2)	50% (0-100)	0% (0-0)	50% (0-100)	
Private sector				
Small animals (n=39)	35.9% (20.8-51)	59% (43.5-74.4)	5.1% (0-12.1)	
Large animals (n=37)	29.7% (15-44.5)	62.2% (46.5-77.8)	8.1% (0-16.9)	**0.002**
Company (n=4)	0% (0-0)	25% (0-67.4)	75% (32.6-100)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	
Main biosecurity measures on livestock farms	**20.6% (12.6-18.7)**	**72.2% (63.3-81.1)**	**7.2% (2.1-12.4)**	
Work area				
Rural-semi-urban (n=27)	25.9% (9.4-42.5)	66.7% (48.9-84.5)	7.4% (0-17.3)	0.33
Urban (n=70)	18.6% (9.5-27.7)	74.3% (64.1-84.5)	7.1% (1.1-13.2)	
Work area				
Public sector (n=14)	14.3% (0-32.6)	71.4% (47.8-95.1)	14.3% (0-32.6)	
Private sector (n=81)	17.3% (9.1-25.5)	77.8% (68.7-86.8)	4.9% (0.2-9.7)	0.1
Unoccupied (n=2)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector				
Small animals (n=39)	25.6% (11.9-39.4)	69.2% (54.8-83.7)	5.2% (0-12.1)	0.13

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Large animals (n=37)	8.1% (0-16.9)	89.2% (79.2-99.2)	2.7% (0-7.9)	
Company (n=4)	25% (0-67.4)	50% (1-99)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	
Main measures to prevent human infection	**2.1% (0-4.9)**	**90.7% (84.9-96.5)**	**7.2% (2.1-12.4)**	
Work area				
Rural-semi-urban (n=27)	0% (0-0)	92.6% (82.7-100)	7.4% (0-17.3)	0.84
Urban (n=70)	2.9% (0-6.8)	90% (82.9-97)	7.1% (1.1-13.2)	
Work area				
Public sector (n=14)	0% (0-0)	85.7% (67.4-100)	14.3% (0-32.6)	
Private sector (n=81)	2.5% (0-5.9)	92.6% (86.9-98.3)	4.9% (0.2-9.7)	0.22
Unoccupied (n=2)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector				
Small animals (n=39)	5.1% (0.4-12.1)	89.8% (75.8-99.2)	5.1% (0.4-12.1)	
Large animals (n=37)	0% (0-0)	97.3% (92.1-100)	2.7% (0-7.9)	0.68
Company (n=4)	0% (0-0)	75% (32.6-100)	25% (0-67.4)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	

A high percentage of the participants (84.5%) identified tick bites and the inhalation of contaminated aerosols as transmission routes (Table 3), but only 15.3% associated human transmission with contact with animals. Regarding clinical manifestations in animals, 53.6% were aware of their asymptomatic nature, but 58.8% incorrectly responded about clinical signs. Only 41.2% accurately identified reproductive disorders. For humans, the majority (83.5%) understood that the most common presentation is asymptomatic, yet only 10.3% identified all clinical signs.

In terms of diagnosis, the majority chose PCR, disregarding ELISA, which is recommended by the WOAH (2018) [11]. Only 20.6% identified all the necessary biosafety measures for livestock farms, with the most selected being faeces treatment, disinfection, vaccination, and tick control (Table 3). Regarding human prevention, 90.7% provided partially correct responses, with the most selected measures being the use of protective clothing and tick control. Additionally, only 14.4% mentioned vaccination, and 17.5% identified quarantine as a preventive measure.

A remarkable percentage of the participants (71.1%) were aware of the classification of Q Fever as a Notifiable Disease (ND) (Table 4). However, the majority (62.9%) answered incorrectly regarding its presentation in humans. Nevertheless, 77.3% correctly associated the lambing season with peaks in cases.

Table 4. Knowledge of the disease in Spain.

Total participants (N=97)				
Question	**Correct % ($CI_{95\%}$)**	**Partially correct % ($CI_{95\%}$)**	**Incorrect or I do not know % ($CI_{95\%}$)**	P Value
Is it a Notifiable Disease?	**71.1% (62.1-80.1)**	**-**	**28.9% (19.9-37.9)**	
Work area				
Rural-semi-urban (n=27)	74.1% (57.5-90.1)	-	25.9% (9.6-42.5)	0.69
Urban (n=70)	70% (59.3-80.7)	-	30% (19.3-40.7)	
Work area				
Public sector (n=14)	57.1% (31.2-83.1)	-	42.9% (16.9-68.8)	
Private sector (n=81)	74.1% (64.5-83.6)	-	25.9% (16.4-35.5)	0.35
Unoccupied (n=2)	50% (0-100)	-	50% (0-100)	
Private sector				
Small animals (n=39)	76.9% (63.7-90.2)	-	23.1% (9.8-36.3)	
Large animals (n=37)	78.4% (65.1-91.6)	-	21.6% (8.4-34.9)	**0.039**
Company (n=4)	25% (0-67.4)	-	75% (32.6-100)	
Technology centre (n=1)	0% (0-0)	-	100% (100-100)	

 doi:10.20944/preprints202506.1903.v1

What is the typical presentation of the disease in humans?	**37.1% (27.5-46.7)**	**-**	**62.9% (53.3-72.5)**	
Work area				
Rural-semi-urban (n=27)	44.4% (25.7-63.2)	-	55.6% (36.8-74.3)	0.35
Urban (n=70)	34.3% (23.2-45.4)	-	65.7% (54.6-76.8)	
Work area				
Public sector (n=14)	21.4% (0-42.9)	-	78.6% (57.1-100)	
Private sector (n=81)	40.7% (30-51.4)	-	59.3% (48.6-70)	0.21
Unoccupied (n=2)	0% (0-0)	-	100% (100-100)	
Private sector				
Small animals (n=39)	43.6% (28-59.1)	-	56.4% (40.9-72)	
Large animals (n=37)	43.2% (27.3-59.2)	-	56.8% (40.8-72.7)	0.3
Company (n=4)	0% (0-0)	-	100% (100-100)	
Technology centre (n=1)	0% (0-0)	-	100% (100-100)	
During what period of the year do most human cases occur?	**77.3% (69-85.7)**	**-**	**22.7% (14.3-31)**	
Work area				
Rural-semi-urban (n=27)	70.4% (53.2-57.6)	-	29.6% (12.4-46.8)	0.31
Urban (n=70)	80% (70.6-89.4)	-	20% (10.6-19.4)	
Work area				
Public sector (n=14)	57.1% (31.2-83.1)	-	42.9% (16.9-68.8)	
Private sector (n=81)	80.3% (71.6-88.9)	-	19.7% (11.1-28.4)	0.12
Unoccupied (n=2)	100% (100-100)	-	0% (0-0)	
Private sector				
Small animals (n=39)	87.2% (76.7-97.7)	-	12.8% (2.3-23.3)	
Large animals (n=37)	83.8% (71.9-95.7)	-	16.2% (4.3-28.1)	**0.001**
Company (n=4)	0% (0-0)	-	100% (100-100)	
Technology centre (n=1)	0% (0-0)	-	100% (100-100)	

More than half of the participants (54.6%) demonstrated *Poor* knowledge, 34% *Well* knowledge, and 11.4% *Very Good* knowledge (Table 2). There were no differences observed based on gender, age, or workplace environment; however, participants aged 22–30 scored higher, with 50% demonstrating *well* knowledge. Additionally, 93.5% considered official information regarding Q Fever as an occupational zoonosis to be insufficient. Moreover, 89.7% lacked a reliable source for protocols to address outbreaks (Table 5).

Table 2. Classification of knowledge.

Total participants (N=97)				
General knowledge	**Poor % (CI95%)**	**Well % (CI95%)**	**Very good % (CI95%)**	P Value
Gender				
Male (n=54)	57.4% (44.2-70.6)	31.5% (19.1-43.9)	11.1% (2.7-19.5)	
Female (n=42)	52.4% (37.3-67.5)	35.7% (21.2-50.2)	11.9% (2.1-21.7)	0.69
Other (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	
Age				
22 - 30 years (n=10)	40% (9.6-70.3)	50% (19-81)	10% (0-28.6)	
31 - 40 years (n=32)	59.4% (42.4-76.4)	28.1% (12.6-43.7)	12.5% (1.1-23.9)	0.61
41 - 50 years (n=35)	60% (43.8-76.2)	34.3% (18.6-50)	5.7% (0-13.4)	
Over 50 years old (n=20)	45% (23.2-66.8)	35% (14.1-55.9)	20% (2.5-37.5)	
Work area				
Public sector (n=14)	42.9% (16.9-68.8)	57.1% (31.2-83.1)	0% (0-0)	
Private sector (n=81)	56.8% (46-67.6)	29.6% (19.7-39.6)	13.6% (6.1-21.1)	0.25
Unoccupied (n=2)	50% (0-100)	50% (0-100)	0% (0-0)	
Total	**54.6% (44.7-64.6)**	**34% (24.6-43.4)**	**11.4% (5-17.6)**	

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Table 5. Perception of Q Fever.

Total participants (n=97)						
Do you think that official media (ministry, regional government, veterinary associations, etc.) sufficiently emphasize the importance of this disease as an occupational zoonosis?						
			% (CI95%)			
Score 1 (P1)			51.2% (41.6-61.5)			
Score 2 (P2)			42.3% (32.4-52.1)			
Score 3 (P3)			5.3% (0.8-9.6)			
Score 4 (P4)			0% (0-0)			
Score 5 (P5)			1.2% (0-3.1)			
	P1 % (CI95%)	**P2 % (CI95%)**	**P3 % (CI95%)**	**P4 % (CI95%)**	**P5 % (CI95%)**	P Value
Age						
22 - 30 years (n=10)	60% (29.6-90.4)	40% (9.6-7.4)	0% (0-0)	0% (0-0)	0% (0-0)	
31 - 40 years (n=32)	46.9% (29.6-64.2)	46.9% (29.6-64.2)	6.2% (0-14.6)	0% (0-0)	0% (0-0)	0.69
41 - 50 years (n=35)	42.9% (26.5-59.3)	48.6% (32-65.1)	5.7% (0-13.4)	0% (0-0)	2.8% (0-8)	
Over 50 years old (n=20)	70% (49.9-90)	25% (6-44)	5% (0-14.6)	0% (0-0)	0% (0-0)	
Knowledge						
Poor (n=53)	54.7% (41.3-68.1)	39.6% (26.4-52.8)	5.7% (0-11.9)	0% (0-0)	0% (0-0)	
Good (n=33)	42.4% (25.6-59.3)	51.6% (34.4-68.6)	3% (0-8.9)	0% (0-0)	3% (0-9)	0.56
Very good (n=11)	63.6% (35.2-92.1)	27.3% (0.9-53.3)	9.1% (0-26.1)	0% (0-0)	0% (0-0)	
Work area						
Public sector (n=14)	71.4% (47.8-95.1)	28.6% (4.9-52.2)	0% (0-0)	0% (0-0)	0% (0-0)	
Private sector (n=81)	48.2% (37.3-59)	44.4% (33.6-55.3)	6.2% (0.9-11.4)	0% (0-0)	1.2% (0-4)	0.78
Unoccupied (n=2)	50% (0-100)	50% (0-100)	0% (0-0)	0% (0-0)	0% (0-0)	
Do you consider you have a reliable source of information regarding the protocol for handling Q fever outbreaks in animals?						
	Yes % (CI95%)	**No % (CI95%)**	P Value			
Age						
22 - 30 years (n=10)	10% (0-28.6)	90% (71.4-100)				
31 - 40 years (n=32)	3.1% (0-9.2)	96.9% (90.9-100)				
41 - 50 years (n=35)	11.4% (0.9-22)	88.6% (78-99.1)	0.28			
Over 50 years old (n=20)	20% (2.5-37.5)	80% (62.5-97.5)				
Knowledge						
Poor (n=53)	5.7% (0-11.9)	94.4% (88.1-100)				

 doi:10.20944/preprints202506.1903.v1

Good (n=33)	18.2% (5-31.3)	81.8% (68.7-95)	0.17
Very good (n=11)	9.1% (0-26.1)	90.9% (73.9-100)	
Work area			
Public sector (n=14)	7.1% (0-20.6)	92.9% (79.4-100)	
Private sector (n=81)	9.9% (3.4-16.4)	90.1% (83.6-96.6)	0.17
Unoccupied (n=2)	50% (0-100)	50% (0-100)	

In your opinion, should veterinarians undergo diagnostic testing for Q fever if the disease is detected in their work area?

	% (CI95%)
Yes, all of them	20.6% (12.6-28.7)
No, none	0% (0-0)
Only veterinarians in contact with animals from the outbreak	24.7% (16.2-33.3)
Only veterinarians in contact with animals susceptible to infection	49.5% (39.5-59.4)
Do not know	5.2% (0.8-9.6)

	All % (CI95%)	**None % (CI95%)**	**Contact animal's outbreak % (CI95%)**	**Contact with susceptible animals % (CI95%)**	**Do not know % (CI95%)**	P Value
Rural-semi-urban (n=27)	22.2% (6.6-37.9)	0% (0-0)	25.9% (9.4-42.5)	51.9% (33-70.7)	0% (0-0)	0.56
Urban (n=70)	20% (10.6-29.4)	0% (0-0)	24.3% (14.2-34.3)	48.6% (36.9-60.3)	7.1% (1-13)	
Public sector (n=14)	14.3% (0-33)	0% (0-0)	21.4% (0-42.9)	50% (23.8-76.2)	14.3% (0-33)	**0.05**
Private sector (n=81)	22.2% (13.2-31.3)	0% (0-0)	25.9% (16.4-35.5)	49.4% (38.5-60.3)	2.5% (0-5.9)	
Unoccupied (n=2)	0% (0-0)	0% (0-0)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector						
Small animals (n=39)	25.6% (11.9-39.4)	0% (0-0)	23.1% (9.9-36.3)	46.1% (30.5-61.8)	5.2% (0-12)	0.45
Large animals (n=37)	16.2% (4.3-28.1)	0% (0-0)	32.4% (17.4-47.5)	51.4% (35.3-67.5)	0% (0-0)	
Company (n=4)	25% (0-67.4)	0% (0-0)	0% (0-0)	75% (32.6-100)	0% (0-0)	
Technology centre (n=1)	100% (100-100)	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)	

Do you think having any of these animals as pets could put you at additional risk of contracting Q Fever?

	% (CI95%)
Dog and cat	64.9% (55.5-74.4)
Birds	9.3% (3.5-15.1)
Rabbit and/or rodents	4.1% (0.2-8.1)
Reptiles	4.1% (0.2-8.1)
Do not know	17.6% (9.9-25.1)

 doi:10.20944/preprints202506.1903.v1

	Dog and cat % (CI95%)	Birds % (CI95%)	Rabbit % (CI95%)	Reptile % (CI95%)	I do not know % (CI95%)	P Value
Age						
22 - 30 years (n=10)	80% (55.2-100)	0% (0-0)	10% (0-28.6)	0% (0-0)	10% (0-28.6)	
31 - 40 years (n=32)	90.6% (80.5-100)	6.3% (0-14.6)	0% (0-0)	0% (0-0)	3.1% (0-9.2)	
41 - 50 years (n=35)	77.1% (63.2-91.1)	0% (0-0)	0% (0-0)	0% (0-0)	22.9% (8.9-36.8)	0.06
Over 50 years old (n=20)	55% (33.2-76.8)	0% (0-0)	5% (0-14.6)	5% (0-14.6)	35% (14.1-55.9)	
Knowledge						
Poor (n=53)	69.8% (57.5-82.2)	1.9% (0-5.6)	3.8% (0-8.9)	0% (0-0)	24.5% (12.9-36.1)	
Good (n=33)	87.9% (76.7-99)	0% (0-0)	0% (0-0)	0% (0-0)	12.1% (1-23.3)	**0.02**
Very good (n=11)	81.8% (59-100)	9.1% (0-16.1)	0% (0-0)	9.1% (0-16.1)	0% (0-0)	
Work area						
Public sector (n=14)	64.3% (39.2-89.4)	0% (0-0)	7.1% (0-20.6)	0% (0-0)	28.6% (4.9-52.2)	
Private sector (n=81)	80.3% (71.6-88.9)	2.5% (0-5.9)	0% (0-0)	1.2% (0-3.6)	16% (8.1-24)	**0.01**
Unoccupied (n=2)	50% (0-100)	0% (0-0)	50% (0-100)	0% (0-0)	0% (0-0)	

Regarding the diagnosis of exposed veterinarians, 49.5% believed that only those working with susceptible animals should undergo testing, and 64.9% associated dogs and cats with transmission, but only 9.3% included birds. Additionally, 17.6% were unaware of the involvement of pets (Table 5).

Concerning the use of protective equipment, 79.4% reported always or almost always using it, while 16.5% used it rarely, particularly government employees and small animal clinicians ($P < 0.05$). In terms of vaccination, 97.9% neither vaccinated nor were aware of the vaccine, except for 2.1% who stated they would vaccinate in the event of an outbreak. Additionally, 97.9% were unaware of the possibility of chemoprophylaxis for exposed professionals, as outlined in the Good Practices Guide of the Ministry of Labor and Social Affairs of Spain (NTP 411) [14]. Moreover, only 1% took preventive medication when there was a possibility of contracting a zoonotic disease (Table 6).

Moreover, 24.7% did not stay informed about Q Fever in animals, rising to 40.2% in humans. The 31–40 age group demonstrated greater interest (Table 6).

Table 6. Attitude towards Q Fever.

Total participants (N=97)					
Do you use appropriate protective equipment when handling animals suspected of having Q Fever, their carcasses, tissues or fluids?					
			% (CI95%)		
Always			44.3% (34.4-54.2)		
Most of the time			35.1% (25.6-44.6)		
Sometimes			4.1% (0.2-8.1)		
Rarely			6.2% (1.4-11)		
Never			10.3% (4.3-16.4)		
	Always % (CI95%)	**Most of the time** % (CI95%)	**Sometimes** % (CI95%)	**Rarely** % (CI95%)	**Never** % (CI95%)	P Value

 doi:10.20944/preprints202506.1903.v1

Age						
22 - 30 years (n=10)	40% (9.6-70.4)	30% (1.6-58)	0% (0-0)	10% (0-28.6)	20% (0-44.8)	
31 - 40 years (n=32)	56.3% (39-73.4)	37.4% (20.7-54.3)	6.3% (0-14.7)	0% (0-0)	0% (0-0)	
41 - 50 years (n=35)	51.4% (34.9-68)	40% (23.8-56.2)	0% (0-0)	0% (0-0)	8.6% (0-17.9)	**0.001**
Over 50 years old (n=20)	15% (0-30.7)	25% (6-44)	10% (0-23.2)	25% (6-44)	25% (6-44)	
Rural-semi-urban (n=27)	51.9% (33-70.7)	25.9% (9.4-42.5)	0% (0-0)	11.1% (0-23)	11.1% (0-23)	
Urban (n=70)	41.4% (29.9-53)	38.6% (27.2-50)	5.7% (0.3-11)	4.3% (0-9)	10% (3-17)	0.35
Public sector (n=14)	50% (23.8-76.2)	21.4% (0-42.9)	0% (0-0)	7.2% (0-20.6)	21.4% (0-42.9)	
Private sector (n=81)	44.4% (33.6-55)	38.3% (27.7-48.9)	4.9% (0.2-9)	6.2% (0.9-11.4)	6.2% (0.9-11.4)	**0.004**
Unoccupied (n=2)	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)	100% (100-100)	
Private sector Small animals (n=39)	41% (25.6-56.5)	38.5% (23.2-53.7)	10.3% (0.7-19)	2.5% (0-7.5)	7.7% (0-16)	
Large animals (n=37)	48.7% (32.5-65)	35.1% (19.7-50.5)	0% (0-0)	10.8% (0.8-21)	5.4% (0-12.7)	0.58
Company (n=4)	25% (0-67.4)	75% (32.6-100)	0% (0-0)	0% (0-0)	0% (0-0)	
Technology centre (n=1)	100% (100-100)	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)	

Are you vaccinated against Q Fever?

	% (CI95%)
Yes	0% (0-0)
No	29.9% (20.8-39)
In shoots	2.1% (0-4.9)
I do not know if there is a vaccine.	68% (58.8-77.3)

	Yes % (CI95%)	**No % (CI95%)**	**In case of outbreaks % (CI95%)**	**I do not know if there is a vaccine % (CI95%)**	P Value
Age					
22 - 30 years (n=10)	0% (0-0)	50% (19-81)	0% (0-0)	50% (19-81)	
31 - 40 years (n=32)	0% (0-0)	25% (10-40)	3.1% (0-9.2)	71.9% (56.3-87.5)	
41 - 50 years (n=35)	0% (0-0)	25.7% (11.2-40.2)	0% (0-0)	74.3% (59.8-88.8)	0.56
Over 50 years old (n=20)	0% (0-0)	35% (14.1-55.9)	5% (0-14.6)	60% (38.5-81.5)	
Rural-semi-urban (n=27)	0% (0-0)	25.9% (9.4-42.5)	3.7% (0-10.9)	70.4% (53.2-87.6)	0.69
Urban (n=70)	0% (0-0)	31.4% (20.6-42.3)	1.4% (0-4.2)	67.2% (56.1-78.2)	
Public sector (n=14)	0% (0-0)	28.6% (4.9-52.2)	0% (0-0)	71.4% (47.8-95.1)	
Private sector (n=81)	0% (0-0)	29.6% (19.7-39.6)	2.5% (0-5.9)	67.9% (57.7-78.1)	0.93
Unoccupied (n=2)	0% (0-0)	50% (0-100)	0% (0-0)	50% (0-100)	
Private sector Small animals (n=39)	0% (0-0)	30.8% (16.3-45.3)	2.6% (0-7.5)	66.6% (51.9-81.5)	
Large animals (n=37)	0% (0-0)	29.7% (15-44.5)	2.7% (0-7.9)	67.6% (52.5-82.7)	0.99
Company (n=4)	0% (0-0)	25% (0-67.4)	0% (0-0)	75% (32.6-100)	
Technology centre (n=1)	0% (0-0)	0% (0-0)	0% (0-0)	100% (100-100)	

Do you take preventative medications when handling animals that show symptoms compatible with Q Fever or have tested positive for a diagnostic test?

	% (CI95%)

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Yes		1% (0-3)	
No		99% (97-100)	
	Yes **% (CI95%)**	**No** **% (CI95%)**	P Value
Age			
22 - 30 years (n=10)	0% (0-0)	100% (100-100)	
31 - 40 years (n=32)	0% (0-0)	100% (100-100)	
41 - 50 years (n=35)	0% (0-0)	100% (100-100)	0.27
Over 50 years old (n=20)	5% (0-14.6)	95% (85.5-100)	
Rural-semi-urban (n=27)	0% (0-0)	100% (100-100)	0.53
Urban (n=70)	1.4% (0-4.2)	98.6% (95.8-100)	
Public sector (n=14)	0% (0-0)	100% (100-100)	
Private sector (n=81)	1.2% (0-3.6)	98.8% (96.4-100)	0.9
Unoccupied (n=2)	0% (0-0)	100% (100-100)	
Private sector			
Small animals (n=39)	2.6% (0-7.5)	97.4% (92.5-100)	
Large animals (n=37)	0% (0-0)	100% (100-100)	0.77
Company (n=4)	0% (0-0)	100% (100-100)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	
Did you know that the Ministry of Labour's Good Practices Guide for occupational zoonoses (NTP411) allows immunoprophylaxis (vaccination) and chemoprophylaxis (antimicrobials) in cases where personal protective equipment (PPE) is not possible?			
		% (CI95%)	
Yes		2.1% (0-4.9)	
No		97.9% (95.1-100)	
	Yes **% (CI95%)**	**No** **% (CI95%)**	P Value
Age			
22 - 30 years (n=10)	10% (0-28.6)	90% (71.4-100)	
31 - 40 years (n=32)	0% (0-0)	100% (100-100)	
41 - 50 years (n=35)	0% (0-0)	100% (100-100)	0.14
Over 50 years old (n=20)	5% (0-14.6)	95% (85.5-100)	
Rural-semi-urban (n=27)	0% (0-0)	100% (100-100)	
Urban (n=70)	2.9% (0-6.8)	97.1% (93.2-100)	0.37
Public sector (n=14)	0% (0-0)	100% (100-100)	
Private sector (n=81)	1.2% (0-3.6)	98.8% (96.4-100)	**0.001**
Unoccupied (n=2)	50% (0-100)	50% (0-100)	
Private sector			
Small animals (n=39)	2.6% (0-7.5)	97.4% (92.5-100)	
Large animals (n=37)	0% (0-0)	100% (100-100)	0.77
Company (n=4)	0% (0-0)	100% (100-100)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	
Are you up to date on the human situation of Q Fever in Spain?			
		% (CI95%)	
Yes		12.4% (5.8-18.9)	
No		40.2% (30.5-50)	
In case of outbreaks		47.4% (37.5-57.4)	
	Yes **% (CI95%)**	**No** **% (CI95%)**	**In case of outbreaks** **% (CI95%)**	P Value
Age				
22 - 30 years (n=10)	0% (0-0)	40% (9.6-70.4)	60% (29.6-90.4)	
31 - 40 years (n=32)	25% (10-40)	21.9% (7.6-36.2)	53.1% (35.8-70.4)	**0.047**

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41 - 50 years (n=35)	8.6% (0-17.9)	45.7% (29.2-62.2)	45.7% (29.2-62.2)	
Over 50 years old (n=20)	5% (0-14.6)	60% (38.5-81.5)	35% (14.1-55.9)	
Rural-semi-urban (n=27)	11.1% (0-23)	33.3% (15.6-51.1)	55.6% (36.8-74.3)	
Urban (n=70)	12.9% (5-20.7)	42.9% (31.2-54.4)	44.3% (32.7-55.9)	0.6
Public sector (n=14)	0% (0-0)	50% (23.8-76.2)	50% (23.8-76.2)	
Private sector (n=81)	14.8% (7.1-22.6)	38.3% (27.7-48.9)	46.9% (36.1-57.8)	0.58
Unoccupied (n=2)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector				
Small animals (n=39)	12.8% (2.3-23.3)	43.6% (28-59.2)	43.6% (28-59.2)	
Large animals (n=37)	18.9% (6.3-31.5)	29.7% (15-44.5)	51.4% (35.3-67.3)	0.66
Company (n=4)	0% (0-0)	50% (1-99)	50% (1-99)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	

Are you up to date on the Q Fever situation in animals in Spain?				
			% ($CI_{95\%}$)	
Yes			29.9% (20.8-39)	
No			24.7% (16.2-33.3)	
In case of outbreaks			45.4% (35.5-55.3)	
	Yes % ($CI_{95\%}$)	**No % ($CI_{95\%}$)**	**In case of outbreaks % ($CI_{95\%}$)**	P Value
Age				
22 - 30 years (n=10)	20% (0-44.8)	30% (1.6-58.4)	50% (19-81)	
31 - 40 years (n=32)	37.5% (20.7-54.3)	3.1% (0-9.2)	59.4% (42.4-76.4)	
41 - 50 years (n=35)	31.4% (16.1-46.8)	25.7% (11.2-40.2)	42.9% (26.5-59.3)	**0.005**
Over 50 years old (n=20)	20% (2.5-37.5)	55% (33.2-76.8)	25% (6-44)	
Rural-semi-urban (n=27)	25.9% (9.4-42.5)	25.9% (9.4-42.5)	48.2% (29.3-67)	
Urban (n=70)	31.4% (20.6-42.3)	24.3% (14.2-34.3)	44.3% (32.7-55.9)	0.86
Public sector (n=14)	14.2% (0-32.6)	42.9% (16.9-68.8)	42.9% (16.9-68.8)	
Private sector (n=81)	33.3% (23.1-43.6)	21% (12.1-29.9)	45.7% (34.8-56.5)	0.29
Unoccupied (n=2)	0% (0-0)	50% (0-100)	50% (0-100)	
Private sector				
Small animals (n=39)	33.3% (18.5-48.1)	20.5% (7.8-33.2)	46.2% (30.5-61.8)	
Large animals (n=37)	37.8% (22.2-53.5)	16.2% (4.3-28.1)	46% (29.9-62)	0.29
Company (n=4)	0% (0-0)	50% (1-99)	50% (1-99)	
Technology centre (n=1)	0% (0-0)	100% (100-100)	0% (0-0)	

4. Discussion

The complex pathogen-host interactions exhibited by zoonotic agents and the increasing rise in zoonoses over the past decades (more than 60% of emerging infectious diseases in humans) [15] have led health authorities to address their prevention through an integrated and multidisciplinary approach (One Health), based on collaboration between animal health, public health, and environmental health [16]. In this context, professions that involve interaction with animals or their products occupy a central position at the human-animal interface, with direct implications at both the individual and collective levels [17].

It is a well-established fact that veterinarians are at a higher risk of infection by zoonotic agents compared to the general population, with a significantly higher seroprevalence for pathogens such as *Brucella spp.*, *Coxiella burnetii*, *Chlamydia psittaci*, *Bartonella henselae*, *methicillin-resistant*

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Staphylococcus aureus (MRSA), *Streptococcus suis type 2*, Hepatitis E, or *Toxocara canis* [18]. Furthermore, among the emerging zoonotic agents identified in recent decades (2007–2015), several pathogens with high occupational transmission have been reported, including the viruses of West Nile Fever, Rift Valley Fever, and Crimean-Congo Hemorrhagic Fever, as well as *Coxiella burnetii*, *S. suis*, and the clonal complex 398 of *methicillin-resistant S. aureus* [19]. The frequency of veterinarians who acknowledge having contracted a zoonotic disease, ranges from 16.7% to 64%, depending on the geographical area [20,21]. In this context, veterinarians can serve as an important source of infection for other individuals and animals and act as sentinels for the early detection of emerging zoonoses.

In the case of Q Fever, studies conducted on veterinary science students and professionals demonstrate a clear link between the impact of Q Fever in humans and its presence in animals, highlighting an underestimation of its prevalence due to the fact that most infections go unreported as they present asymptomatically or with mild flu-like symptoms [22]. In Canada, surveys showed a seroprevalence of 76.2% (95% CI: 52.8% – 91.8%) in active veterinarians, 50% (95% CI: 6.8% – 93.2%) in inactive veterinarians, and 14.3% (95% CI: 0.3% – 57.9%) in veterinary students [23]. These studies emphasize the need to incorporate zoonotic disease education from the early years of veterinary training and to promote continuous professional development, with special attention to biosafety measures, personal protective equipment, risks associated with animal handling, and specific risks related to preexisting medical conditions, such as immunosuppression or pregnancy [17,18]. Furthermore, health authorities and veterinary faculties are advised to implement surveillance and monitoring programs for the most relevant and emerging zoonoses among students and active veterinarians to enable early case detection and transmission prevention.

Nevertheless, very few studies have been conducted in Europe to assess the actual knowledge, perception, and attitude of veterinarians regarding Q Fever [24], with our research being the first to address this issue in Spain. Spain is the fourth country in the European Union with the highest number of registered veterinarians (30,000; 0.58 per-1,000 inhabitants), surpassed only by Germany, Ukraine, and Italy [25]. The average age of veterinarians in Spain is 42 years, with a gender distribution of 36% men and 63% women. In Andalusia, however, the latest data published by the National Institute of Statistics (INE) indicate a gender distribution similar to that obtained in our research sample (50.8% men and 49.2% women) [26].

According to the results obtained in this study, the majority of participants (54.6%) had a rather poor understanding of Q Fever, particularly regarding its transmission to humans through contact with animals, their carcasses, tissues, or fluids, as well as the ingestion of contaminated water and food, which poses a significant risk of infection. These findings align with those reported by Bañuls et al. (2024) concerning Crimean-Congo hemorrhagic fever (CCHF) in Spain (65.2% *Poor*, 24.4% *Well*, and 10.4% *Very good*) and by Crist et al. (2022) [27] in Illinois (USA) for other tick-borne diseases.

Additionally, 17.6% were unaware of the role of pets (dogs and cats) as potential sources of infection [5,6], despite the fact that more than half of the respondents (9/17 = 52.9%) were clinicians specializing in small and large animals. This aligns with the findings of Sellens et al. (2016) [28], whose study concluded that many Australian veterinary clinicians were unaware of the risk posed by pets as a source of Q Fever infection, due to the belief that only ruminant livestock can transmit the disease to humans.

In respect of their ability to identify the clinical manifestations of this disease in animals, only 41.2% correctly recognized the reproductive disorders typical of Q Fever, a significantly lower percentage than that reported by Winter and Campe (2022) [29] in Germany (72.6%). No significant differences were observed between regions or work environments (clinical practice, livestock farming, food industry, etc.), although it would have been expected that veterinarians specializing in large animals would demonstrate greater knowledge. Regarding human health, the majority of participants (62.9%) admitted to not being familiar with the clinical presentation of the disease, which contrasts with its endemic nature in Spain [15] and the fact that Spain is the European Union country—excluding the United Kingdom—with the highest number of annually reported cases: 303 out of 719 cases in 2023, with an incidence rate of 0.64 per 100,000 inhabitants (European average:

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0.17 cases per 100,000 inhabitants), second only to Hungary (incidence rate of 0.69) [3]. Data published by the Spanish Epidemiological Surveillance Network for 2023 confirm an increasing trend compared to 2021 and 2022, with a total of 519 autochthonous cases and three imported cases reported. Additionally, 81.4% of respondents overlooked symptoms such as *Fatigue*, *Pneumonia*, and *Endocarditis*, which may be attributed to limited training in public health during and after their studies and/or the clinical variability of the acute form of the disease depending on the geographical region [30].

The surveillance of Q Fever in the European Union is mandatory in 24 countries (including Spain), voluntary in France, and nonexistent in Austria. However, nearly 30% of veterinarians were unaware of the reporting requirement [31], a percentage very similar to that reported by Bañuls et al. (2024) [32] for CCHF (70.6%). Regarding their perception of occupational risk and their attitude toward prevention, almost 90% of respondents highlighted the limited information provided by official communication channels (ministries, professional associations, etc.) and the lack of a reliable source for consultation on the response protocol in the event of an outbreak in animals. As for the protective measures used, although the majority reported routinely using personal protective equipment (PPE), they did not usually complement it with periodic serological screenings, medical prophylaxis, or vaccination. Similar results were reported at the national level by Bañuls et al. (2024) [32] for zoonoses in general. Finally, it is noteworthy that only 17.5% of veterinarians identified animal quarantine or systematic pesticide treatment as preventive measures for human infection, both of which are fundamental given the zoonotic nature of this disease [15,33].

In general, proper hygiene and the use of personal protective equipment (PPE) are considered important measures to prevent infection by *Coxiella burnetii* [22]. However, these measures may not be sufficient. Following the culling campaign conducted in the Netherlands between 2009 and 2010 to control Q Fever outbreaks in goat herds, 17.5% of workers seroconverted despite their experience in using PPE, which led to the implementation of vaccination for this at-risk group [34]. Although the Australian vaccine is contraindicated for seropositive individuals, it could be a viable option for seronegative veterinary students and professionals, particularly those with a medical history that increases their risk. In any case, when presenting with symptoms such as fever, fatigue, headache, or general discomfort, veterinarians working with livestock should inform their physician of their occupational exposure to facilitate early diagnosis of *C. burnetii* infection and prevent the development of more severe chronic forms, such as valvular endocarditis [17].

The results of our study support the recommendations made by other authors regarding the need to review and improve the content on zoonotic diseases in veterinary degree programs, promote continuous education among healthcare professionals, and develop risk management plans through official channels [35]. In this regard, it is important to highlight the Standard Operating Procedures for Biosafety manual, developed by the Biosafety Working Group of the Faculty of Veterinary Medicine at the University of Liège (2019) [36], under the direction of Professor Saegerman. This manual outlines general and specific protocols related to the handling of animal species and various professional fields, tailored to different user profiles (students, students with disabilities, veterinarians, visitors, staff). Similarly, the development and publication of books or manuals on protection, occupational health, and control measures against zoonoses are of particular interest [37,38].

Finally, we must not overlook the crucial preventive role of veterinarians in public health education for the general population and the need to promote campaigns advocating proper hygiene and the safe handling of pets and food.

7. Conclusions

As the findings of this study demonstrate, veterinarians present an excellent opportunity for the monitoring of endemic diseases such as Q Fever. Therefore, it is essential to strengthen training programs and health education initiatives within the sector, particularly in the case of zoonoses, where a lower level of knowledge has been observed among these professionals.

 doi:10.20944/preprints202506.1903.v1

Additionally, the study highlighted the importance of epidemiological surveys as a tool for identifying and addressing potential knowledge gaps related to this disease.

Limitations

Due to the cross-sectional nature of the survey, the sample size in some demographic categories was small, which could have influenced the detection of differences as significant ($P < 0.05$) despite being irrelevant.

Conflicts of Interest: There is no conflict of interest.

Appendix A. Supporting Information

Supplementary data associated with this article can be found in the online versión at ….

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