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# Adoption of the One Health approach to improve zoonosis control in low-income countries: Insights from the case of rabies management in Burkina Faso

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## Abstract

**Background and Aim:** Rabies is a neglected zoonotic disease transmissible to humans and domestic and wild animals through biting, scratching, or licking. This study aimed to analyze the adoption of the One Health approach by the stakeholders involved in rabies control in Burkina Faso.

**Materials and Methods:** The stakeholders involved in rabies control were from the Ministry of Livestock, Ministry of Health, Ministry of the Territory Administration, Ministry of Environment and Wildlife, and Ministry of Higher Education and Research. A structured questionnaire was used in face-to-face interviews to collect data from the stakeholders. The collected data included stakeholders' knowledge of rabies and the One Health approach and their levels of involvement in the multisectoral collaboration.

**Results:** Most participants could not describe rabies correctly (80%), and only 52.9% had heard of the One Health approach. In addition, there was no significant association between knowledge of rabies and participants' characteristics, and the knowledge of the One Health approach was significantly influenced by a participant's affiliation (place of work).

**Conclusion:** The results call for an increase in One Health education for its effective adoption by all the rabies control stakeholders. Additional efforts should focus on continual training of the One Health workforce, from policy-makers to frontline personnel.

**Keywords:** Burkina Faso, zoonosis, One Health, rabies control system, stakeholders, multisectoral collaboration, public health.

## Introduction

Rabies is a neglected zoonotic disease transmissible to humans and domestic and wild animals through biting, scratching, or licking. Nevertheless, it remains a major public health problem in low- and middle-income countries, causing approximately 59,000 human deaths annually [1]. Burkina Faso is no exception in this situation. For example, rabies has been endemic for decades in Ouagadougou, the administrative capital and the most populous city in the country [2-4]. Although underreported, the annual number of dog bites recorded in Burkina Faso is already one of the highest in the sub-region of West Africa [5,6]. Rabies is 100% preventable through appropriate post-exposure prophylaxis and mass canine vaccination [7]. However, canine vaccination coverage remains much lower than the 70% required to stop the virus transmission [7-9].

Meanwhile, the One Health approach calls for a close collaboration between the human health, animal

health, environment, and wildlife sectors to realize outcomes that are not achievable if each sector works in a silo. An example of One Health collaboration is the Tripartite Alliance established between the World Animal Health Organization (OIE), World Health Organization (WHO), and Food and Agriculture Organization (FAO) of the United Nations that led to the launch of the United Against Rabies platform in September 2020 aiming to eliminate human rabies by 2030. Since the regional One Health ministerial meeting in November 2016, all member states of the Economic Community of West African States have adopted the One Health approach to address zoonosis and other public health threats in the sub-region. However, at the national level, the actual coordination of One Health interventions by public health-related field personnel remains challenging [10-13]. The previous studies have reported similar difficulties in Burkina Faso [14,15].

Stakeholders' preparedness and various drivers influencing the level of One Health adoption for rabies control have not been assessed in Burkina Faso. Therefore, this study aimed to make a timely contribution toward the operationalization of the One Health approach for zoonosis control in a low-income country by assessing the following: (1) The knowledge of the workforce regarding rabies as a zoonosis and (2) the workforce's understanding of the One Health initiative in the context of rabies control.

## Materials and Methods

### Ethical approval and informed consent

The study protocol was approved by the Research Ethical Committee of the Université Cheikh Anta Diop (Protocol-0322/2018/CER/UCAD), including the use of oral consent for data collection. Therefore, before the administration of questionnaire interview, each participant was informed about the background and purpose of the study, indicating that their participation was voluntary, and their answers would be kept confidential. Only participants who verbally provided consent were interviewed.

### Study period and area

Data collection was performed in Ouagadougou in two different periods, from August to October 2018 and from August to October 2019. Ouagadougou is the administrative capital of Burkina Faso, where ministries and national public health and animal health offices, including agencies involved in rabies control, operate. In addition, animal and human rabies have been endemic in the same area for decades [2-4,6]. Per the custom in several African countries, local populations keep dogs for various socio-economic and cultural purposes, including house and property security, protection against evil schemes, companionship (especially for children), sources of protein for human consumption, and disposal of a family's leftover food, which is prohibited from being thrown into the garbage in some local cultures [16,17].

### Sampling and questionnaire interviews

Interview participants were selected following dual sampling methods: First purposive sampling and then respondent-driven sampling. Based on the literature review, institutions playing a role in rabies control were identified: The National Veterinary Office, responsible for surveillance, biting dog observation, and dog vaccination; the Veterinary Laboratory, responsible for diagnostic and surveillance; the Rabies Treatment Center, responsible for pre-exposure and post-exposure prevention; and the Referral Hospital Center, responsible for treating rabid patients. First, in each institution, one participant was interviewed (purposive sampling). Then, the initial participants introduced the interviewers to other relevant stakeholders involved in rabies control (respondent-driven sampling).

Subsequently, a total of 140 participants were interviewed, corresponding to five groups concerning their involvement with the rabies control interventions: Ministry of Livestock (MoL) (n=55); Ministry of Health (MoH) (n=45); Ministry of the Territory Administration (MoA) (n=20); Ministry of Environment and Wildlife (MoEW) (n=19); and Ministry of Higher Education and Research (MoER) (n=1) (Figure-1). The employed sampling methods were effective and appropriate for the study due to logistic convenience [18]. A structured questionnaire was used to collect data during the face-to-face interviews. The obtained data included participants' demographics, professional data (e.g., sector, affiliation, gender, employment position, and professional experience), ability to describe rabies as a zoonotic disease (e.g., its type, transmission, severity, and prevention methods), rabies control interventions in which the participant was involved, knowledge of One Health, and perceived involvement in One Health collaboration.

### Statistical analysis

The obtained data were recorded into a Microsoft Excel 2016 database for processing and calculation. Based on their accuracy and completeness, the answers to the questions on a participant's knowledge of rabies and the One Health approach were classified into "unable to describe," "partially described," or "correctly described."

A participant's knowledge of rabies as a zoonotic disease was measured by his understanding of the following characteristics: Type, transmission, severity, and prevention methods of rabies. The participant was classified as "unable to describe" if he could not explain at least two characteristics, "partially described" if he could describe two characteristics correctly, and "correctly described" if he could describe more than two characteristics correctly.

A participant's knowledge of the One Health approach was measured by his understanding of the following characteristics: The usefulness for rabies control and categories of stakeholders to be included in the One Health system. The participant was classified

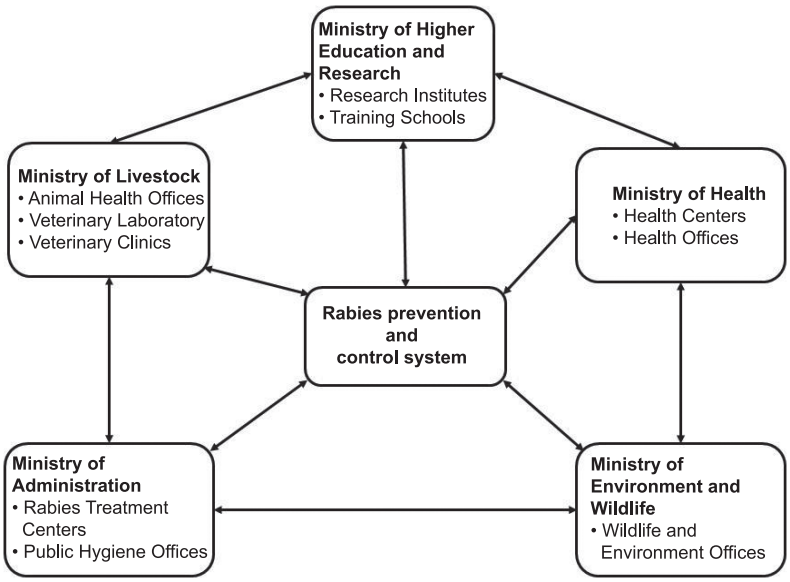


**Figure-1:** Conceptual framework of the multi-sectoral rabies control system, Burkina Faso.

as "unable to describe" if he could not describe the usefulness or stakeholders, "partially described" when he could partially describe the usefulness or stakeholders, and "correctly described" when he could describe the usefulness and stakeholders.

The statistical association between participant characteristics and dependent variables including the ability to describe rabies as a zoonotic disease, having rabies control-related interventions, having heard about the One Health approach, the ability to describe the One Health approach, and using the One Health collaboration in rabies control-related interventions was determined with Chi-square tests and Fisher's exact tests with a 95% confidence level using the Rx64 3.6.1 software (The R Foundation for Statistical Computing, https://cran.r-project.org/bin/windows/base/old/3.6.1/). For these tests, statistical significance was set at $p<0.05$.

## Results

### Description of the rabies control system and participants' characteristics

Based on the collected data, the rabies control system was conceptualized and represented to provide a better overview of rabies management in the study area (Figure-1). The participants' characteristics are presented in Table-1. The study included participants from the MoL (39.3%), MoH (32.1%), MoA (14.3%), MoEW (13.6%), and MoER (0.7%). Most of the participants were male (69.3%) and had fewer than 10 years of work experience (50%).

### Control interventions and participants' knowledge of rabies

All participants were aware of rabies as a public health threat. However, only 20% of all participants could correctly describe the disease type (viral and zoonotic), transmission (vector animals and roots), clinical signs, level of severity, and prevention methods. In contrast, physicians (50%) and veterinarians (55.5%) were more likely to know rabies than were the participants in other professional categories.

**Table-1:** Demographic and professional characteristics of surveyed participants.

| Variables | Number of observed | Frequency (%) |
|---|---|---|
| Gender (n=140) | | |
| Female | 43 | 30.7 |
| Male | 97 | 69.3 |
| Professional experience (years) (n=140) | | |
| <10 | 70 | 50.0 |
| 10-20 | 35 | 25.0 |
| Over 20 | 35 | 25.0 |
| Employment position (n=140) | | |
| Environment officer | 15 | 10.7 |
| Physician | 16 | 11.4 |
| Paramedical officer | 41 | 29.3 |
| Pharmacist | 4 | 2.9 |
| Veterinarian | 36 | 25.7 |
| Veterinary Paraprofessional | 20 | 14.3 |
| Wildlife officer | 8 | 5.7 |
| Sector (n=140) | | |
| MoA | 20 | 14.3 |
| MoEW | 19 | 13.6 |
| MoH | 45 | 32.1 |
| MoL | 55 | 39.3 |
| MoER | 1 | 0.7 |
| Affiliation (n=140) | | |
| Animal health office | 19 | 13.7 |
| Animal health school | 7 | 5.0 |
| Rabies treatment center | 16 | 11.5 |
| Environment and Wildlife office | 19 | 13.7 |
| Health center | 34 | 24.5 |
| Health office | 10 | 7.2 |
| Pharmacy | 1 | 0.7 |
| Public hygiene office | 4 | 2.9 |
| Veterinary clinic | 14 | 10.1 |
| Veterinary laboratory | 15 | 10.8 |

MoA=Ministry of the Territory Administration; MoEW=Ministry of Environment and Wildlife; MoH=Ministry of Health; MoL=Ministry of Livestock; and MoER=Ministry of Higher Education and Research

**Table-2:** Participants' level of knowledge of rabies and their involvement in rabies control.

| Variables | Ability to describe rabies (n=140) | | | p-value | Having experience in rabies control interventions (n=140) | | p-value |
|---|---|---|---|---|---|---|---|
| | Unable to describe (%) | Partially described (%) | Correctly described (%) | | No (%) | Yes (%) | |
| Gender | | | | | | | |
| Female | 46.5 | 39.5 | 14.0 | 0.42 | 20.9 | 79.1 | 0.26 |
| Male | 40.2 | 36.1 | 23.7 | | 13.4 | 86.6 | |
| Professional experience (years) | | | | | | | |
| <10 | 52.9 | 28.6 | 18.5 | 0.13 | 15.7 | 84.3 | 0.95 |
| 10-20 | 28.6 | 48.6 | 22.8 | | 17.1 | 82.9 | |
| Over 20 | 34.3 | 42.9 | 22.8 | | 14.3 | 85.7 | |
| Employment position | | | | | | | |
| Environment officer | 100.0 | 0.0 | 0.0 | NA | 6.7 | 93.3 | 0.00 |
| Physician | 12.5 | 37.5 | 50.0 | | 31.2 | 68.8 | |
| Paramedical officer | 63.4 | 34.1 | 2.5 | | 24.4 | 75.6 | |
| Pharmacist | 50.0 | 50.0 | 0.0 | | 25.0 | 75.0 | |
| Veterinarian | 13.9 | 30.6 | 55.5 | | 2.8 | 97.2 | |
| Veterinary Paraprofessional | 30.0 | 70.0 | 0.0 | | 0.0 | 100.0 | |
| Wildlife officer | 37.5 | 62.5 | 0.0 | | 50.0 | 50.0 | |
| Sector | | | | | | | |
| MoA | 50.0 | 45.0 | 2.0 | NA | 0.0 | 100.0 | 0.00 |
| MoEW | 73.7 | 26.3 | 0.0 | | 26.3 | 73.7 | |
| MoH | 53.3 | 28.9 | 17.8 | | 35.6 | 64.4 | |
| MoL | 20.0 | 43.6 | 36.4 | | 0.0 | 100.0 | |
| MoER | 0.0 | 100.0 | 0.0 | | 100.0 | 0.0 | |
| Affiliation | | | | | | | |
| Veterinary office | 15.8 | 26.3 | 57.9 | NA | 0.0 | 100.0 | NA |
| Animal health school | 42.9 | 42.9 | 14.3 | | 0.0 | 100.0 | |
| Rabies Treatment Center | 37.5 | 56.2 | 6.2 | | 0.0 | 100.0 | |
| Environment and Wildlife office | 73.7 | 26.3 | 0.0 | | 26.3 | 73.7 | |
| Health center | 64.7 | 26.5 | 8.8 | | 32.4 | 67.6 | |
| Health office | 20.0 | 30.0 | 50.0 | | 50.0 | 50.0 | |
| Pharmacy | 0.0 | 100.0 | 0.0 | | 0.0 | 100.0 | |
| Public hygiene office | 100.0 | 0.0 | 0.0 | | 0.0 | 100.0 | |
| Veterinary clinic | 14.3 | 57.1 | 28.6 | | 0.0 | 100.0 | |
| Veterinary laboratory | 20.0 | 53.3 | 26.7 | | 0.0 | 100.0 | |

MoA=Ministry of the Territory Administration; MoEW=Ministry of Environment and Wildlife; MoH=Ministry of Health; MoL=Ministry of Livestock; and MoER=Ministry of Higher Education and Research

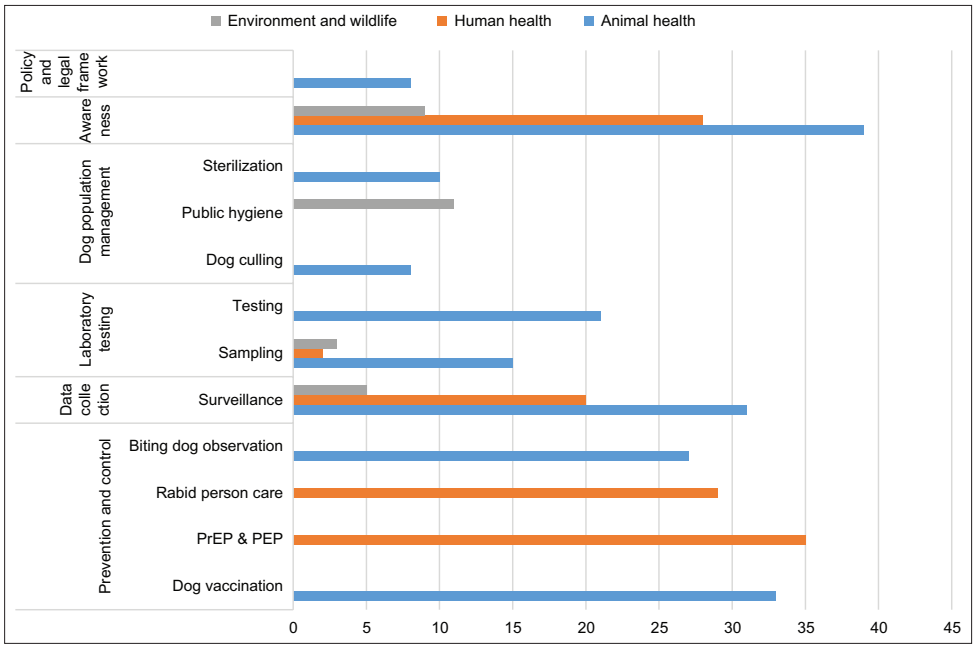


**Figure-2:** Main interventions cited by the three key stakeholder groups involved in rabies prevention and control, Burkina Faso (PrEP=*Preexposure prophylaxis*; PEP=*Postexposure prophylaxis*).

Nevertheless, there was no significant association between the characteristics of the participants and their ability to describe rabies as a disease ($p>0.05$) (Table-2). Meanwhile, the largest number of rabies control interventions was conducted in the animal health sector, which was responsible for awareness raising, dog vaccination, surveillance, biting dog observation, laboratory testing, sample collection, sterilization of dogs, free-roaming dog culling, and policy and regulations, followed by the human health sector, which was responsible for pre-exposure and post-exposure prophylaxis, rabid person care, awareness raising, surveillance, and sample collection, and the environment and wildlife sector, which was responsible for public hygiene, awareness raising, surveillance, and sample collection (Figure-2). At the individual level, males, participants working as veterinarians or veterinary paraprofessionals, and those with more than 20 years of professional experience were more likely to be involved in rabies control interventions. However, only participants' employment position and their affiliated sectors showed a significant association with having experience in rabies control intervention ($p<0.05$).

**Participants' knowledge and perceived roles concerning One Health**

Participants' knowledge and perceived involvement in the One Health strategy for rabies control are presented in Table-3. While 52.9% of participants (n=74) had heard of One Health before this study, only a participant's sector of affiliation was significantly associated with the participant having heard of One Health. Indeed, participants from the MoL were more likely to be aware of the multisectoral collaboration ($p<0.05$). In addition, among the participants who have heard of the One Health approach, 6.8% were unable to describe it, 22.9% could partially describe it, and 70.3% could describe it correctly. Moreover,

**Table-3:** Participants' knowledge of the One Health approach and its perceived use in rabies prevention and control interventions.

| Variables | Having heard about One Health (n=140) | | p-value | Ability to describe the One Health approach (n=74) | | | p-value | Use of One Health collaboration (n=74) | | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | No | Yes | | Unable to describe (%) | Partially described (%) | Correctly described (%) | | No | Yes | |
| Gender | | | | | | | | | | |
| Female | 58.1 | 41.9 | 0.08 | 11.1 | 33.3 | 55.6 | 0.28 | 16.7 | 83.3 | 0.77 |
| Male | 42.3 | 57.7 | | 5.4 | 19.6 | 75.0 | | 19.6 | 80.4 | |
| Professional experience (years) | | | | | | | | | | |
| <10 | 45.7 | 54.3 | 0.09 | 2.6 | 23.7 | 73.3 | 0.37 | 26.3 | 73.7 | 0.06 |
| 10-20 | 48.6 | 51.4 | | 16.6 | 16.7 | 66.7 | | 22.2 | 77.8 | |
| Over 20 | 48.6 | 51.4 | | 5.6 | 27.7 | 66.6 | | 0.0 | 100.0 | |
| Employment position | | | | | | | | | | |
| Environment officer | 66.7 | 33.3 | NA | 0.0 | 20.0 | 80.0 | 0.29 | 100.0 | 0.0 | 0.00 |
| Physician | 37.5 | 62.5 | | 0.0 | 40.0 | 60.0 | | 20.0 | 80.0 | |
| Paramedical officer | 82.9 | 17.1 | | 28.6 | 42.9 | 28.5 | | 0.0 | 100.0 | |
| Pharmacist | 75.0 | 25.0 | | 0.0 | 0.0 | 100.0 | | 21.4 | 78.6 | |
| Veterinarian | 8.3 | 91.7 | | 3.0 | 18.2 | 71.4 | | 0.0 | 100.0 | |
| Veterinary Paraprofessional | 30.0 | 70.0 | | 14.3 | 14.3 | 71.4 | | 3.0 | 97.0 | |
| Wildlife officer | 50.0 | 50.0 | | 0.0 | 25.0 | 75.0 | | 75.0 | 25.0 | |
| Sector | | | | | | | | | | |
| MoA | 85.0 | 15.0 | 0.00 | 33.3 | 0.0 | 66.7 | 0.07 | 0.0 | 100.0 | 0.00 |
| MoEW | 52.6 | 47.4 | | 0.0 | 22.2 | 77.8 | | 88.9 | 11.1 | |
| MoH | 66.7 | 33.3 | | 6.7 | 46.6 | 46.7 | | 13.3 | 86.7 | |
| MoL | 16.4 | 83.6 | | 6.5 | 15.2 | 78.3 | | 8.7 | 91.7 | |
| MoER | 0.0 | 100.0 | | 0.0 | 100.0 | 0.0 | | 0.0 | 100.0 | |
| Affiliation | | | | | | | | | | |
| Veterinary office | 0.0 | 100.0 | NA | 10.6 | 10.5 | 78.9 | 0.03 | 5.3 | 94.7 | 0.00 |
| Animal health school | 42.9 | 57.1 | | 0.0 | 25.0 | 75.0 | | 0.0 | 100.0 | |
| Rabies Treatment Center | 81.2 | 18.2 | | 33.3 | 0.0 | 66.7 | | 0.0 | 100.0 | |
| Environment and Wildlife office | 52.6 | 47.4 | | 0.0 | 22.2 | 77.8 | | 88.9 | 11.1 | |
| Health center | 79.4 | 20.6 | | 14.3 | 57.1 | 28.6 | | 0.0 | 100.0 | |
| Health office | 20.0 | 80.0 | | 0.0 | 37.5 | 62.5 | | 25.0 | 75.0 | |
| Pharmacy | 100.0 | 0.0 | | - | - | - | | - | - | |
| Public hygiene office | 100.0 | 0.0 | | - | - | - | | - | - | |
| Veterinary clinic | 35.7 | 64.3 | | 0.0 | 44.4 | 55.6 | | 11.1 | 88.9 | |
| Veterinary laboratory | 6.7 | 93.3 | | 7.1 | 0.0 | 92.9 | | 14.3 | 87.7 | |

MoA=Ministry of the Territory Administration; MoEW=Ministry of Environment and Wildlife; MoH=Ministry of Health; MoL=Ministry of Livestock; and MoER=Ministry of Higher Education and Research

only a participant's affiliation showed a significant influence on his ability to explain what the One Health approach meant correctly ($p<0.05$). In addition, the participants working in veterinary offices and laboratories were more likely to be able to describe the One Health strategy. Furthermore, most of the stakeholders (60%) familiar with the One Health approach stated that they practiced multisectoral collaboration in their daily rabies control activities based on their professional relationships. Finally, the perceived use of One Health collaboration in rabies interventions was significantly associated with a participant's employment position, sector of origin, and affiliation ($p<0.05$).

## Discussion

Rabies remains a major threat to animal and human health in Burkina Faso [1,3,6]. However, a global goal of zero animal-mediated human rabies cases by 2030 has been demonstrated achievable [19,20]. In addition, the urgent need to operationalize the One Health approach for effective rabies control is recognized by key international public health organizations OIE, WHO, FAO, and the Global Alliance for Rabies Control; thus, implementation of large-scale prevention and control programs is advocated.

The One Health strategy is a cost-effective way to control rabies for low- and middle-income countries like Burkina Faso [21-23]. For example, collecting samples in humans and animals simultaneously through an integrated intervention framework decreases cost and shortens detection time [24]. In addition, the strategy contributes to improving rabies surveillance and bite case management. According to the Stepwise Approach toward rabies elimination, integrating the One Health approach into rabies control strategies can enable effective surveillance through data collection, reporting, and information sharing across sectors. Moreover, multisectoral collaboration can increase vaccination coverage in the canine population, availability of and accessibility to post-exposure prophylaxis, awareness and education of the general public, and availability of laboratory testing for humans and animals [22,25-27].

The study's findings indicated that various stakeholders and administrative institutions, including the MoL, MoH, MoA, MoEW, and MoER, were involved in rabies control interventions in Burkina Faso. Similar results were reported in Chad [28], Guinea [29], Liberia [13], and Nepal [21]. Furthermore, Marcotty *et al*. [30] observed that animal health participants outnumbered stakeholders from other sectors, indicating that not all the potential One Health stakeholders were involved in or aware of the outcomes created by a close multisectoral collaboration for human health and well-being.

There is also a difference between sectors in their involvement in rabies control in a country. For example, in Chad, where joint rabies control activities have been conducted for years, there is a higher participation of human health workers in the rabies control efforts, according to Mbaipago *et al*. [28]. Therefore, effective participation of sectors in rabies control requires all One Health stakeholders to be aware of and understand the added value of the increased synergy between sectors and disciplines. Furthermore, beyond multisectoral collaboration, Zinsstag [31], Narrod *et al*. [32], Antoine-Moussiaux *et al*. [33], and Buregyeya *et al*. [34] have documented the added value of effective community engagement as the key partners address the complexity of rabies elimination in a transdisciplinary way.

Moreover, achieving a sustained operationalization of the One Health collaboration adds a significant value in diseases control. In other words, beyond intersectoral competencies, each stakeholder must be familiar with the problem to be addressed [30]. However, the present study showed that most participants lacked a satisfactory level of knowledge of rabies, indicating the need to increase rabies training for pre-service and in-service animal health, human health, and wildlife professionals. In addition, Mbaipago *et al*. [28] and Nguyen *et al*. [35] have reported similar knowledge gaps of the One Health approach in personnel involved in rabies control in Chad and Vietnam, respectively. In Burkina Faso, the observed low awareness in the stakeholders can also be explained by the absence of a national rabies control program that results in underreporting and neglect of the disease [5,36].

In the last decade, a high-level international commitment has been increasing to promote intersectoral collaboration as the most effective strategy to control rabies in and across countries. However, the present study found that only about half of the stakeholders were aware of the One Health approach in Burkina Faso, even though the country has recently established a national One Health platform and selected rabies as one of the five high-priority zoonotic diseases (the other four were brucellosis, anthrax, high pathogen avian influenza, and dengue) [37]. Nevertheless, integrated management of rabies remains at a nascent stage in the country, revealing the need to train stakeholders, including field workers and policy-makers, in One Health leadership and core competencies [14,38-41].

Despite the lack of a legal One Health framework in the country, animal and human health workers are practicing informal collaboration through their professional relationships. As efforts are underway to operationalize the newly developed One Health platform, further research is required to assess challenges and opportunities effectively to understand the contribution of the One Health approach to the effective management of rabies in Burkina Faso [42]. Finally, the findings have revealed an urgent need to create an integrated national control program to improve stakeholders' engagement across sectors.

## Conclusion

The control of rabies, a zoonosis, requires close collaboration and coordination between various sectors

and stakeholders, particularly those in veterinary and medical services. However, this study revealed that most of the stakeholders involved in rabies control in Burkina Faso lacked a satisfactory level of knowledge of rabies to implement the One Health approach effectively. In addition, there is not an effective close multisectoral collaboration for rabies control, especially between animal health and human health sectors. Therefore, there is a need to develop an integrated national strategic plan, including strengthening both rabies and One Health training for pre-service and in-service personnel to increase the country's preparedness to reach the goal of zero human death from dog-mediated rabies by 2030.

## Authors' Contributions

MS, HZ, SDN, KAS, AJA, and RBA: Designed, conceptualized, and supervised the study implementation, conducted research, collected data, analyzed, and wrote the manuscript. MS, HZ, and SDN: Collected and interpreted data. SGI, LDD, AKI, VS, and ZT: Provided research material and analyzed data. SGI, LDD, VS, and ZT: Interpreted data and provided logistic support. All authors read and approved the final manuscript.

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## Competing Interests

The authors declare that they have no competing interests.

## Publisher's Note

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