

Reducing the risk of zoonotic pathogen transmission in slaughterhouses in Dakar and Kaolack (Senegal): Staff knowledge, attitudes and practices

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Abstract

In Senegal, livestock farming is a strategic sector. By 2023, livestock production accounted for 3.4% of Senegal's Gross Domestic Product. Despite the vital importance of livestock, the sector faces constraints linked to zoonoses.

Zoonoses are a real public health problem for slaughterhouse personnel. To the best of our knowledge, there are few studies carried out in Senegal to assess the knowledge, attitudes and practices of abattoir personnel regarding the risks of contracting zoonotic agents during the exercise of their profession. The aim of the present study was to gather information on the characteristics, knowledge and behaviors of slaughterhouse personnel in Senegal in relation to the risks associated with the transmission of priority zoonotic agents.

Thus, this descriptive cross-sectional study was conducted from March 04 to April 19, 2024 involving slaughterhouse workers and inspectors from Dakar and Kaolack present at the time of the study. We carried out analyses to assess the association between socio-demographic data on the one hand, and the knowledge and behaviors of the respondents on the other. The surveys showed that 90% of slaughterers had heard of at least one priority zoonosis. Of these, 13%, 90%, 63% and 4.3% respectively had heard of rabies, tuberculosis, avian flu and Ebola fever, while none of them had heard of Rift valley fever, Marburg hemorrhagic fever or anthrax.

In contrast, abattoir inspectors have a good knowledge of zoonoses, their symptoms and modes of transmission.

Furthermore, with regard to knowledge of zoonoses, there was a significant variation depending on the age group of the personnel. Concerning attitudes and practices, 80.8% of slaughterhouse professionals take personal protection measures, 53.2% take hygiene measures for their work equipment, and 40.4% protect their workplace. We noticed a significant variation in the use of workplace protection measures, depending on the number of years' experience of the staff. In view of the shortcomings noted, it is essential to raise awareness among abattoir personnel of zoonosis prevention and control measures. In order to have a more global and precise view of the situation regarding the knowledge, attitudes and practices of slaughterhouse staff in Senegal, it would be wise to push the limits of this study by taking into account a larger sample including all slaughterhouses throughout the Senegalese national territory and by developing more explicit questionnaires for slaughterhouse professionals.

Keywords: Zoonoses; Priority; Slaughterhouses; Kaolack; Dakar; Risk; KAP

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1. Introduction

In Senegal, livestock farming is a strategic sector that employs more than half of agricultural households [1].

Indeed, livestock products make it possible to meet the needs of households in terms of food supply, education and training in a timely and continuous manner. Socio-cultural values make livestock a valued commodity that helps to strengthen social ties and relationships. Livestock activities accounted for 3.4% of Gross Domestic Product (GDP) in 2023 [2]. In addition, nearly 33% of households and more than half of the rural population derive their income from livestock activities. Despite this capital importance of livestock, it is confronted with several constraints: diseases [3]. Among the many diseases that affect animals are zoonoses, defined as diseases affecting domestic animals, wildlife and humans at the same time [4].

Zoonoses are therefore a real public health problem, especially for people who are in constant contact with animals such as farmers, slaughterhouse staff and human and animal health professionals. Indeed, according to Adam-poupart *et al.* [5], it is in slaughterhouses that the transmission of zoonotic pathogens between infected animals and professionals is the most important due to the close and direct contact between staff, live animals, tissues or biological fluids.

With the support of the African Centre for Disease Prevention and Control (CDC) in collaboration with the International Association of National Institutes of Public Health (IANPHI), six priority zoonotic diseases have been identified: rabies, avian influenza, bovine tuberculosis, anthrax, Rift Valley fever, Ebola, and Marburg hemorrhagic fevers [3].

While all actors in animal value chains are exposed to the risk of contracting a zoonotic infectious agent, certain links in the chain such as slaughterhouse professionals are more exposed due to the proximity between slaughterhouse professionals and the animals (products) [6]. Infants can become infected accidentally through wounds, needle sticks, direct skin contact or indirectly oral-fecal contact, primarily related to hand hygiene [5].

To reduce the impact of zoonotic diseases on slaughterhouse staff, these professionals must acquire certain knowledge. Similarly, risky behaviors must be assessed in order to propose mitigation measures.

The objective of this work is to establish a useful database in the fight against the transmission of priority zoonoses at the level of Senegal's slaughterhouses.

2. Material and methods

2.1. Hardware

The materials used to carry out the study consisted of an interview guide, a questionnaire and office equipment (pen, notepad). The interview guide, consisting of seven parts, was intended for slaughterhouse inspectors while the questionnaire, consisting of five parts, was intended for slaughterhouse workers.

2.2. Type of Study and Sampling

This was a cross-sectional descriptive study. The population concerned by the survey included slaughterhouse inspectors and staff operating on the assembly line or in direct contact with carcasses, offal or even live animals before slaughter. The latter are SOGAS employees and the inspectors depend on the Ministry of Agriculture, Food Sovereignty and Livestock (MASAE) working at the Pikine (Dakar) and Kaolack slaughterhouses. In order to determine which slaughterhouses should be preferred to carry out the surveys, an interview was conducted at the Ministry of Agriculture, Food Sovereignty and Livestock in Diamniadio with the Director of Veterinary Services, who told us which two slaughterhouses have a higher prevalence of zoonoses. The actors interviewed were chosen based on professional criteria, i.e. the staff (slaughterers and inspectors) working under contract in these two slaughterhouses. This option made it possible to collect information from the main players who are constantly at the heart of the slaughter operations. All contract slaughterhouse workers present at the time of the study were included in the study (51 workers).

2.3. Data Collection

2.3.1. Data Analysis

The survey was carried out by direct interview with the individuals included in the study. They were asked questions about their identity, their knowledge of priority zoonoses, their attitudes towards these diseases, and the practices they carry out or have had to carry out in relation to these diseases. Before administering the questionnaire, respondents were informed in advance of the objectives of the study and of the confidentiality of the information collected. Verbal consent was obtained from all participants in the sample. The questionnaire was organized into four distinct parts. The first part included questions on respondents' demographic characteristics, such as gender, age, years of experience and level of education. The second part of the questionnaire focused on hygiene and safety knowledge, and included questions on personal, environmental and equipment hygiene, species of animal slaughtered and animal products handled. The third part of the questionnaire focused on workers' knowledge of priority zoonoses, as well as their attitudes and safety practices in relation to priority zoonoses. It included four questions on their views on the existence of zoonoses, sources of contamination, and the handling and storage of products of animal origin. The fourth part of the questionnaire concerned

The data collected was entered on an Excel spreadsheet in order to be processed. The Excel spreadsheet of Microsoft Office 2010 has made it possible to create VENN diagrams, figures and tables. The data were then analyzed using R software version 4.0.4. With this software, the frequencies of responses for each modality of the different variables were determined. Frequency comparisons were made using the chi-square test of independence or the Fischer Exact test at the 5% significance level. For these tests, the variable responses were, on the one hand, knowledge of the existence of priority zoonoses, their mode of transmission, their zoonotic potential and their symptoms, and the taking of protective measures with regard to zoonoses when handling animals, on the other hand. The explanatory variables were the socio-professional characteristics of the farmers, in particular their number of years of experience in a slaughterhouse, their slaughterhouse of origin, their level of education and their age.

3. Results

3.1. Socio-demographic characteristics of the study population

For the purposes of this study, 51 professionals responded to the questionnaire. This sample was composed of 47 slaughterers and 4 veterinary inspectors, state agents in charge of meat inspection in the slaughterhouses monitored. The socio-demographic data collected during these surveys are summarized in Table 1. All respondents in the sample were male, and most of them (54%) were between the ages of 40 and 49. The majority (90.7%) of slaughterhouse staff had more than 20 years' experience. Of the slaughterers, 58%, 48% and 19% operated on cattle, small ruminants and pigs respectively. The survey also revealed that 28.2% of respondents slaughtered small ruminants exclusively, while 20% of respondents slaughtered cattle, sheep and goats at the same time. However, none of them combined the slaughter of all of these species. The socio-demographic data collected during these surveys are summarized in Table 1.

Table 1 Socio-demographic data of respondents

Variable	Category	Proportion (%)
Age range (years)	20-29	10
	30-39	18
	40-49	56
	50-59	14
	60+	2
Number of years of experience (years)	0-5	8
	6-10	14
	>10	78
Slaughterhouse	Dakar	86

	Kaolack	14
Gender	Masculine	100
	Female	0
Literacy level	Non-literate	36
	Literate	64
Species handled	bovine	58,6
	Small ruminants	47,8
	Pigs	19,5

3.2. Respondents' Knowledge of Priority Zoonotic Diseases

Among slaughterhouse staff, around 90% were aware of the existence of at least one of the 6 zoonoses recognized as priorities in Senegal: rabies, avian influenza, bovine tuberculosis, anthrax, Rift Valley fever and Ebola and Marburg hemorrhagic fevers. Among the zoonoses mentioned, tuberculosis and avian flu were the most popular, with 80% and 63% of respondents respectively aware of their existence. On the other hand, some 13% and 4% of respondents were aware of rabies and Ebola fever respectively. However, none was aware of Rift Valley fever, Marburg fever or anthrax. On the other hand, slaughterers in Dakar (82.5%) were more likely to cite priority zoonoses than those in Kaolack (66.7%). A significant variation in knowledge according to age was observed. All respondents aged under 30 cited at least one priority zoonosis, compared with 79.5% of those aged between 30 and 59 (p-value of 0.03107). No respondent aged 60 or over was aware of the existence of zoonoses. However, this variation was not significant with regard to their level of literacy (p=0.128). In addition, in our study, 8%, 49.2%, 2.6 % and 37.8% of slaughterers could respectively cite two symptoms of rabies (paralysis and coordination disorders), tuberculosis (enlarged lymph nodes and chronic lymph nodes and chronic cough), Ebola fever (localized hemorrhaging) and avian flu (breathing difficulties, swelling of the head swelling). On the other hand, 95% of slaughterhouse inspectors surveyed were aware of the priority zoonoses. In addition, 75% of them recognized signs (one in humans and one in animals) for each priority zoonosis. In terms of contamination routes, depending on the zoonosis concerned, 44.4%, 53.3% and 46.7% of workers stated that the pathogens were transmitted by air, contact and oral-fecal routes respectively. More than half (55.6%) were unaware of the modes of transmission of the zoonoses in this study. These results are reported in table 2 and illustrated in Figures 1 and 2.

Table 2 Slaughterhouse Staff's Knowledge of Priority Zoonotic Diseases

Variable	Category	Frequency (%)	95% CI
Heard about priority zoonotic diseases (n=51)	Rabies	13	9-17
	Tuberculosis	90	85-95
	Avian influenza	63	58-68
	Ebola fever	4	2-6
	Rift Valley fever	0	
	Anthrax	0	
	Marburg fever	0	
Clinical signs (n=51)	Rabies	8	5-11
	Tuberculosis	49	44-54
	Ebola fever	2	0-4
	Avian influenza	37	32-42
	Rift Valley fever	0	
	Anthrax	0	
	Marburg fever	0	

Species affected (n=51)	Sheep	17	.13-21
	Goats	18	14-22
	Pigs	7	5-9
	Cattle	21	17-25
	Don't know	42	37-47
Animal/carcass contamination route (n=51)	Contact	53	48-58
	Aerosol	44	59-49
	Oral-fecal	46	41-51
	Don't know	55	50-60

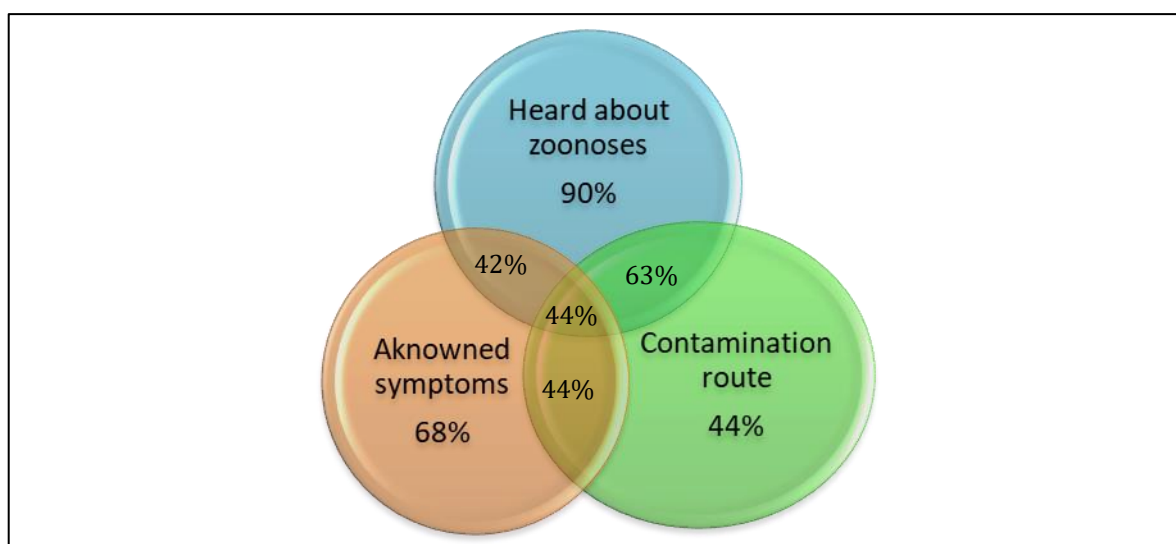


Figure 1 VENN diagram showing the frequencies of the level of knowledge of slaughterhouse staff on priority zoonotic diseases

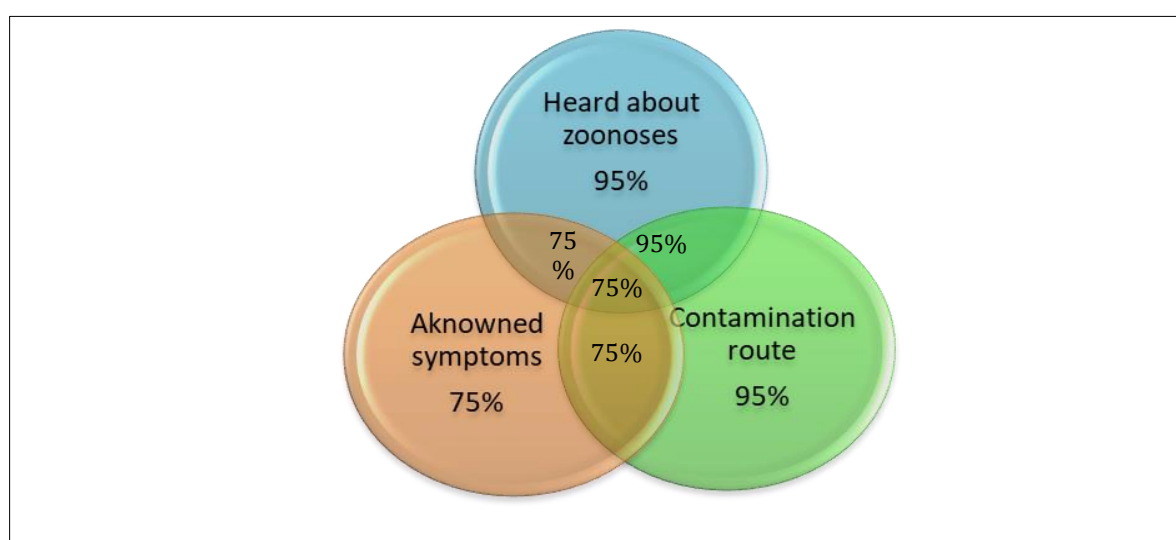


Figure 2 VENN diagram showing the frequencies of veterinary slaughterhouse inspectors' level of knowledge on priority zoonotic diseases

3.3. Attitudes and practices of slaughterhouse personnel towards priority zoonotic diseases

Of the respondents, 93.4% were in contact with the animal prior to slaughter, 95.7% were touching the carcass and body fluids, and 78% were touching the viscera. The survey found that 80.8% of workers reported taking measures to protect themselves from zoonoses. Indeed, 74% of them were in the 30-59 age group, and 23% in the 0-29 age group (p-value = 0.2223). In addition, non-wearing of masks and gloves was noted among both slaughterers (80.8%) and the majority (75%) of inspectors.

The survey also found that 94.5% of workers with more than 10 years of experience, 87.5% of those with 5 to 10 years of experience, and all those with less than 5 years of experience took hygiene measures for themselves (p-value = 0.7896).

We also have 40.4% of workers who took hygiene measures for their work equipment. Specifically, 51% of people aged between 30 and 59, 46.8% of workers aged 0 to 29 and all respondents aged 60 or over took hygiene measures for their work equipment (p-value = 0.06053). The study found that 51.3% of workers with more than 10 years of experience, 75% of those with 5-10 years of experience, and 50% of those with less than 5 years' experience took hygiene measures for their work equipment (p-value = 0.8718). The majority (80%) of these workers respected neither the procedure nor the key moments for washing hands or work equipment

There were 43.5% of workers aged between 30 and 59 and 28.5% of workers aged 0 to 29 who took hygiene measures for their environment, but the variation was not significant (p-value = 0.289).

Also, 42.1% of workers with more than 10 years of experience, 37.5% of those with between 5 and 10 years of experience and all those with less than 5 years of experience took hygiene measures for their workplace with a significant variation (p-value = 0.01304).

Our survey also noted that 53.1% of slaughterers took hygiene measures for their workplace, while 95% of slaughterhouse inspectors surveyed took hygiene measures for themselves and their environment.

In addition, 85.7% of respondents stated that the knife used for inspection was only cleaned in two circumstances: at the end of the inspection of all carcasses or after contact with a suspicious carcass.

They were all in contact with living animals (ante-mortem), their biological fluids and their viscera for a period of more than two hours per day. Of the inspectors surveyed, 75% reported washing their hands (soap + water) before carcass incision, after carcass inspection and after contact with a suspect carcass, while 25% reported washing their hands (soap + water) after carcass inspection and after contact with a suspect carcass. Data on respondents' attitudes and practices are reported in Table 3.

Table 3 Attitudes and practices of investigations in relation to priority zoonoses

Variable	Category	Frequency (%)	IC 95 %
Individual protection measures	Inspectors	95	90-100
	Slaughterers	80	75-85
Protective measures for work equipment	Inspectors	95	90-100
	Abatteurs	40	35-45
Workplace protection measures	Inspectors	75	70-75
	Abatteurs	53	48-58
Individual protection measures + Material protection measures	Inspectors	95	90-100
	Abatteurs	48	43-53
Protective measures for work equipment + workplace protection measures	Inspectors	75	70-80
	Abatteurs	28	23-33
Workplace protection measures +	Inspectors	75	70-75

individual protection measures	Abatteurs	38	33-43
Workplace protection measures + individual protection measures + protective measures for work equipment	Inspectors	75	70-80
	Abatteurs	25	20-30

Figure 3 shows the proportions of workers and slaughterhouse inspectors combined with three most associated risk practices for zoonotic contamination.

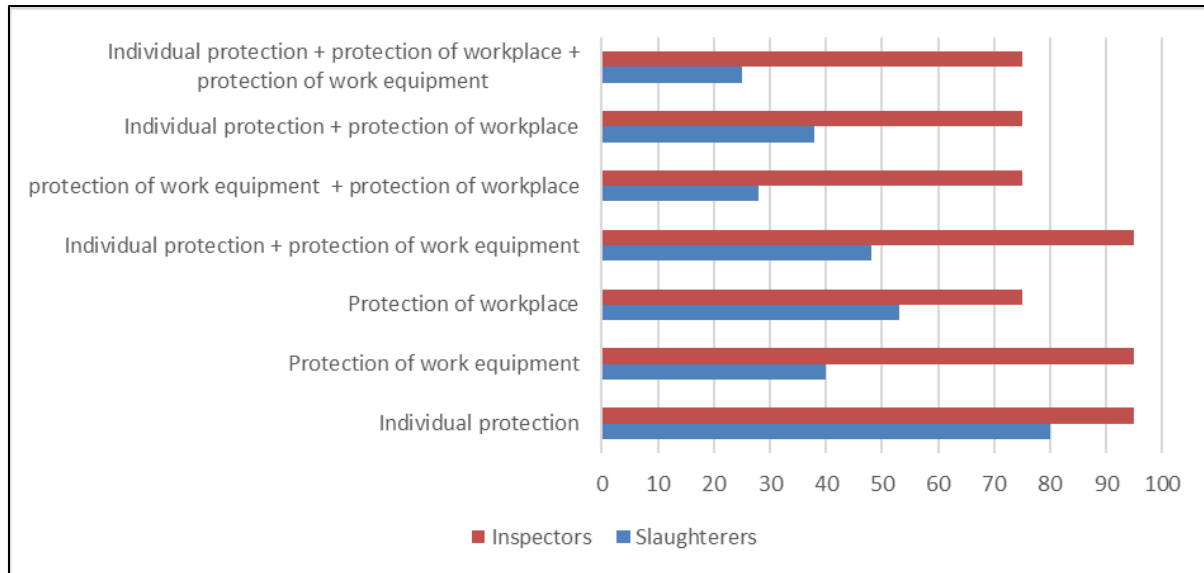


Figure 3 Frequencies of Slaughter Personnel Practices in Relation to Priority Zoonoses

4. Discussion

This study showed that 90% of slaughterers had heard of at least one priority zoonosis in Senegal. The proportions found varied significantly according to the diseases cited ($p=0.021$), and tuberculosis was the most well-known zoonosis (table 2). These data are similar than those obtained in the study carried out by De St Maurice et al [7] in Uganda on RVF among slaughterhouse workers, where most (90%) of the participants said they had heard of Rift Valley fever. However, the proportions about RVF are lower in our study. The difference between the frequencies of RVF epidemics in the two countries may be one the reasons. Indeed, sporadic RVF epidemics occurred from mid-October 2017 to mid-January 2018 in Uganda, affecting humans, domestic animals and wild animals with prevalences of 29%, 44%, 46% and 45% respectively of humans, cattle, goats and sheep tested [7]. While in Senegal we have an overall prevalence rate of 9.94% for animal RVF in 2022 [8]. For tuberculosis, on the other hand, our results (Table 2) corroborate those of a study carried out in Pakistan by Khattak et al [9] among slaughterhouse workers, where some 96% of workers reported having heard of tuberculosis. Our results on tuberculosis also concur with those of Hamid et al [10] who, in his study carried out in Senegal (at the Dakar abattoir and among farmers in Pout) found that 98.2% of respondents were aware of the existence of tuberculosis. Slaughterhouse staff in Dakar had heard more about zoonoses than those in Kaolack. The predominance of tuberculosis cases of tuberculosis seizures at the Pikine abattoir could be a reason. Indeed, the study by Zouaka [11] carried out at the Pikine abattoir revealed a proportion of 2.7% of respondents claiming to have frequently encountered cases of bovine tuberculosis. In Senegal, tuberculosis is the subject of a special awareness campaign the National Tuberculosis Control Program set up and run carried out since 1985 by the Ministry of Health and Social Action. This is not the case for other priority zoonoses. The Dakar slaughterhouse record more slaughterings and therefore more seizures and have more than the Kaolack abattoir. On the other hand, all the abattoir inspectors knew about the existence of priority zoonoses, some of their symptoms and their modes of transmission, their symptoms and modes of transmission. The higher quality of training of animal health inspectors might be a reason. This study confirms that the lack of community education and professional refresher courses contributes significantly to low awareness of zoonoses and consequently to a low level of knowledge to prevent zoonoses. In Senegal, Hamid [10] found that overall, only 2.5% of participants in his study had a satisfactory level of knowledge about the disease. This result differs from that of our study, where 28% of respondents had a satisfactory level of knowledge about bovine tuberculosis. In fact, the samples of the two studies are different, as our study takes into account only slaughterhouse professionals, whereas Hamid's study [10] concerns slaughterhouse professionals and livestock farmers. Also in his

study, according to his results, participants from abattoirs were 11 times more likely to have tuberculosis than those from livestock farms. In our study, 2.60% of slaughterers were able to cite at least two symptoms of Ebola fever. The study by Nyakarahuka et al [12] had better results than those obtained in our study (Table 2). In their study, Nyakarahuka et al [12] had 48.5% of participants classified as well informed about the symptoms of hemorrhagic fevers. Indeed, Uganda has recorded several outbreaks of Ebola and Marburg fevers, whereas Senegal has so far been recognized as free of these diseases. As for the clinical signs of anthrax, none of the workers could name at least one. Indeed, Uganda has recorded several epidemics of Ebola and Marburg fevers, while to date, Senegal has been recognized as free of these diseases. About clinical signs of anthrax, none of the workers could name at least one. In the Ethiopian anthrax, study by Romha et al. [13], 26.3% and 36.8% of respondents could identify at least one symptom of anthrax in animals and humans, respectively. With regard to rabies, only 8% of slaughterers recognized signs of rabies. The result obtained in this study is lower than that obtained by Mapatse et al [14] in Mozambique with 18.9% of households that recognized signs of rabies. All these results testify to the low level of knowledge of the symptoms of these zoonoses among slaughterhouse workers in our study. As far as knowledge of contamination routes is concerned, the results obtained in this study are similar to those of St Maurice et al [7], where 53% of participants declared that they had knowledge of the modes of transmission of to humans or animals, and identified contact with animals as the most common mode of transmission. The same applies to tuberculosis for which the study by Khattak et al [9] in Pakistan, where 45% of respondents said that tuberculosis could be transmitted from animals to Humans via aerosols. Generally, the results of this study highlight the low level of knowledge of priority zoonoses, their symptoms and their symptoms and modes of transmission, but also show the good level of training the good level of training of veterinary inspectors in these diseases. Furthermore, the low level of knowledge among slaughterers may play a crucial role in the spread of zoonoses.

Around 93.5% of those surveyed had been in contact with animals before their slaughter and 95.7% after the slaughter (carcass and biological fluids) and 78% who had been exposed to the viscera (table 3). In the study by Khattak et al [9], 83% reported direct contact with blood and carcasses [9]. Non-wearing of masks and gloves was noted among both slaughterers (80.8%) and the majority (75%) of inspectors (table 3). These results concur with those of the Tanywe et al. study [15], in which only 3.9% of slaughterhouse workers in Yaoundé observed the wearing of gloves. In the same study, hand washing was regularly practised by 84% of those interviewed during their activities at the abattoir, thus corroborating the results of our study where around 80% of workers washed their hands at the start (with water only) and at the end of slaughtering (water + soap). Thus, the majority of these workers respected neither the procedure nor the key moments for washing hands or work equipment. The study by De St Maurice et al [7] confirms the same trends, with 29% of participants claiming to use personal protective equipment when handling animals, but mainly using rubber boots and aprons, and few butchers using gloves. Similar results were found in the Khattak et al. study [9] where none of the slaughterhouse employees used masks, hairnets or gloves, but 40% used boots and 21% aprons. Our observations enabled us to note that in the Pikine and Kaolack abattoirs, the workers was dumping waste in the open air or at sea without prior septic tanks were full, attracting scavengers and dogs. Nyakarahuka [12] noted these same practices in the study. Our survey also revealed that 40% of workers said they regularly cleaned their work equipment regularly. This was also the case in the study by Odetokun et al [16], where less than a third of respondents correctly practiced regular hand washing, and 21.8% sterilized meat-handling handling tools. This indicates an insufficient level of protection for the workers in our survey for their work environment. Overall, workers have adopted bad practices and attitudes, increasing the risk of catching or spreading or spreading priority zoonoses within the abattoir. These results led to the formulation of recommendations to the various stakeholders.

5. Conclusion

In sum, the majority (74%) of slaughterers had limited knowledge about zoonotic diseases. On the other hand, all the inspectors had a good knowledge of zoonoses, in particular their zoonotic potential, their mode of transmission and their symptoms (animal and human). In addition, 85.2% of slaughterers adopted poor practices and attitudes towards zoonoses. In contrast, 75% of slaughterhouse inspectors had good behaviors that allowed them to be less exposed to zoonotic risks.

Regarding knowledge on zoonoses, we had a significant variation according to the age group. In terms of practices, there was a significant variation in the implementation of workplace protection measures based on the number of years of experience of staff.

Thus, the main target for awareness about zoonotic diseases should be people who are over 30 years old and less experienced.

In order to have a more global and precise view of the situation regarding the knowledge, attitudes and practices of slaughterhouse staff in Senegal, it would be wise to push the limits of this study by taking into account a larger sample including all slaughterhouses throughout the Senegalese national territory and by developing more explicit questionnaires for slaughterhouse professionals.

Compliance with ethical standards

Acknowledgement

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

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