Analysis of the Awareness, Perception, and Adoption of Biosecurity Measures by Slaughterhouse Workers in Koinadugu District, Sierra Leone

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Abstract: Slaughterhouse workers are more susceptible to zoonotic disease infections from cuts and bloodletting, spreading blood-borne pathogens to societies. Adopting biosecurity measures by slaughterhouse workers in their daily tasks can lower the risk of spreading zoonotic diseases while improving food safety. This study aims to examine slaughterhouse workers' awareness of biosecurity, their perception of the efficiency of biosecurity measures in reducing zoonotic infections, and, most crucially, their adoption of such measures. The research was carried out in Sierra Leone's Northern Province's Koinadugu district. A total of 18 slaughterhouses were randomly selected in six chiefdoms of the Koinadugu district.
A semi-structured questionnaire was used to survey 87 slaughterhouse workers in the 18 slaughterhouses selected in the six chiefdoms. The data were analyzed using Microsoft Excel version 2016 software. Results show that most slaughterhouse workers (87.4%) are well aware of biosecurity measures. They perceived cleaning and disinfecting the materials and equipment used in the slaughterhouse ($\bar{x}$ = 4.43), as well as the workplace itself ($\bar{x}$ = 4.33), and receiving proper training ($\bar{x}$ = 4.33) as crucial biosecurity measures. The results also reveal little use of personal protective equipment by slaughterhouse workers (27%). There is low adoption of biosecurity measures by slaughterhouse workers in the district. Corruption and inadequate funding of relevant institutions affect the enforcement of biosecurity legislation in the district. Therefore, education and training programs can improve slaughterhouse workers' knowledge and understanding of biosecurity measures. Also, good governance should be fostered at all institutional levels to increase the effectiveness and efficiency of public sector service delivery.

Keywords: Adoption, Awareness, Biosecurity Measures, Slaughterhouse, Zoonotic Disease.

1. INTRODUCTION

Animals are a major source of food and revenue across the world, and as a result, there is a considerable risk of zoonosis transmission and occurrence [1]. Humans are susceptible to zoonotic infections because they rely on animals and products for sustenance [2]. Zoonotic diseases are transmitted from animals to humans by consuming animal products, direct contact with animals, animal fluids, or animal excrement [3]. New emerging, re-emerging, or endemic food-borne and zoonotic diseases pose significant issues in developing countries, where they cause major morbidity and mortality due to weak policies and institutions [2]. Zoonotic infections are exceptionally high among slaughterhouse workers [4]. An increased incidence of contamination causes high prevalence rates among slaughterhouse workers during processing, which is caused by cross-contamination, particularly in unsanitary slaughterhouses [5]. Slaughterhouse workers are susceptible to infections from cuts, bloodletting, and the danger of spreading blood-borne pathogens to their colleagues [6].

Biosecurity refers to adopting actions that safeguard human health by limiting the danger of disease and disease agents being introduced and transmitted [7],[8]. Biosecurity in the context of livestock value chains refers to adopting a set of attitudes, behaviors, and practices that reduce the risk of zoonosis and disease transmission from domesticated animals and their products, as well as related wastes, by value chain actors [9]. Developing nations lack robust government regulations on food safety and inadequate organizations with unclear inspection mandates and little enforcement power. Given their weakened healthcare systems, which are prone to misdiagnosis and underreporting of disease outbreaks, biosecurity measures can help to reduce the danger of zoonotic diseases [10].

Adopting biosecurity measures by slaughterhouse workers in their daily tasks can lower the risk of spreading zoonotic disease while improving food safety [10],[11]. However, empirical research reveals that biosecurity measures are rarely implemented among slaughterhouse workers in underdeveloped nations [12],[13]. In Sierra Leone, few studies have been conducted, leaving a gap in knowledge on biosecurity measures used by slaughterhouse workers and their understanding, perception, and acceptance of biosecurity measures. Therefore, the current study aims to examine slaughterhouse workers' awareness of biosecurity, their perceptions of the efficiency of biosecurity measures in reducing zoonotic infections, and, most crucially, their adoption of such measures.

2. METHODOLOGY

2.1. Study Area

The research was carried out in the Koinadugu district. Koinadugu District is located in Sierra Leone's Northern Province. It's bordered on the west by Bombali, on the southwest by Tonkolili, on the south by Kono, on the east by Falaba, and on the north by the Republic of Guinea. It is Sierra Leone's biggest district geographically and one of the least thickly populated districts. According to the 2015 Sierra Leone national census, the District of Koinadugu has a population of 404,097 people and a total area of 12,121 km^2 (4,680 sq mi). The district of Koinadugu is divided into eleven chiefdoms. Like the rest of the country, the region has two

seasons: rainy and dry. The dry season runs from November to April, while the rainy season runs from May to October, with an average of 147 wet days and 208 cm of rain. The district has the country's highest cattle population, producing animal protein.

2.2. Sampling procedure

The study adopted the random sampling technique to select slaughterhouse workers from six (6) chiefdoms in the Koinadugu district (Kasunko, Mongo, Wara Wara Yagala, Senqbe, Folosaba Dembelia, and Dembelia Sinkunia). A total of 18 slaughterhouses were randomly selected in the six chiefdoms for the studies. A semi-structured questionnaire was to survey 87 slaughterhouse workers employed in the 18 different slaughterhouses selected in the six chiefdoms. The questionnaire was administered during a face-to-face interview to get information from slaughterhouse workers, with the primary prominence being on awareness, perception, and adoption of biosecurity practices.

Table 1: Sampling procedures indicating chiefdoms, the number of slaughterhouses, and the number of slaughterhouse workers

Chiefdoms	No. of slaughterhouses	No. of slaughterhouse workers
Kasunko	4	21
Mongo	2	11
Wara Wara Yagala,	3	13
Senqbe	4	18
Folosaba Dembelia	3	15
Dembelia Sinkunia	2	9
Total	18	87

Source: Field survey, 2021

2.3. Data analysis

The data were analyzed using Microsoft Excel version 2016 software. Tables and graphs depicting frequency and percentage statistics were used to present the data.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic characteristics of Slaughterhouse workers

Table 2 demonstrates that slaughterhouse workers are overwhelmingly male (93.1%), while females make up (6.9%). Due to the local community's social, cultural, and religious norms, there is a gender imbalance among slaughterhouse workers in the Koinadugu area, with women traditionally excluded. This finding is consistent with Nyokabi [12], who discovered that the slaughterhouse workers in Kenya are dominated by males, with women banned from slaughtering operations. The bulk of the workers (69%) are between the ages of 26 and 35, and the majority (75.9%) have no formal education. Most slaughterhouse workers (65.5%) have 11 to 20 years of experience, and most workers (90.5%) have not received formal training in their accountable jobs. The findings are consistent with Klous et al. [14], who indicated that lack of proper training might impair the slaughterhouse worker's understanding of their biosecurity risks due to their work practices.

Table 2: Socioeconomic characteristics of slaughterhouse workers (N=87)

Variables	Frequency	Percentages
Gender		
Male	81	93.1
Female	6	6.9
Age		
Below 26	3	3.4
26-35	60	69.0
36-45	11	12.6
46-55	8	9.3
Above 56	5	5.7
Educational level		
No formal education	66	75.9
Primary school	7	8.0
Secondary school	12	13.8
Tertiary education	2	2.3
Marital Status		
Single	58	66.7
Married	20	23.0
Others	9	10.3
Household size		
Less than 5	15	17.2
5-8	54	62.1
9-12	8	9.2
Above 13	10	11.5
Years of working in the slaughterhouse		
1-10	5	5.7
11-20	57	65.5
21-30	11	12.6
31- and above	14	16.2
Level of training		
Formal training	8	9.2
On-the-job training	79	90.8

Source: Field survey, 2021

3.2. Access to Information

Most slaughterhouse workers (58.6%) rely on veterinary officials for information (Figure 1). The capacity of slaughterhouse workers to learn about and implement biosecurity measures in their daily operations can be seriously influenced by the flow and dissemination of information from veterinary officers to slaughterhouse workers [15]. A sound information dissemination system can improve slaughterhouse personnel's knowledge of the linkages between human infection and occupational hazards in meat processing and their role in exacerbating zoonotic disease outbreaks through cross-contamination [5].
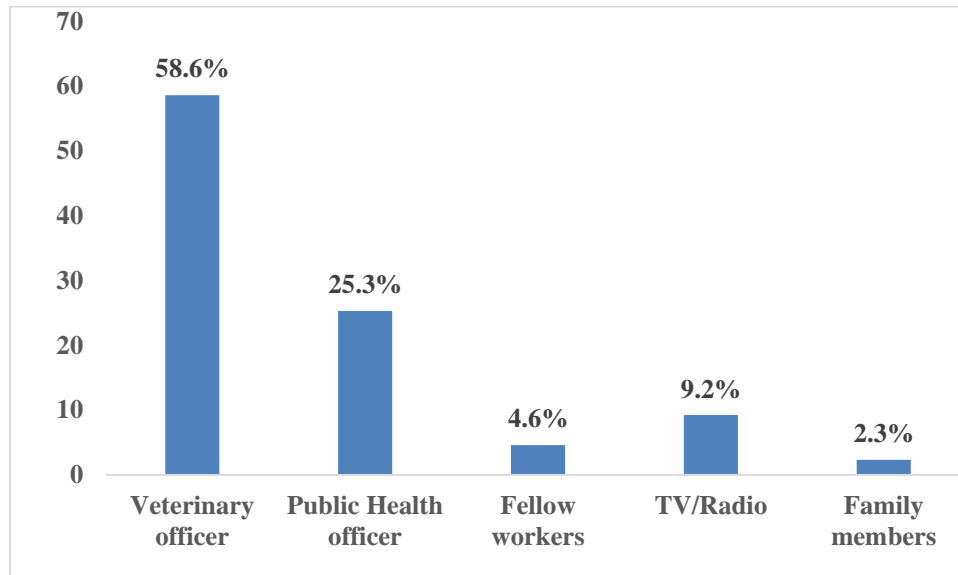
Fig. 1 Slaughterhouse workers' source of information

3.3. Slaughterhouse worker's awareness of zoonotic diseases

Figure 2 demonstrates that (94.3%) of slaughterhouse workers have heard of zoonotic disease and are aware that they can become infected by animals or livestock products. As a result, slaughterhouse workers in the Koinadugu district are quite aware of zoonotic diseases. Their awareness of zoonotic diseases is due to their experience with the 2014 Ebola virus outbreak in the country, where the government was involved in a massive sensitization campaign [16].
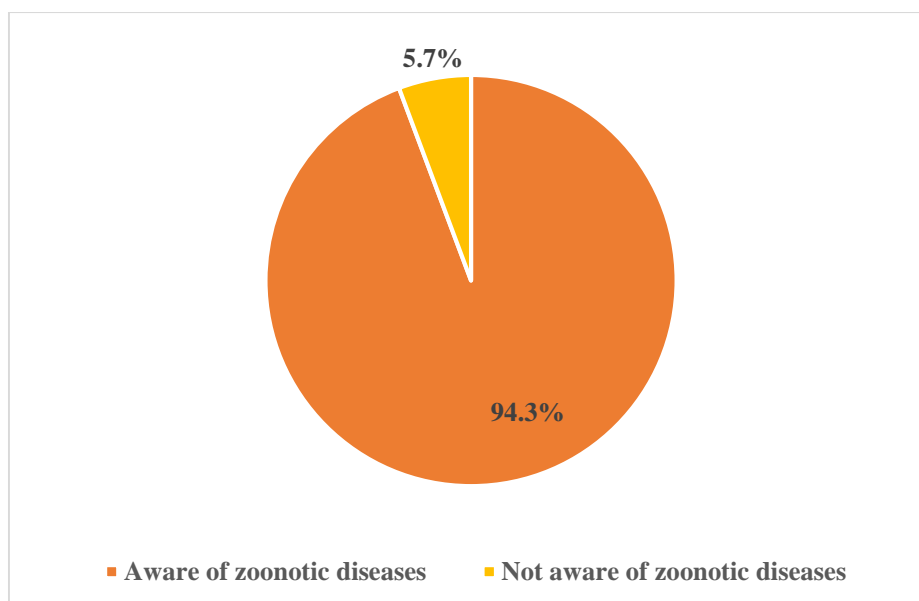

Fig. 2 Slaughterhouse worker's awareness of zoonotic diseases

3.4. Slaughterhouse worker's awareness of biosecurity measures

Most slaughterhouse workers (87.4%) are well aware of biosecurity measures and their critical role in their daily operations (figure 3). They understand the need for basic biosecurity measures such as hand washing and disinfection, wearing face masks, and wearing hand gloves. Most of them learned about such biosecurity measures during the 2014 Ebola virus disease outbreak in the country, and some knew about it during the current COVID-19 pandemic ([17],[16].
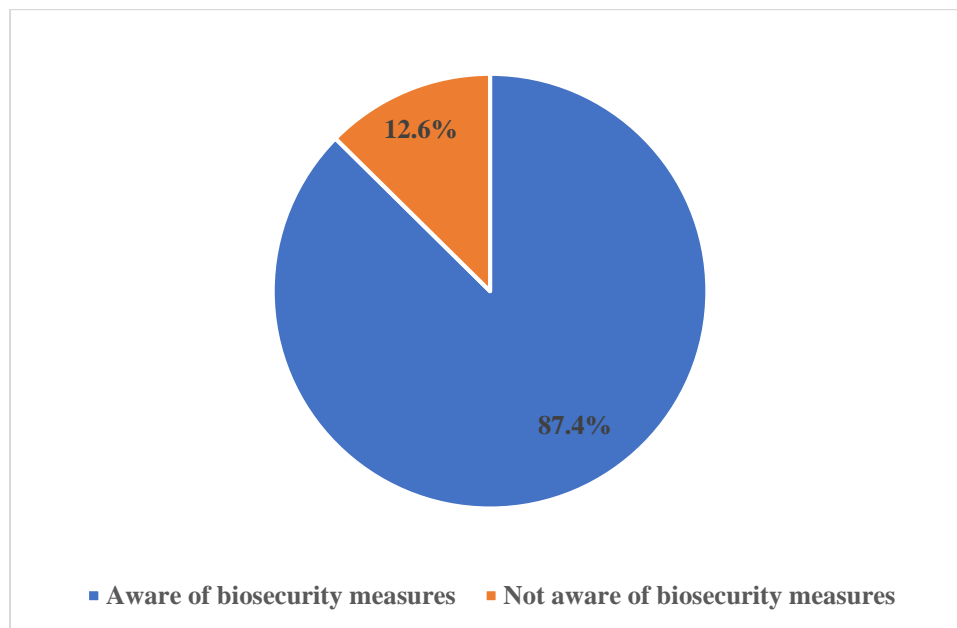

Fig. 3 Slaughterhouse worker's awareness of biosecurity measures

3.5. Perceptions of the Importance of Biosecurity Measures

According to the findings presented in Table 3, the vast majority of slaughterhouse workers perceived cleaning and disinfecting the materials and equipment used in the slaughterhouse ($\bar{x}$ =4.43), as well as the workplace itself ($\bar{x}$ =4.33), and receiving proper training ($\bar{x}$ =4.33) as very important biosecurity measures. At every level of the livestock value chain, fundamental training that covers individual responsibilities, biosecurity controls, first-aid procedures, fire safety, and emergency procedures is essential [18]. Training on disease transmission, prevention, and biosecurity measures should be provided to all slaughterhouse personnel as this will enable them to overcome the challenges of low education [9].

Most slaughterhouse workers regarded knowledge of biosecurity ($\bar{x}$ =4.20) as being essential. Extremely few participants in the value chain have even the necessary knowledge of the procedures involved in biosecurity, and this is especially true of individuals who do not have the appropriate education or training for the job [9]. In order to successfully convince operators along the value chain to adopt biosecurity and other risk-reduction initiatives, knowledge is vital [19].

In addition, they recognized investment in biosecurity ($\bar{x}$ = 4.14) as very important. People not only profit in terms of their health from biosecurity measures, but they also benefit in terms of their company from these efforts [20]. According to Nyokabi [12], most actors in the value

chain are interested in investing in biosecurity measures but do not have the expertise necessary to implement or utilize them.

Table 3: Slaughterhouse worker's perception of the importance of biosecurity

Attribute	Very important	Important	Neutral	Low importance	Not at all important	Total	Mean
Knowledge of Biosecurity	65.5	12.6	4.6	10.3	6.9	87	4.20*
Used of PPE	6.9	74.7	4.6	8.0	5.7	87	3.69*
Cleaning and disinfecting of workplace	66.7	13.8	9.2	6.9	3.4	87	4.33*
Cleaning and disinfecting of materials and equipment	72.4	12.6	4.6	5.7	4.6	87	4.43*
Start the day with clean and disinfected PPEs	8.0	72.4	10.3	5.7	3.4	87	3.76*
Training	64.4	18.4	6.9	6.9	3.4	87	4.33*
Invest in biosecurity	62.1	13.3	6.9	10.3	6.9	87	4.14*

Note: * = Significant impact if mean score is ≥ 3.0
Source: field survey, 2021

3.6. Use of Personal Protective Equipment (PPE) by slaughterhouse workers

Figure 4 shows that slaughterhouse workers' adoption and use of PPE as a personal biosecurity measure is low (27%). The findings are consistent with Nyokabi [12], who indicated that the use of PPE by livestock values chain actors in Kenya is minimal as some merely wore gloves, while others wore jackets but no gumboots or coats but no gumboots. The findings are also in line with Cook et al. [5], who observed low rates of PPE use among milk and meat value chain operators in western Kenya. As a result of their work, slaughterhouse workers who do not wear personal protective equipment (PPE) are more likely to contaminate the products they handle, serve as a reservoir for pathogens, and become infected with zoonotic diseases [21]. Personnel

in the livestock value chain can be safeguarded from occupational pathogen exposure using personal protective equipment [22].
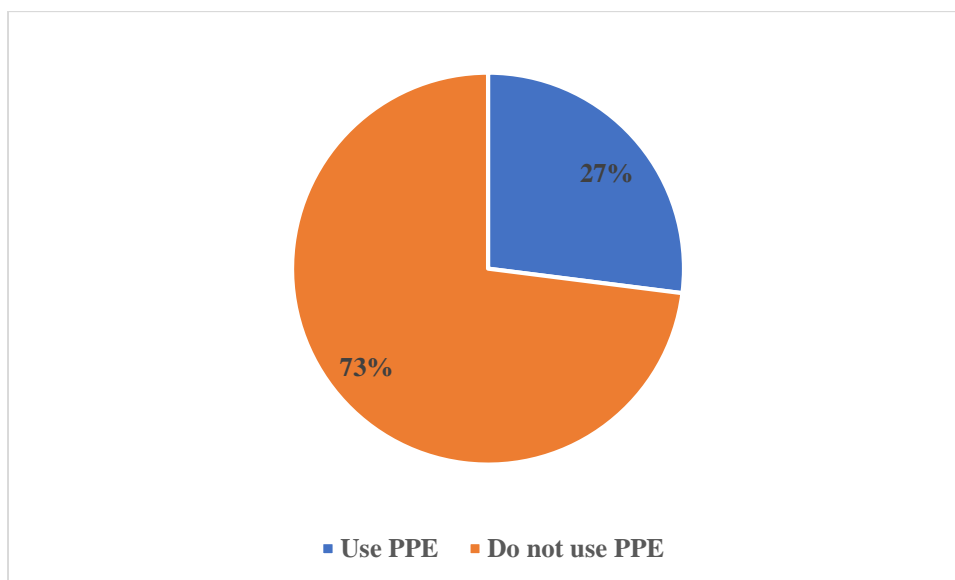

Fig. 4 Use of personal protective equipment (PPE)

3.7. Knowledge of compulsory biosecurity legislation

Slaughterhouse workers' understanding of mandatory biosecurity regulations is shown in Table 4. According to the findings, slaughterhouse workers have little knowledge of biosecurity legislation and can't tell the difference between voluntary and mandatory biosecurity procedures. They only completely understand meat inspection (100%) and company licenses (96.6%) as mandatory biosecurity legislation. This is due to veterinary officers regularly visiting them as they are in charge of animal inspections and determining if the meat is fit for human consumption, while district public health offices are in charge of slaughterhouse inspections. Public health officials also enforce biosecurity legislation and give health certifications to actors involved in food production and handling [12]. Even though wearing PPE is required by law, slaughterhouse workers' understanding of the use of PPE as mandatory biosecurity legislation is generally low (41.4%), with many seeing the measures as voluntary rather than compulsory. Many farmers who raise livestock are under the impression that biosecurity measures are optional rather than mandatory [23]. In research carried out on dairy farms in Spain by Moya et al. [24], the participants voiced a variety of perspectives on the question of whether or not biosecurity measures should be made mandatory or allowed to remain voluntary.

Table 4: Knowledge of mandatory biosecurity legislation (N=87)

Biosecurity measures	Frequency	Percentage	Ranking
Meat inspection	87	100	1
Personal protective equipment	36	41.4	6

Business License	84	96.6	2
Medical check-up	23	26.4	8
Handling training	30	34.5	7
Proper waste disposal	37	42.5	5
Proper meat storage	44	50.6	4
Premise inspection certificate	52	59.8	3

*Responses are not 100% due to multiple responses from the respondents.
Source: field survey, 2021

3.8. Challenges faced by slaughterhouse workers in the implementation of biosecurity measures

Table 5 reveals that slaughterhouse workers' poor acceptance and adoption of biosecurity measures is due to the district's responsible institutions' inadequate enforcement of biosecurity legislation (83.9%). The other major obstacle to implementing biosecurity measures in the Koinadugu district is a lack of knowledge of biosecurity (78.2%) measures among slaughterhouse workers. Slaughterhouse workers need to be provided with needs-based knowledge of biosecurity that reacts directly to the biosecurity threats they face in their daily tasks [25].

Table 5: Challenges in the implementation of biosecurity (N=87)

Challenges	Frequency	Percentage	Ranking
Lack of knowledge of biosecurity	68	78.2	2
Lack of interest in biosecurity	40	46.2	6
Not willing to invest in biosecurity	50	57.5	4
Don't believe in biosecurity	62	71.3	3
Can't afford to invest in biosecurity	42	48.3	5
Lack of enforcement of legislation	73	83.9	1

*Responses are not 100% due to multiple responses from the respondents.
Source: Field survey, 2021

3.9. Factors adversely affecting the enforcement of biosecurity legislation

Figure 6 shows that one of the major issues affecting the district's biosecurity legislation enforcement is corruption (86.2%). Even though Sierra Leone has a well-established anti-corruption body, there are still instances of personnel demanding payments in exchange for the issue of particular credentials. Fear of being victimized makes value chain operators hesitant to disclose bribe demands, improperly imposed penalties, and harassment by government employees entrusted with executing laws and regulations. Corruption makes it challenging to implement simple but crucial biosecurity measures to prevent the spread and transmission of zoonotic diseases [26]. Another issue affecting the implementation of biosecurity legislation in the district is a lack of funding (69.5%). There is a paucity of public health training and education due to inadequate financing of institutions that provide these services [27]. In the aftermath of a zoonotic disease pandemic, it is difficult to ensure that people and animals have access to treatments because of late budget approvals [28].
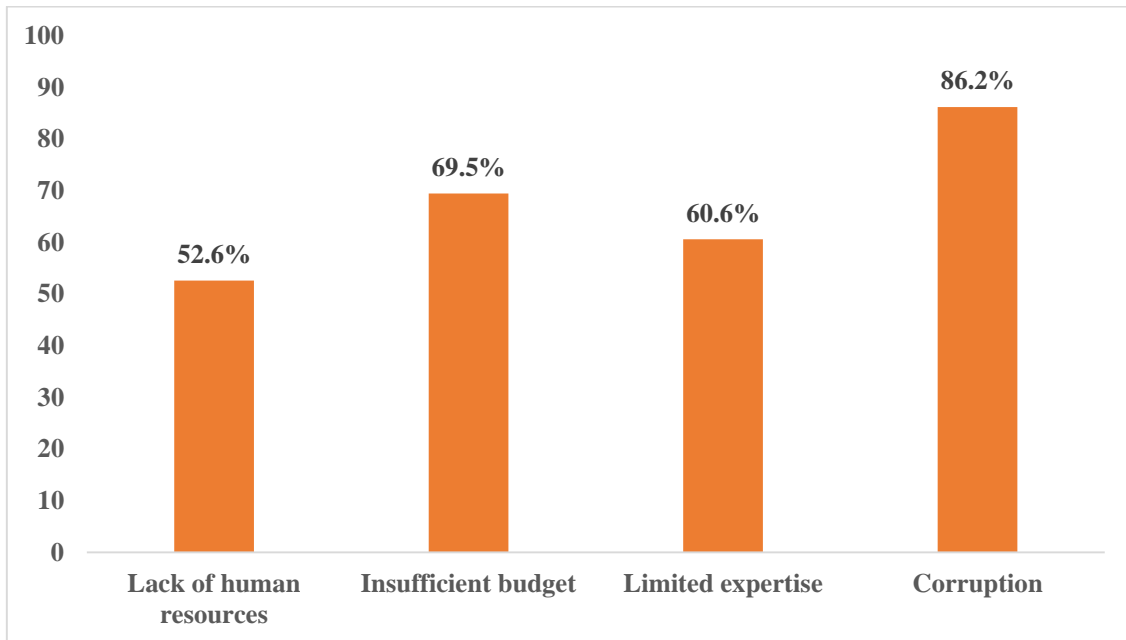
Fig. 5 Factors affecting the enforcement of biosecurity legislation

4. CONCLUSION

Slaughterhouse workers are greatly responsible for preventing zoonotic disease development and transmission. Adopting biosecurity measures by slaughterhouse workers in their daily tasks is a public good for zoonotic disease control at a fundamental level. Slaughterhouse workers are well aware of zoonotic diseases and biosecurity measures. Despite their awareness of zoonotic diseases and biosecurity measures, slaughterhouse workers don't realize how their hygiene, sanitation, livestock, and food handling expose them and others to zoonotic diseases. Personal protective equipment is seldomly used in their daily operations. There is low adoption of biosecurity measures by slaughterhouse workers in the district. Challenges faced by slaughterhouse workers in implementing biosecurity measures include inadequate enforcement of biosecurity legislation and a lack of knowledge of biosecurity measures among slaughterhouse workers. Corruption and lack of funding affect the enforcement of biosecurity legislation in the district.

Therefore, the relevant authorities should enforce slaughterhouse workers' responsibilities and obligations in implementing biosecurity measures and procedures per statutes and applicable food handling regulations. Education and training programs can improve slaughterhouse workers' knowledge and understanding of biosecurity measures. Also, good governance should be fostered at all institutional levels to increase the effectiveness and efficiency of public sector service delivery.

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