

## A STUDY OF SKIN SEPSIS AMONGST ABATTOIR WORKERS IN MONIYA, IBADAN, OYO STATE, NIGERIA

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### ABSTRACT

**Background:** Skin sepsis is a pyodermal infection caused by Lancefield's group streptococci and *Staphylococcus aureus*. It is characterized by discolored and mottled skin, cellulitis, impetigo and multi-systemic collagen muscularitis and can be transmitted from person to person.

**Objective:** This study sampled the skin of consented abattoir workers in Moniya Ibadan, for clinical sepsis, with a view to establishing a causal relationship between the infection obtained and the abattoir workers examined.

**Methodology:** A total of 100 meat handlers' hands and forearms were examined. Swabs were taken from lesions which appeared clinically to be infected and then propagated on selective culture media designed for staphylococci and streptococci. Conventional biochemical tests and Lancefield determination were carried out as considered appropriate.

**Results:** Of the 100 swabs from the categories of abattoir workers examined, 43 streptococci (35 from lesion 8 from wound) and 36 *Staphylococcus aureus* (20 from lesion and 16 from wound) were obtained. The regression analysis from the grouping of gender, causative agents and specific infection as a predictor of infection were recorded to be significant ( $b = 0.18$ ;  $t = 1.74$ ;  $p < 0.05$ ) for the nature of but non-significant ( $b = -0.067$ ;  $t = -0.649$ ;  $p > 0.05$ ) for the gender. In-vitro antigen antibody reaction on Streptex<sup>M</sup> kit elicited varied reactions to Lancefield's serological grouping (A (56%), B (9%) C (7%) G (22%) and L (7%). Resistance of *Staphylococcus aureus* in varying percentages (Tetracycline and gentamicin 62%, meropenem and ceftriaxone 100%, amikacin, 10%, and vancomycin 80%) to conventional antibiotics were observed.

**Conclusion:** From this study point of view, the causal relationship between the infection and the infected has been established, from the pathogens of pyodermal origin contacted from cows, that causes sepsis across all the category of abattoir workers studied. There is a need to provide an ideal functioning abattoir fully equipped with required facilities for safety and ease of execution of duties.

**Keywords:** Skin sepsis, Abattoir, Abattoir workers, Moniya, Ibadan.

### INTRODUCTION

Streptococcal skin sepsis is a pyodermal infection caused by Group A Lancefield's related streptococci and *Staphylococcus aureus*. It is characterized by discolored and mottled skin, cellulitis, impetigo and multi-systemic collagen muscularitis. Skin sepsis appears to be common among meat handlers attributable to their behavioral attitude toward the norms of personal hygiene. By comparison, outbreaks of streptococcal and staphylococcal skin infections occur fairly frequently and in recent years have become increasingly recognized

as an occupational hazard of meat handlers. When such episodes occur they can involve a substantial proportion of those at risk.<sup>1</sup>

Abattoir workers and meat handlers are professional personnel trained in the art of killing, skinning, dressing and cutting up of carcass of animals. Their function also includes indoor confinement of animals while awaiting slaughter and wrapping raw or frozen stored slaughtered animals for human consumption. These

categories of workers are at risk of zoonotic skin infections from animal parasites, fungi, bacterial or infection of viral origin.<sup>2</sup>

Abattoir popularly called “Kara” which means cattle colony in the southwest Nigerian states are made up of manual slaughter house, mechanical slaughter house and the lirage (a holding pasture where the animals are allowed to graze until 24 hours before slaughter) for veterinary inspection. Abattoir workers are usually exposed to biological, chemical and physical occupational hazards at work. The biological hazards could originate from parasite, bacterial or viral loads inherent within and without the animals, chemical from disinfection and sterilization procedures, while physical hazards include; injuries, cuts, wounds, needle-stick injuries, scalds, accidents from direct confrontation with a maddening cow. Other predisposing factors are contaminated animal contact, slippery surfaces, polluted air, unkempt environment, as well as behavioral unhygienic practices.<sup>3</sup>

Abattoir worker can be a victim of mechanical injury, shock and other risk factors like waist pain, stress, injury while lifting heavy equipment and manipulating body parts of large animals which could stress their muscles and joints, thus subjecting them to severe physical stress and pain. These activities might predispose them to problems with muscles and bones. Also, the use of chemicals with different concentration in abattoir environment for sterilization, disinfection, decontamination, control of vectors of diseases and cleaning are another occupational health hazards in addition to other preventive and biosecurity measures, which are capable of causing inflammation, cancer, respiratory diseases, and allergic hypersensitivity reactions thus jeopardizing workers health.<sup>4</sup>

The nature of slaughtering and meat handling involves a high risk of traumatic injury by knives and bone-splinters. Animal bone splinters can cause a variety of injuries varying from simple punctures to large lacerations. These are usually more traumatic than the single cuts caused by knives, and bone punctures appear predominately to be those which develop into skin infections of prolonged duration. The groups of meat handlers who are especially at risk are butchers and those handling unboned or part carcasses.<sup>5</sup> *Beta-hemolytic streptococci* or *Staphylococcus aureus* had been reported in the variety of skin infections which includes wound, lesion, septic cuts, abscess, lymphangitis and scratches, as well as infection in pierced ear lobes<sup>6</sup>.

The mental orientation, poverty redesigned minds and carefree attitudes of the abattoir workers simply

disregard the few facilities for safety, though most of those facilities were unmaintained where available. And due to their daily exposure to the work, their immunity may have been fortified, but may not be sufficient to suppress both the inherent and outsource biological challenges from the sick animals.<sup>7</sup>

In Nigeria, predominantly where abattoir are built by government, community or self-effort, the facilities are either not there or functioning sequel to the negligence, underfunding, mismanagement or misplaced priority from the providers thereby exposing various categories of abattoir workers to occupational health hazards.<sup>8</sup>

The Centers for Disease Control and Prevention stated that occupational hazards have continued to rise in the past decades, resulting in increasing rates of occupational exposure to blood-borne illnesses and other communicable diseases mostly in the developing and transitioning countries.<sup>9</sup>

This study therefore, sampled the skin of consented abattoir workers in Moniya Ibadan, Southwest Nigeria for clinical sepsis, unravel the Lancefield's status of streptococci isolated, determine the susceptibility of *Staphylococcus aureus* obtained from the sample to some selected conventional antibiotics and relates the causal agent with the zoonotic infection unmasked.

## METHODS

### Study Design

This was a cross-sectional descriptive study among abattoir worker in Moniya Ibadan.

### Place of the study

*This survey was carried out on a state-owned abattoir in Moniya, Akinyele local government area (Oyo State), a town in Nigeria of about 267- miles (or 429 km) to the south-west of Abuja, the country's capital city. Moniya Abattoir is the largest in Oyo State, Nigeria.*

### Collection of samples

Face-to-face interaction with consented subjects was conducted at the abattoir to examine the skin of the volunteers, specific work of each participants and its nature, and the predominant micro-climate surrounding the workplace environment.

### Bacteriology

A total of 100 skin swab samples were collected from infected individuals and cultured separately on sheep blood agar base, incubated at 37°C for 24 hours anaerobically for *Seta-haemolytic Steptococcus* and on mannitol salt agar for *Staphylococcus aureus*. Conventional biochemical and confirmatory tests which included catalase test, coagulase test, DNase test, for

*Staphylococcus aureus* and Lancefield serological test and catalase tests for  $\beta$ -haemolytic streptococci were carried out on the isolates.

### Lancefield antigen determination

A rapid slide agglutination test was carried out on 24 hours old distinct colony of  $\beta$  haemolytic isolates of streptococcus spp. on ProlexStreptex diagnostic kit. A clear distinct view with blue latex agglutination (antigen-antibody reaction test on Streptex™ Reagents) on a black background within 30 seconds, was observed. The Polyvalent Streptex™ strains were used as positive control for each latex reagents.

### Determination of Antibiogram

Antimicrobial susceptibility patterns of the 37 isolates of *Staphylococcus aureus* to selected antibiotics were determined using the Kirby-Bauer modified agar diffusion technique. *Staphylococcus aureus* strain ATCC 29213 was used as standard control.

A volume of 0.1mL of the 24 hours broth culture of each isolate was pipette in to 9.9mL of sterile distilled water in the vials. The inoculums were standardized by diluting the broth culture until it matched the 0.5 McFarland turbidity standards. A sterile cotton swab was dipped into each of the standardized suspension, drained and used for inoculating 20mL of Mueller Hinton agar (Oxoid, UK) on 100-mm disposable plate (Sterlin, UK). The inoculated plates were air dried for 30 min, and antibiotic discs (Oxoid, UK) were placed on the agar using flamed forceps and were gently pressed down to ensure maximum contact. Discs containing the following antibiotics were used for the susceptibility testing; Tetracycline(10 $\mu$ g/mL), Cotrimoxazole (10 $\mu$ g/mL) Gentamicin (30 $\mu$ g/mL), Meropenem (30 $\mu$ g/mL), and ceftriaxone (30 $\mu$ g/mL), Cefuroxime(30 $\mu$ g/mL) Cefotaxime (30 $\mu$ g/mL), Chloramphenicol(30 $\mu$ g/mL), Ciprofloxacin(30 $\mu$ g/mL), Amikacin(30 $\mu$ g/mL), Vancomycin(30 $\mu$ g/mL),

were used. The plates were incubated aerobically at 37°C for 24 hours before measuring the diameter of zones of growth inhibition. Sensitive, intermediate and resistant strains were marked S,I and R respectively and were analyzed as specified by Clinical Laboratory Standard Institute (CLSI, 2016 guide).

### Ethical consideration.

Ethical approval with reference number AD 13/479/44945<sup>B</sup> was obtained from the Department of Planning Research and Statistic Division, Oyo State Ministry of Health before embarking on this study. The participants were informed of the purpose of the study and that they can decide to accept or reject at will. Permission was also granted by the market chairman after satisfactory verbal explanation.

### Statistical Analysis

Data collected was analyzed using SPSS 15 and graph was plotted using Graph Pad prism 8.1 Version 5 for Windows.

## RESULTS

A total number of 100 volunteers comprising 64 males and 36 females were sampled, the gender distribution varied according to their preference for specific duty in abattoir, variation in the instrumentality that causes the infection and numbers of the infected individuals were observed and recorded as shown in Table 1.

A total sum of 100 skin swabs was taken, of which 37 isolates of *Staphylococcus aureus* (20 from lesion and 17 from wound) while a total sum of 45  $\beta$ -hemolytic streptococcus sp(37 from lesion and 8 from wound) were obtained respectively as shown in Table 2.

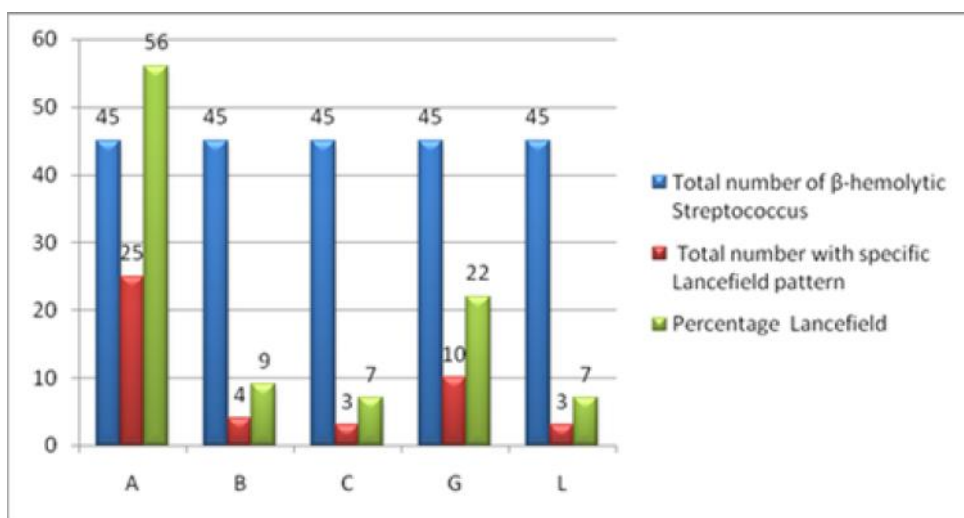
The result from Table 5 elicited the independent variables (nature of work and gender) as having a relationship with bacterial infections of abattoir workers (R = 0.18). This implies that all independent

**Table 1:** Gender distribution, physical causes of infection and numbers infected

Categories of work	Gender			Causes of infected lesion			Number of workers infected		
	Male	Female	Total	Bone	Knife	Grazer	Male	Female	Total
<b>Butcher</b>	30	5	35	14	10	4	24	4	28
<b>Slaughterer</b>	15	0	15	9	5	-	14	-	14
<b>Gut cleaner</b>	2	13	15	5	7	-	1	11	12
<b>Packer</b>	3	7	10	6	2	-	1	7	8
<b>Loader</b>	10	5	15	8	-	4	9	3	12
<b>Inspector</b>	3	2	5	-	-	-	-	-	0
<b>Grazer</b>	4	1	5	-	2	3	4	1	5
<b>Total sum</b>	<b>64</b>	<b>36</b>	<b>100</b>	<b>42</b>	<b>26</b>	<b>11</b>	<b>53</b>	<b>26</b>	<b>79</b>

**Table 2:** Bacteriological distributions of the isolates of skin sepsis from the categories of the abattoir workers

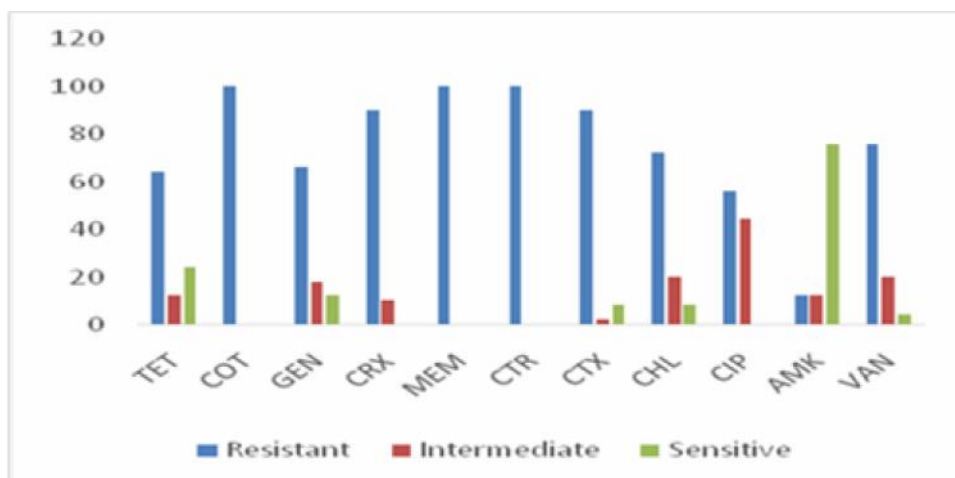
Categories of work	Gender			<i>Staphylococcus aureus</i>		<i>B- hemolytic Streptococcus sp</i>	
	Male	Female	Total	Lesion	wound	Lesion	Wound
Butcher	30	5	35	4	8	8	8
Slaughterer	15	0	15	3	5	4	2
Gut cleaner	2	13	15	1	5	3	3
Packer	3	7	10	4	-	4	-
Loader	10	5	15	2	4	2	4
Inspector	3	2	5	-	-	-	-
Graze	1	4	5	2	1	1	1
<b>Total sum</b>	<b>64</b>	<b>36</b>	<b>100</b>	<b>20</b>	<b>16</b>	<b>35</b>	<b>8</b>



**Figure 1:** Lancefield determination of the isolates of β-hemolytic Streptococcus obtained

$$\text{Percentage of Lancefield's group} = \frac{\text{Number obtained} \times 100}{\text{Total number}}$$

Of the 45 β-haemolytic *Streptococcus spp* obtained from the total isolates collected, there were variations in their Lancefield group profiles, Lancefield group A was the highest (25) while Lancefield group C and L (7) were the lowest as shown in Figure 1.



**Figure 2:** Percentage susceptibility of the isolates of *Staphylococcus aureus*

*Staphylococcus aureus* obtained, elicited varied susceptibility pattern to conventional antibiotic tested in varied percentage as shown in Figure 2.

**Table 3:** Profession, gender distribution and *Staphylococcus aureus* that causes lesion and wound

Categories of work	<i>Staphylococcus aureus</i> Lesion		<i>Staphylococcus aureus</i> Wound	
	Male	Female	Male	Female
	Butcher	4	-	7
Slaughterer	3	-	5	-
Gut cleaner	-	1	-	5
Packer	1	3	-	-
Loader	2	-	2	2
Inspector	-	-	-	-
Grazer	2	-	-	-
<b>Total sum</b>	<b>12</b>	<b>4</b>	<b>14</b>	<b>9</b>



**Figure 3:** Loaders (Loading bay)

**Table 4:** Profession, gender distribution and *B-Streptococci sp.* that causes lesion and wound

Categories of work	<i>B-hemolytic Streptococcus sp</i> Lesion		<i>B-hemolytic Streptococcus sp</i> Wound	
	Male	Female	Male	Female
	Butcher	7	1	6
Slaughterer	4	-	2	-
Gut cleaner	1	2	-	3
Packer	-	4	-	-
Loader	2	-	3	1
Inspector	-	-	-	-
Graze	1	-	1	-
<b>Total sum</b>	<b>15</b>	<b>7</b>	<b>12</b>	<b>6</b>



**Figure 4:** (budded, bleeding infected anus)

**Table 5:** Summary of multiple regression analysis of composite contribution of all the independent variables on bacterial infections of abattoir workers

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.102	2	3.051	1.550	.022 <sup>b</sup>
	Residual	190.888	97	1.968		
	Total	196.990	99			
<b>R = 0.176<sup>a</sup></b>		<b>R<sup>2</sup> = 0.031</b>		<b>Adjusted R<sup>2</sup> = 0.011</b>		

**Table 6:** Relative contributions of all the independent variables to bacterial infections of abattoir workers

Variables	Unstandardized Coefficients		Standardized Coefficients	Ranking	t	Sig.
	B	Std. Error	βeta			
(constant)	2.135	0.440			4.849	.000
Nature of Work	0.134	0.077	0.179		1.743	<b>.038</b>
Gender	-0.199	0.307	-0.067		-0.649	<b>.318</b>

measures are variables to put into consideration when predicting bacterial infections of abattoir workers. Moreover, the independent measures have a significant ( $F_{(2,97)} = 1.55$ ;  $p < 0.05$ ) composite contribution to the dependent measure with an adjusted  $R^2$  value 0.011. This leads to the fact that the independent variables accounted for 1.1% of the variance observed in

bacterial infections of abattoir workers. Therefore, the composite contribution of independent variables (nature of work and gender) on the dependent variable (bacterial infections of abattoir workers) is significant. Table 6 recorded, shows that the nature of work ( $\beta = 0.18$ ;  $t = 1.74$ ;  $p < 0.05$ ) have a significant relative contribution to the bacterial infections of abattoir





**Figure 5:** ( Sick , malnourish with septic skin blister)



**Figure 6:** (Gut cleaner at work)

workers. However, the table indicates that gender ( $\beta = -0.067$ ;  $t = -0.649$ ;  $p > 0.05$ ) have no significant relative contribution to bacterial infections of abattoir workers. The implication of this result is that nature of work is a strong predictor of bacterial infections of abattoir workers. On the other hand, gender does not necessarily determine bacterial infections of abattoir workers.

## DISCUSSION

Meat processing industry provides a significant opportunity of employment for the abattoir workers serving as an alternative resort to the epidemic of joblessness in Nigeria, but it has its own associated occupational health hazards. The nature of the work of abattoir workers always exposes them to various infections of which the skin that serves as a primary contact bears the burden.<sup>10</sup>

In this study, the masculine gender had the highest number among the butcher, slaughterer and the loaders; 30, 15, 10 respectively while the feminine



**Figure 7:** (Infected cow and carefree handlers)

gender predominates gut cleaners, parkers and inspectors in ratio 13, 7 and 3 as shown in Table 1. The gender distribution observed in regarded to specific practices or profession among the abattoir workers studied could be attributed to preference of choices due to the demanding challenges of the strength and ease of accomplishment each task may require.<sup>11</sup>

Forty-five (43) streptococci were obtained in this study, 35 from lesion while 8 were from wound of the meat handlers as shown in Table 1. The distribution of streptococci in this study could be attributed to favorable climate of incubation within the skin or open wound of the handlers, immune status of the handlers and readiness on the part of the handlers not to use protective facilities for handling animals. *Streptococcus pyogenes* also known as beta-hemolytic Lancefield's group A is the most pathogenic bacterium in the genus *Streptococcus*. The frequency of the occurrence of Lancefield's group A (25 of the 43 *Streptococcus spp*) from the sample collected, as shown in Figure 1 elicited the potential health risk these workers are exposed and also the possibility of transference of these microbes from infected individuals. Lancefield's group A was found to be the commonest cause of streptococci skin sepsis.<sup>12</sup>

Lancefield's group B, C, G were found in lesser number 4, 3, and 10 respectively in comparison with Lancefield A (25) as shown in Figure 1. The main carriage routes of Lancefield's group B, C and G is predominantly nose and throat of humans. Infected person with any of these groups may initiate person-to-person transfer and spread amongst meat handlers. Group L streptococci (7% in this study) which can also be found as normal flora in both pigs and poultry are capable of causing endocarditis in cows.<sup>13</sup>

A total sum of 36 isolates of *Staphylococcus aureus* were obtained as shown in Table 2, which are capable of causing food borne disease, due to the armaments of

its toxin producing potential. Of the 36 isolates of *Staphylococcus aureus* obtained, 20 were from lesion while 16 were from wound. The distribution patterns of *Staphylococcus aureus* among the abattoir workers varied, butchers had the significant number of 12 in ratio 4 from lesion to 8 from wound isolates, while gut cleaner had 6 in ratio 1 from lesion to 5 from wound isolates as shown in Table 2 and neither lesion nor wound infection of *Staphylococcus aureus* were recorded among the meat inspectors which could be due to their knowledge of the pathogenesis of infection. The distribution of *Staphylococcus aureus* amongst the abattoir workers in this study, could be attributed to many factor that ranged from unprotected direct contact with the animal which could be harboring unknown underlying inherent infection, the immune status of the handlers or non-adherence to hygiene rules and regulations which conventional possibilities of contacting infection.<sup>14</sup>

The culprit isolates of staphylococcal and streptococcal sepsis were recorded to be varied in number in regard to wound and lesion implicated as showed in Table 3 and 4. The independent variables on (the nature of work and gender) have a relationship with the bacterial infection of the abattoir workers with a significant measure ( $F_{(2,97)}=1.55$ ;  $p < 0.05$ ) composite contribution to the dependent measure as showed in Table 5 while the relative contribution of the independent variables to bacterial infections of the abattoir workers to gender elicited no significance ( $\beta = -0.067$ ;  $t = -0.649$ ;  $p > 0.05$ ) as indicated in Table 6 in this study. This implies that the nature of the work is a strong predictor to bacterial infection types but on the other hand, gender does not necessarily determine bacterial infection of the abattoir workers as showed in this very study.

There were remarkable resistance to the conventional antibiotics appropriated; Tetracycline and gentamicin 62%, meropenem and ceftriaxone 100%, amikacin, 10%, and vancomycin 80% as shown in Figure 2. The resistance obtained could be due to inherent genetic factors within the isolates, which corroborates the study of Ambrina on the antimicrobial susceptibility patterns and identification of plasmid-borne methicillin resistant *Staphylococcus aureus*.<sup>15</sup>

The percentage of Lancefield's A in comparison to other Lancefield's group coupled with the remarkable number of *Staphylococcus aureus* that were resistant to conventional antibiotics of therapeutic values from this present study, serves as evidence of threat to the health of abattoir workers. This is contrary to what were obtainable in Malaysia, reportedly to have the best equipped infrastructure for abattoir workers unlike

Nigeria. Effort should be made by individuals, community, government and abattoir related service providers to put in place infrastructure for health safety and maximum delivery.<sup>16</sup>

## CONCLUSION

Lancefield's A grouping, and other infectious serotypes streptococci from serological point of view and *Staphylococcus aureus* capable of transmitting resistance factors when unguided, could results in therapeutic failures and economic loss, – the link of these pathogens as a causal agent of the infection from the infected subjects with skin sepsis that cut across all the category of abattoir workers was established. This could be attributed to the lack of an ideal facilities in the abattoir studied.

**Recommendation:** Regular disinfection of equipment and environment should be practiced. Slaughterhouse legislation that required high standard of hygiene's should be enforced. Provision and maintenance of modern facilities for safety and ease of carrying out their various duties should be attended. Periodical enlightenment program from the ministry of natural resources and veterinary inspectors on how important hand-washing and other related profitable information as regards their duties should be an added advantage.

**Conflict of Interest:** None

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