PREVALENCE OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* IN CATTLE AND THEIR ATTENDANTS IN A LIVESTOCK INVESTIGATIVE FARM, VOM

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Abstract

Staphyloccocos aureus is a Gram positive organism that colonizes the nasal passage of about 30% of healthy humans and animals (Scott, 2009). Methicillin resistant *Staphylococcus aureus* is a *Staphylococcus aureus* that has acquired the *mecA* gene which encodes a protein (PBP2A) that reduces the binding affinity of penicillins and cephalosporins, causing serious life threatening infection if left untreated (Weese, 2005). Over the past two decades, methicillin-resistant *Staphylococcus aureus* has evolved from hospital associated infection to a significant public health threat in the community, causing outbreaks of soft tissue infection in healthy individuals (Kelly *et al.,* 2013).

The research work was carried out to determine the prevalence of methicillin resistant *Staphylococcus aureus* in cattle and their attendants in the livestock investigative department. A total of 76 nasal swap samples were collected, 71 from cattle and 5 from attendants. The samples were seeded in peptone water, cultured, tested for methicillin susceptibility and statistical analysis carried out on the results obtained. Findings show that there was a high prevalence of methicillin resistant *Staphylococcus aureus* of 90% and 100% in cattle and attendants respectively. The high prevalence of MRSA in both cattle and their attendants may be as a result of indiscriminate use of antibiotics belonging to the beta-lactam family in the treatment of *Staphylococcus* infection.

Key words: methicillin, *Staphylococcus aureus,* beta-lactam, MRSA, cattle, livestock, *mecA* gene

INTRODUCTION

Staphylococcus aureus often called *Staph aureus* or *S. aureus*, is a bacterium that is normally carried in the nose of about 30% of the entire human population. Generally, it causes no problems, but it is an opportunistic pathogen which can take advantage of a compromised immune system to cause infection. It can affect almost any tissue, but skin and soft tissue infection are most common (Scott, 2009).

Strains of *S. aureus* can either be Methicillin Resistance (MRSA) or Methicillin Susceptible (MSSA). But MRSA strain are not just resistant to methicillin, they are resistant to all antibiotics in the same drug family as methicillin (beta lactams) including many common drugs such as penicillin and cephalosporins some strains of MRSA are also resistant to other families of antibiotics, which can make them extremely difficult to treat. Therefore, MRSA is a type of *Staphylococcus* bacteria that becomes resistant to many antibiotics used to treat ordinary *Staphylococcus* infections (Sandhya *et al*, 2005). It acts by nullifying the action of drugs in the beta lactams family.

Pets can carry MRSA in their noses and around the anus. Direct contact with these areas or tissues with MRSA (for example, an infected incision) is most likely to result in transmission from pets to humans.

According to (Kara, 2014) methicillin antibiotic is a semi synthetic derivative of penicillin that was first produced in the late 1950s and was developed as a type of antibiotic called a penicillinase-resistant penicillin. It contains a medication of the original penicillin structure that made it resistant to a bacterial enzyme called penicillinase. This enzyme is produced by most strain of *Staphylococcus* and disrupts certain types of penicillins by hydrolyzing the beta-lactam ring that is central to the antimicrobial activity of this drug. The aim of this work is to determine the prevalence of MRSA in staff and cattle in a livestock investigation farm

METHODOLOGY

Samples were collected from the nares and nose of cattle and attendants respectively from a livestock investigation farm in Vom which is a village in Plateau state, Nigeria situated near the source of Kaduna River, 18 miles (29km) southwest of Jos town. It is 1285 meters above sea level. Vom has a remarkably cool climate owing to its altitude and constant wind flow.

Sample Collection and Bacterial Isolations

A total of 71 nasal samples were collected from the 102 cattle and 5 nasal samples from the 7 attendants in livestock investigative farm, Vom using a sterile swab stick. The swab sticks were inserted into the inner nasal septum of anterior nares of the cattle and attendants, rubbed several times, removed, capped, labeled and transported immediately in ice pack to the laboratory for analysis. 4.5ml of peptone water was dispensed in 76 empty sample bottles each, into which the 76 samples collected were dipped. They were then incubated for 24 hours at 37^{o}C, after which it was brought out and inoculated onto Mannitol Salt Agar (MSA) plates and incubated for another 24 hours at 37^{o}C. After 24 hours, *Staphylococcus aureus* colonies with yellowish appearance surrounded by a yellow zone were observed. Growth of yellow colonies on Mannitol salt agar (MSA) surrounded by yellow zones is indicative of positive *Staphylococcus aureus* growth (David and Daum, 2010). The antibiotic sensitivity test was carried out with the organism subcultured onto nutrient agar, oxacillin test disc placed on it and incubated again, for 24 hours at 37^{o}C

(Clinical and Laboratory Standard Institute, 2006).

Susceptibility Testing of MRSA Isolates

The diameter of zone of inhibition produced by each of the discs was measured, recorded and the isolates were classified as resistant (≤ 10 mm) or sensitive (≥ 13 mm) based on the standard interpretative chart as recommended by the Clinical and Laboratory Standard Institute (CLSI, 2007; CLSI, 2010).

Data analysis

Descriptive analysis methods were used to indicate the prevalence of MRSA in cattle and staff. Using R Commander, version 3.6.2 (Fox and Bouchet-Valat, 2019) the Chi-square ($\chi 2$) test was used to determine association between prevalence of MRSA in cattle and attendants. P value less than 0.05 was considered statistical significance.

Result 1; Isolation of *Staphylococcus aureus*

Variables	**Total samples**	**Number of Positive *Staphylococcus aureus***
Cattle	71	71
Attendant	5	5

Table 2: *Staphylococcus aureus* and MRSA isolates in cattle and their attendants.

Variables	**Total samples**	**Number of *S. aureus***	**Number of MRSA**
Cattle			
Dairy	22	22	20
Beef	49	49	44
Attendant			
SIWES students	3	3	3
Personal	2	2	2

Table 3: Susceptibility of *Staphylococcus aureus* in Cattle based on sex

Variable	**Number positive**	**Susceptibility patterns**		
		Resistant	**Intermediate**	**Susceptible**
MALE	36	31	2	3
FEMALE	35	33	0	2
TOTAL	71	64	2	5

Table 4: Susceptibility of *Staphylococcus aureus* in attendants based on sex

Variable	Number positive	Susceptibility patterns		
		Resistant	Intermediate	Susceptible
MALE	4	4	0	0
FEMALE	1	1	0	0
TOTAL	5	5	0	0

Table 5: Association between the Prevalence of MRSA In Cattle and Attendants.

No Examined	No. Positive	No. Resistant(%)	No. Moderately Resistant(%)	No. Susceptible(%)
CATTLE	71	64 (90.14)	2(2.82)	5(7.04)
ATTENDANTS	5	5(100)	0	0
TOTAL	76	69	2	5

Considering prevalence of MRSA in cattle and attendants, using Chi-squared test of independence and a P-value of 5% significant level, $\chi^2 = 7.51$, df = 1, P-value = 0.006127, the null hypothesis was accepted, meaning that there is no association between prevalence of MRSA in cattle and attendants.

The correlation coefficient between prevalence of MRSA in cattle and attendants is +1 which indicates that there is a perfect positive correlation. So, as MRSA in cattle increases, MRSA in attendants equally increases and vice versa.

DISCUSSION

The epidemiology of MRSA infection continues to evolve, with different characteristic patterns and associated clinical complications. Adequate knowledge on the predisposing risk factors and infection control approach within the hospital and community setting is of utmost importance. The emergence of Livestock associated MRSA has created additional epidemiological dimension to the understanding of MRSA infection. In developing counties especially in sub Saharan Africa with a paucity of epidemiological data on MRSA infection, future data are needed from both human and animal population.

The main finding of the study shows a high prevalence of MRSA in both cattle and attendants (90.14 and 100%). It is important to note that MRSA colonization varies in animal species, sample and geographical location. The colonization rate in this study is high as compared to other research works. In a study carried out in France, a relatively high prevalence of MRSA among cattle (44.8%) was recorded. In Tunisia (29%) and Saudi Arabia (21.8%) (Vautor *et al*., 2005; Ghara *et al*., 2012).

Finding MRSA in both cattle and attendants may be suggestive of interspecies transmission. However, it can only be speculated about the transmission and there is possibility that both species became infected from different sources. Findings of

Ferreira *et al*., 2011 carried out in the United States is in line with the result of this research work which shows no significant difference between MRSA in the animals and their attendants.

Hence, this result is of public health importance because the cattle constitute the highest number of ruminant animals reared within the community in the study area and the major source of animal protein. Possible transmission and dissemination of the MRSA isolate could occur through their level of contact that include close proximity through rearing and domestication, nasal dropping during movement within the community and contamination of meat by infected handlers (Lee, 2003)

CONCLUSION

Based on the findings of this study, it can be stated that the presence of MRSA in cattle and their attendants in the livestock investigation farm is high. It is a known fact that these resistant strains can be transmitted and disseminated between humans and animals and in extension other parts of the country so caution should be taken. Due to the fact that there is scarce information on MRSA in Nigeria, it will be important to carry out works on MRSA in other parts of the country so as to enable the country have a record of this growing infection.

REFERENCES

Clinical and Laboratory Standard Institute (CLSI). (2007). Performance Standards for Antimicrobial Susceptibility Testing, Seventeenth International Supplement, CLSI document M100-S17. Vol. 27-1 [ISBN 1- 56238-625-5], PA, USA.

Clinical and Laboratory Standard Institute (CLSI).(2010).Performance standards for antimicrobial susceptibility testing.Approved standard M100-S20.Vol.30, No. 1.National Committee for Clinical Laboratory Standards, Wayne, PA. USA.

David, M.Z and Daum, R.S (2010). Community Associated Methycilline Resistant *Staphylococcus aureus*: Epidemiological and clinical consiquences of an emerging epidemic. Clinical microbiology. Review 23(3): 616-87.

Ferreira, J.P., Anderson, K.L., Correa, M.T., Lyman, R., Ruffin, F., Reller, L.B. (2011). Transmission of MRSA Between Companion Animals And Infected Human Patients Presented To Outpatient Medical Care Facilities. Plos ONE 6 (11): e26978.

Fox, J. and Bouchet-Valat, M. (2019).Rcmdr: R Commander. R package version 3.6.2.

Ghara, H., Slama, K.B., Lozano, C., Gomez-Sanz, E., Klibi, N., Sallem, R.B. (2012).Prevalence of antibiotic resistance, virulence trait and genetic linage of *Staph aureus* in health sheep in Tunisia.Vet microbiology 156:367-373.

Kara, R. (2014). Methicilin, Encyclopedia retannica, Inc. htt://www.britannica.com/EB checked/topic/1522060/methicilin.

Kelly, W., April, B., Katherine, P.,and Elise, L. (2013). The prevalence of Methicillin Resistant *Staphylococcus aureus* colonization in emergency department. *World J EmergMed, Vol 4,* No 4.

Lee, J.H. (2003). Methiciline resistant *Staphylococcus aureus* strain isolated from major food animals and their potential transmission to humans. Appl. Environ. Microbiology. 69: 6482-94.

Sandhya, P., Andres, A., Nicholas, D., and Mojun, Z. (2005).MRSA infections.Center for diseases Control and Prevention.http://www.cdc.gov/mrsa/index.html. accessed August 13. 2015

Scott.J. Weese (2009). MRSA.CDC. htt://www.veterinary partners.com/content.Pp 3006.

Vautor, E., Abadie, G., Guibert, J.M., Chevalier, N., Pe'Pin, M. (2005).Nasal carriage of Staph.Pseudointermedinius.Vet Microbiology. 106: 235-239.

Weese, J.S. (2005). Methicillin Resistant *Staphylococcus aureus:* an emerging pathogen in small animals. Am Anim Hosp Assoc, 41:150-7