



## Antibiotic Use and Resistance Development: Exploring Livestock Owners' Knowledge, Attitudes and Practices in south-western Nigeria

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### SUMMARY

Antibiotic injudicious use and resistance development remains a growing public health concern globally putting the livestock industry and human health at stake, given the resulting increasing emergence of resistant strains of pathogenic bacteria. Despite this, the role of livestock owners who manage the majority of the national herds in most developing countries especially Nigeria remains largely un-investigated.

We conducted a qualitative study among 216 randomly selected livestock owners in south-western Nigeria to explore their knowledge, attitudes and practices on antibiotic use and resistance development using semi-structured questionnaires. Data were analysed using SPSS version 15.0.

The results revealed indiscriminate use of antibiotics by the livestock owners on ready-for-sale cattle. Only 49.54% had good knowledge which was significantly associated with tertiary education ( $p = 0.01$ ) and 81.02% were unaware of antibiotic withdrawal period. Also, approximately two-thirds (63.89%) had poor attitudes with only 11.11% concerned with the need to

observe withdrawal periods. In addition, 91.67% claimed that their veterinarians had never advised them to observe withdrawal period and 95.37% had never observed it. Poor professional attitudes of the so-called veterinarians as well as lack of law enforcement against uncontrolled sales of veterinary drugs were attributed to the livestock owners' poor knowledge, attitudes and practices.

The role of livestock owners should be considered when designing programmes towards preventing antibiotic injudicious use and resistance development. Furthermore, efforts geared towards regulating sales of veterinary drugs as well as enforcement of veterinary professional ethics are needed to safeguard antibiotic effectiveness in both animals and humans, now and in the near future.

**KEYWORDS:** Livestock owners; antibiotic resistance; knowledge; attitudes; practices

## INTRODUCTION

The increasing emergence and spread of resistant strains of bacterial pathogens as a result of injudicious use of antibiotics poses a serious challenge to both animal and human health. Generally, antibiotics are used therapeutically or as prophylaxis to treat or prevent diseases and to promote growth in cattle, poultry and swine (Sawant *et al.*, 2005; CDC, 2007). The utilization of these antimicrobial drugs has played an important role in animal husbandry (Abdellah *et al.*, 2009). However, their extensive use in food animals and human has led to an increase in multidrug resistant bacteria among several bacterial strains (Abdellah *et al.*, 2009). Such uncontrolled usage is common among livestock farmers in most developing countries including Nigeria where there is little or no adherence to drug withdrawal periods.

In developed countries, withdrawal periods and residue controls are conducted in slaughterhouses to prevent harmful drug residues in the food animals (More, 2011); these are however, lacking in most developing countries. Previous reports showed that drug residues in food animal products are attributable to the abuse or injudicious use of veterinary drugs (Salehzadeh *et al.*, 2006; Pavlov *et al.*, 2008). This injudicious use of drugs particularly antimicrobial agents is a very important public health issue which often results in the acquisition of antibiotic-resistant bacteria (Blanco *et al.*, 2007) and the alteration of normal protective flora (Blanco *et al.*, 2006).

Despite the violative levels of antibiotic residues reported in food animals in Nigeria (Adetunji, 2008; Fagbamila *et al.*, 2010; Olatoye and Ehinmowo, 2010) as well as the increasing incidence of infectious diseases and the resulting indiscriminate use of antibiotics, the role of livestock owners in antibiotic use and resistance development has been grossly neglected. Whereas, the livestock owners especially the nomads control the majority of the livestock animals on which the teeming

population of over 150 million people in Nigeria depends for animal protein. Currently, both trained and untrained persons, the livestock owners being the majority purchase and administer antibiotics on animals. Also, veterinary drugs are often marketed freely and long-acting drug preparations are particularly favoured for use. The livestock owners constitute a major stakeholder in the events and conditions encountered by the live animals with respect to antibiotic use. We therefore carried out a survey to explore the knowledge, attitudes and practices of livestock owners on antibiotic use and resistance development in south-western Nigeria.

## MATERIALS and METHODS

### Study setting

The study was carried out in Ibadan, south-western Nigeria. Ibadan is located about 120 km east of the border with the Republic of Benin. It has a major tropical cattle market that supplies cattle for human consumption in the south-western part of the country. This cattle market receives an average of 600 cattle daily from the Northern parts of Nigeria as well as Neighbouring African Countries such as Niger, Sudan, Burkina Faso, Cameroon and Republic of Benin. It supplies more than 60% of cattle slaughtered for human consumption in the south-western region of the country. We therefore chose this site because it constitutes a central convergent point for livestock owners from different parts of the country. This site provides an opportunity to have access to livestock owners from different herds congregating at this point, thus making a better assessment possible. The aim of this study was to explore these livestock owners' knowledge, attitudes and practices on antibiotic use and resistance development with a view to determining their roles in the growing concern for antibiotic resistance in animals and humans.

### Participants and Questionnaire administration

We designed a semi-structured questionnaire to obtain data on the livestock owners' knowledge,

attitudes and practices of antibiotic use and resistance development. The questionnaire included five parts. In the first part, we attempted to determine their socio-demographic profiles with six questions. The second part consisted of seven questions to assess their history of operations while the third part had six questions to determine their level of knowledge on antibiotic use and resistance development. The fourth and fifth parts contained five items each to determine their work place practices and attitudes, respectively about antibiotic use and resistance development. The purpose of the study was explained to the livestock owners and a pre-test was carried out after which some of the questions were modified in order to improve clarity. Out of 325 livestock owners on the study site, 228 (70% of the population) were chosen. This type of purposive convenience sampling had earlier been used and shown to be appropriate in public health work for recruiting information rich cases within a sample population (Hoffman-Goetz *et al.*, 2006). The participants were selected based on their willingness to participate in the study until the sample size (228) was reached.

### Statistical analysis

Data were analyzed using SPSS version 15.0. Knowledge on antibiotic use and resistance development was assessed with reference to answers to five questions (the sixth question: question No 3 only meant to provide further information on question 2). Positive responses were scored 1 and negative 0. Scores ranged between 0 and 5. Scores  $\geq 3$  were taken as good knowledge while scores  $< 3$  were taken as poor knowledge. Attitudes towards antibiotic use and resistance development were also scored with reference to five questions. Positive responses were scored 1 and negative or 'indifferent' responses were scored 0. Scores ranged between 0 and 5. Scores  $\geq 3$  were taken as good attitudes while scores  $< 3$  were taken as poor attitudes. Practices related to antibiotic use and resistance development such as non-observance of withdrawal period, among others

were documented. Univariate analysis using Chi-squared statistic was conducted to identify significant variables ( $p < 0.10$ ) for logistic regression model. The model was then used to determine association between the socio-demographic characteristics of the livestock owners and their knowledge level on antibiotic use and resistance development. Factors were considered significant at  $p \leq 0.05$ .

## RESULTS

### Socio-demographic profiles

Out of the 228 questionnaires administered, only 216 (94.74%) were found useful for analysis. Of these, 197 (91.20%) were males and 91.7% were Muslims. The mean age of the respondents was 46.0 +/- 11.0 years. The average number of years the livestock owners had been involved in livestock business was 19.6 +/- 9.8 years. Fifty-eight (26.85%) were Yoruba, 55 (25.46%) were Hausa and 103 (47.69%) were Fulani. Half of the livestock owners had no formal education while only nine (4.17%) had tertiary education.

### Operations' history

Majority (88.43%) of the livestock owners indicated their animals were brought from the northern states of Nigeria. A significantly higher proportion (74.54%) did not keep the records of medical history on their animals. More than half (60.65%) stated they always administered antibiotics to their animals once they arrived at the market site from the places of purchase (Table I). While approximately half (49.54%) always employed the services of only the veterinarians at the market site in administering antibiotics to their animals, 48.15% of the livestock owners either administered the antibiotics themselves or sometimes employed the services of the veterinarians. More than two-thirds (72.68%) purchased the antibiotics from the veterinarians and approximately 92% knew the kinds of antibiotics being administered to their animals. Also, more than half (59.26%) had administered antibiotics to their animals within

the last 24 hours prior to the period of the interview (Table I). The major reasons given for administering these antibiotics to the animals included treating diseases, alleviating pain, reducing stress, and boosting their appetite.

### Knowledge on antibiotic use and resistance development

More than half (50.46%) of the livestock owners had poor knowledge on antibiotic use and resistance development. Ninety-nine (45.8%) knew that antibiotics administered to animals could form residues in milk or meat after slaughter. While 196 (90.74%) had heard of antibiotic resistance before, the veterinarians on the study site constituted only 2.04% of their information sources. Though almost 85% knew the possible causes of antibiotic resistance, 92.59% were not aware that prolonged antibiotic residues consumption through meat or milk could result in antibiotic resistance. In addition, 81.02% had never heard of antibiotics withdrawal period (Table I). The knowledge of the livestock owners on antibiotic use and

resistance development was significantly associated with tertiary education ( $p = 0.01$ ) and religion ( $p = 0.04$ ). However, age, gender, tribe and length of years in the livestock business did not play any statistically significant role in their knowledge ( $p > 0.05$ ; Table II).

### Attitudes towards antibiotic use and resistance development

In all, 63.89% of the livestock owners had poor attitudes towards issues related to antibiotic use and resistance development. While only 11.11% saw the need to observe antibiotic withdrawal period in animals before milking or slaughter, 86.57% could milk or slaughter animals undergoing treatment with antibiotics. Again, 82.41% were not concerned that antibiotic administered to animals could readily form residues in humans who consume such animal products without observing withdrawal period. In addition, only 6.02% agreed that antibiotic resistance in humans could develop due to its prolonged consumption through animal products (Table III).

**TABLE I: DISTRIBUTION OF LIVESTOCK OWNERS WITH RESPECT TO THEIR HISTORY OF OPERATIONS AND KNOWLEDGE ON ANTIBIOTIC USE AND RESISTANCE DEVELOPMENT.**

	Good Number (%)	Poor Number (%)	Total	OR (95% CI)	(p Value)
<b>EDUCATION</b>					
None	58 (53.70)	50 (46.30)	108	REF	
Primary	19 (38.0)	31 (62.0)	50	0.50(0.241.06)	0.07
Secondary	21 (42.86)	28 (57.14)	49	0.65(0.341.35)	0.28
Tertiary	9 (100.0)	0 (0.0)	9	Undefined	0.0 <sup>†</sup>
<b>TRIBE</b>					
Yoruba	33 (56.90)	25 (43.10)	58	REF	
Hausa	25 (45.45)	30 (54.55)	55	0.63(0.281.42)	0.30
Fulani	49 (47.57)	54 (52.3)	103	0.69(0.341.38)	0.33
<b>GENDER</b>					
Male	97 (49.24)	100 (50.76)	197	0.87(0.342.45)	0.97
Female	10 (52.63)	9 (47.37)	19	1.15(0.443.23)	
<b>RELIGION</b>					
Christianity	11 (78.57)	3 (21.43)	14	4.14(1.0319.33)	0.04 <sup>†</sup>
Islam	93 (46.97)	105 (53.03)	198	REF	
Traditional	3 (75.00)	1 (25.00)	4	3.39(0.3486.00)	0.35
<b>AGE</b>					
≤40 years	39 (54.17)	33 (45.83)	72	1.32(0.722.42)	0.41
>40 years	68 (44.44)	76 (55.56)	144	0.76(0.441.39)	
<b>YEAR IN BUSINESS</b>					
≤20 years	67 (45.89)	79 (54.11)	146	0.64 (0.341.18)	0.16
>20 years	40 (57.14)	30 (42.86)	70	1.57(0.852.91)	

Practices related to antibiotic use and resistance development

Indiscriminate use of antibiotics on cattle meant for immediate or eventual disposal to prospective buyers at the market site was a common practice observed among the livestock owners. One hundred and sixty (74.07%) of the livestock owners milked their animals while

undergoing treatment with antibiotics. Of these, more than half (55%) always drank from the milk and sold the rest. Almost 92% of the livestock owners indicated that the veterinarians had never advised them on antibiotic withdrawal period. Consequently, only less than one percent always observed antibiotic withdrawal periods (Table III).

**TABLE II: RELATIONSHIP BETWEEN LIVESTOCK OWNERS' KNOWLEDGE LEVELS AND THEIR SOCIO-DEMOGRAPHIC CHARACTERISTICS.**

	Good Number (%)	Poor Number (%)	Total	OR (95% CI)	(p Value)
<b>EDUCATION</b>					
None	58 (53.70)	50 (46.30)	108	REF	
Primary	19 (38.0)	31 (62.0)	50	0.50(0.24 – 1.06)	0.07
Secondary	21 (42.86)	28 (57.14)	49	0.65(0.31 – 1.35)	0.28
Tertiary	9 (100.0)	0 (0.0)	9	Undefined	0.01 <sup>a</sup>
<b>TRIBE</b>					
Yoruba	33(56.90)	25 (43.10)	58	REF	
Hausa	25(45.45)	30 (54.55)	55	0.63(0.28 – 1.42)	0.30
Fulani	49(47.57)	54 (52.43)	103	0.69(0.34 – 1.38)	0.33
<b>GENDER</b>					
Male	97 (49.24)	100(50.76)	197	0.87(0.31 – 2.45)	0.97
Female	10(52.63)	9(47.37)	19	1.15(0.41 – 3.23)	
<b>RELIGION</b>					
Christianity	11 (78.57)	3 (21.43)	14	4.14(1.03 – 19.33)	0.04 <sup>a</sup>
Islam	93(46.97)	105 (53.03)	198	REF	
Traditional	3 (75.00)	1 (25.00)	4	3.39(0.31 – 86.00)	0.35
<b>AGE</b>					
=40 years	39(54.17)	33 (45.83)	72	1.32(0.72 – 2.42)	0.41
>40 years	68 (44.44)	76 (55.56)	144	0.76(0.41 – 1.39)	
<b>YEAR IN BUSINESS</b>					
=20 years	67 (45.89)	79 (54.11)	146	0.64 (0.34 – 1.18)	0.16
>20 years	40 (57.14)	30 (42.86)	70	1.57(0.85 – 2.91)	

## DISCUSSION

Most studies on antibiotics in Nigeria (Fagbamila *et al.*, 2010; Ibrahim *et al.*, 2010; Olatoye and Ehinmowo 2010) used quantitative methods, focusing only on residue detection or isolation of resistant bacteria. To our knowledge, this is the first study that has

approached the subject by exploring the knowledge levels as well as the attitudes and practices of livestock owners at such a convergent site on antibiotic use and resistance development. Generally, livestock owners constitute a major group that determines the events and conditions to which food animals are

subjected from the farm to the fork. However, they are often a neglected group in most developing countries in the drive to combat antibiotic residues in animals. We revealed from this study that they played a major role in the growing concern for antibiotic use and resistance development in Nigeria. This striking finding furthers our knowledge about the impacts of livestock owners' activities on food animals and consequently human health.

These are often seen in the potential detrimental effects of circulating antibiotics on these food animals and their products which could result in the selection and dissemination of antibiotic resistant bacteria. Our findings are therefore paramount to strengthen the existing efforts aimed at preventing the occurrence of antibiotic residues in animal products and the resulting resistance.

**TABLE III: DISTRIBUTION OF LIVESTOCK OWNERS WITH RESPECT TO THEIR ATTITUDES AND PRACTICES IN RELATION TO ANTIBIOTIC USE AND RESISTANCE DEVELOPMENT.**

Item	Attitudes			Question	Practice	Response frequency N (%)
	Agree Number (%)	Disagree Number (%)	Indifferent Number (%)			
1. There is need to observe antibiotic withdrawal period.	24 (11.11)	100 (46.30)	92 (42.59)	1. Do you milk animals undergoing treatment with antibiotics?		
				Yes		160 (74.07)
				No		56 (25.93)
2. Animals under treatment with antibiotic could be milked or slaughtered.	187 (86.57)	11(5.09)	18 (8.33)	2. What do you do with the milk?		
				Drink it		37 (23.13)
				Sell it		11 (6.88)
				Drink and sell it		88 (55.0)
				Process, drink and sell it		24 (15.0)
3. Antibiotics used in animals cannot form residues in humans through consumption.	178(82.41)	11(5.09)	27(12.50)	3. How often do the veterinarians advise you on antibiotic withdrawal period?		
				Always		2 (0.93)
				Often		3 (1.39)
				Sometimes		13 (6.02)
				Never		198 (91.67)
4. Resistance to an antibiotic could develop in humans due to its prolonged consumption through animal products.	13(6.02)	117(54.17)	86(39.81)	4. How often do you observe antibiotic withdrawal period?		
				Always		2 (0.93)
				Sometimes		8 (3.70)
				Never		206 (95.37)
5. No health risk is associated with consuming products of animals under antibiotic treatment.	108(50.00)	9(4.17)	99(45.83)	5. How often do you drink raw milk from animals?		
				Always		127 (58.80)
				Often		21 (9.72)
				Sometimes		55 (25.46)
				Never		13 (6.02)

Furthermore, the results showed that more than half of the livestock owners had poor knowledge of antibiotic use and resistance development. Consequently, a significant proportion (81.02%) had never heard of antibiotic withdrawal period, which was evidenced by the indiscriminate use of antibiotics by these livestock owners on ready-for-sale animals in this study area. This poor knowledge about withdrawal period is in contrast to the findings reported from Tanzania (Nonga *et al.*, 2009) where 80% knew about antibiotic withdrawal period. The present finding could be attributed in part to the lack of public health education among the livestock owners despite the fact that half of them had basic education. This implies that mere basic education without the inclusion of public health education is not sufficient to improve knowledge on such health-related issues as antibiotic use and resistance development.

A cursory look at the sources of information of the livestock owners on antibiotic use and resistance development showed that the veterinarians on the study site constituted only 2.04%. This percentage is lower when compared to 35% reported in South Carolina (Friedman *et al.*, 2007). The negligence of these veterinarians regarding public health extension education is a matter of concern. Worse still, more than half of the livestock owners employed the services of these veterinarians in administering antibiotics to the ready-for-sale animals. As often being practised by the quacks, antibiotics administered were often below the required dosages. This practice contravenes the ethics of Veterinary Public Health profession, which aim at protecting the health of both animals and humans. In addition, it was striking to find that 91.67% of the livestock owners were never advised by their veterinarians on the need to observe antibiotic withdrawal periods. It therefore, suffices to say that the poor veterinary profession also contributed to the poor knowledge and practices of these livestock owners on antibiotic use and resistance development.

Our findings also showed that most (92.59%) of the livestock owners did not know that prolonged consumption of meat or milk containing antibiotics residues could result in the development of antibiotic resistance in humans. This is similar to the 86% reported from South Carolina (Friedman *et al.*, 2007) in a related study. According to previous reports (Stolker and Brinkman, 2005; Labio *et al.*, 2007; Abdellah *et al.*, 2009; Kabir, 2009), extensive antibiotic ingestion through meat or milk have potential negative health effects. These effects include bacterial flora alteration which may temporarily reduce host resistance to pathogens as a result of increase in bacterial multidrug resistant strains. This has therefore led to the concern that some therapeutic treatments for human diseases might be jeopardized due to the appearance of such resistant bacteria.

Furthermore, 63.89% of the livestock owners had poor attitudes towards antibiotic use and resistance development. Our study revealed that very low proportions (11.11%) were concerned with the need to observe antibiotic withdrawal periods in animals before milking or slaughter. While withdrawal periods and residue controls are conducted in slaughterhouses in developed countries (More, 2011), food animals are generally milked or slaughtered in developing countries particularly Nigeria without any assessment for antibiotic residues. Whereas, a report has shown that failure to observe drug withdrawal periods is a major cause of drug residues in food animals (Dalton, 2011) resulting in emergence of resistant bacteria in humans who consume such products over time (Dipeolu, 2010). The consumers might therefore show resistance to treatment with the antibiotics when the need arises. This becomes worse particularly when such people do not have access to substitute antibiotics, which in most cases are unaffordable.

Similarly, our findings showed that 86.57% of the livestock owners indicated that they could

milk or slaughter animals undergoing treatment with antibiotics while 82.41% were not concerned that antibiotics administered to animal could form residues in the consumers of such products. Such poor attitudes were also reported in South Carolina (Friedman *et al.*, 2007). Public health education therefore remains a vital tool in ensuring proper use of antibiotics in food animals as well as preventing development of resistance in both animals and humans.

Above findings notwithstanding, this study had some limitations. First, none of the veterinarians on the study site was available for interview; interactions with them would have shed more lights on the practice of routine administration of antibiotics to food animals meant for immediate or eventual slaughter. Second, the authors did not discuss the roles of specific antibiotics with the livestock owners. Future studies involving education about common antibiotics used by these livestock owners are warranted.

Despite these limitations, the role of livestock owners should be considered when designing programmes to stampede antibiotic injudicious use and resistance development in Nigeria, considering their poor knowledge, attitudes and practices in this study. Furthermore, since injudicious use of antibiotics and the resulting resistance development is not only limited to Nigeria, but also a concern to other sub-Saharan African countries and the world at large, public health extension education of livestock owners becomes very imperative. In addition, the authors recommend the enforcement of veterinary professional ethics as well as controlled sales of veterinary drugs in order to safeguard antibiotic effectiveness in both animals and humans now and in the near future.

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