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Research Article

Antibacterial Use and Level of Resistance in Poultry: A Retrospective Study in North-Central and South-West Nigeria

Kantiyok T. Josiah[1], Arowolo O.A. Reubem[2], Semaka A. Asaaga[3], Gberindyer F. Aondover[4*]

ABSTRACT: There is no doubt that antibacterial agents have saved the human race as well as animals from deaths and sufferings due to bacterial diseases. However, bacterial resistance is a major threat to human and animals. The objectives of this study were to investigate the pattern of antibacterial use in poultry, and the level of resistance by common bacterial agents of economic importance in Nigeria. Pattern of antibacterial use in poultry practice in North-Central and South-West Nigeria were obtained from 150 questionnaires administered to practicing veterinarians, animal health workers and poultry farmers. Again, the level of antibacterial resistance was investigated employing laboratory results from three renowned veterinary diagnostic laboratories in the country where the rates of sensitivity as well as resistance were obtained. Among the commonly used antibiotics in poultry practice, doxycycline and oxytetracycline were the most frequently prescribed for chickens infected with common bacteria organisms. Well over 50% of the treatments with different antibiotics did not follow the specifications, including dosage regimen. Over 50% of *Salmonella spp*, *Pasteurella spp, Avibacterium paragallinarum, Mycoplasma spp,* and *Escherichia coli* clinical isolates from poultry were resistant to the commonly used antibacterial agents such as amoxicillin, ampicillin, colistin, gentamicin, tylosin, erythromycin, and enrofloxacin. The observed inappropriate use of antibacterial agents in poultry could explain the high prevalence of bacterial resistance to common antibacterial agents. Judicious antibacterial use in poultry practice is imperative in order to circumvent the emergence of resistant bacteria organisms, public health implications, and economic losses in poultry production.

Keywords: Antibacterial drugs, Antibacterial resistance, Poultry, Prescription pattern

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Kanatlılarda Antibakteriyel kullanımı ve Direnç Seviyesi: Orta-Kuzey ve Güney-Batı Nijerya'da Geçmişe Yönelik Bir Çalışma

ÖZ: Şüphesiz antibiyotikler hayvanların yanı sıra insanları da bakteriyel hastalıklar ve bunlardan kaynaklanan ölümlerden kurtarmıştır. Ancak, bakteriyel direnç insan ve hayvanları çok ciddi tehdit etmektedir. Bu çalışmanın amacı Nijerya'da kanatlılarda antibiyotik kullanımını ve ekonomik öneme sahip yaygın antibiyotiklere karşı direnç düzeyini araştırmaktı. Orta-Kuzey ve Güney-Batı Nijerya'da kanatlı pratiğinde antibiyotik kullanım şekli veterinerler, hayvan sağlığı ile ilgili çalışanlar ve kanatlı yetiştiricilerine 150 anket uygulanarak elde edilmiştir. Yine, duyarlılık ve direnç oranlarının elde edildiği, ülkedeki üç tanınmış veteriner tanı laboratuvarından laboratuvar sonuçları kullanılarak antibakteriyel direnç düzeyi araştırılmıştır. Kanatlı pratiğinde yaygın olarak kullanılan doxycycline ve oxytetracycline yaygın bakteriyel enfeksiyonlarda en sık reçete edilen antibiyotiklerdi. Farklı antibiyotiklerle tedavilerin %50'den fazlasında antibiyotik dozu da dahil, spesifikasyonlar izlenmiyordu. *Salmonella spp*, *Pasteurella spp, Avibacterium paragallinarum, Mycoplasma spp,* ve *Escherichia coli*'nin kanatlılardan elde edilen klinik izolatlarının %50'den fazlası amoxicillin, ampicillin, colistin, gentamicin, tylosin, erythromycin ve enrofloxacin gibi yaygın olarak kullanılan antibiyotiklere dirençliydi. Kanatlılarda antibiyotiklerin uygunsuz kullanımı, yaygın antibiyotiklere karşı yüksek antibakteriyel direnç prevalansını açıklayabilmektedir. Kanatlı yetiştiriciliğinde dirençli bakterilerin ortaya çıkmasını, halk sağlığını etkilemesini ve ekonomik kayıpları önlemek için kanatlılarda doğru antibiyotik kullanımı zorunludur.

Anahtar Kelimeler: Antibiyotikler, Antibiyotik direnci, Kanatlı hayvanlar, Reçete

INTRODUCTION

Antibiotics are commonly used for the treatment of clinically sick animals, disease prophylaxis during periods of high risk of infection, and promotion of growth in food animals through enhanced feed conversion efficiency (1). Appropriate, judicious or rational use of drugs in veterinary medicine generally requires that patients receive medicines applicable to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to the client (2). However, 20 to 50% of the total antibacterial drugs used in human and animals have been reported to be inappropriate (3). This is one of the major risk factors of the rising prevalence of bacterial resistance to antimicrobial agents in human and animals. Bacterial resistance is not a new spectacle because Sir Alexander Fleming, in his Nobel Lecture (4) cautioned about the possibility of microbes becoming resistant to penicillin when exposed to sub-lethal concentrations.

Bacterial resistance to antibacterial agents has been identified by the World Health Organization (WHO) as a major threat to human and animals due to lack of new antibacterial agents in the development pipeline, and infections caused by multi-drug resistant pathogens becoming untreatable (5-6). This development led to the need for antimicrobial agents' stewardship, particularly in veterinary medicine (7). There is inadequate report on the

[1]Veterinary Council of Nigeria, Abuja, Nigeria
[2]Department of Veterinary Physiology, Biochemistry and Pharmacology, Federal University of Agriculture, Abeoukuta, Nigeria
[3]Department of Veterinary Medicine, Poultry Unit, Federal University of Agriculture, Makurdi, Nigeria
[4]Department of Veterinary Pharmacology and Toxicology, Federal University of Agriculture, Makurdi, Nigeria.
*Corresponding Author: Gberindyer F. Aondover, e-mail: fidegber@yahoo.com

level of antibacterial resistance in poultry from clinical samples in Nigeria in the recent years, hence the need to conduct periodic antibiogram audit in order to improve patient outcome as well as minimizing the rate and extent of the emergence of antibacterial resistant organisms following their rational use. The aims of this study were to investigate pattern of antibacterial use in poultry, and the level of resistance by common bacterial agents of economic importance in poultry in Nigeria.

MATERIALS AND METHODS

This retrospective study involved administration of 150 questionnaires to some major poultry stakeholders in north-central and south-west Nigeria. The targeted respondents were practicing veterinarians, animal health workers, and poultry farmers. The questionnaire was design to extract information on the manner of antibacterial use in poultry practice in Nigeria. Specific information obtained from the questionnaire were types of antibacterial agents commonly used, indications for their use, and compliance to drug product label instructions, including dosage regimen (dose, duration, frequency and route of administration).

Thereafter, antibacterial susceptibility test results from three major veterinary diagnostic laboratories in the north-central and south-west regions of Nigeria were obtained. The rates of sensitivity defined as percentage (%) sensitive, intermediate and resistance of the clinical bacterial isolates from various poultry farms to commonly used antibacterial agents were extracted from the laboratory records of each of the three laboratories.

RESULTS

Table 1 presents a summary of common poultry diseases and the respective antibacterial agents used to treat them. The result demonstrated that doxycycline and oxytetracycline are the most frequently prescribed antibiotics either as a single dose or as fixed-dose formulation containing other drugs for the treatment of all the common bacterial infections of poultry in Nigeria.

Figure 1 shows the level of compliance with the drug products labeled instructions for their use. The result showed that most veterinarians, other animal health workers, and poultry farmers do not adhere to the guidelines as to the use of antibiotic formulations in poultry such as labeled animal species indicated (Lsp), disease indication (Ldi), withdrawal period (LWP), dose (Ldo), duration of treatment (Ldu), frequency of dosing (Lfr) and route of administration (Lro).

Figure 2 summarizes percentage sensitivities of some common clinical bacterial isolates from poultry to frequently prescribed antibacterial drugs in the south-west Nigeria. The result demonstrated that more than 50% of the bacterial isolates were sensitive to streptomycin; whereas, the sensitivity of the isolates to other antibiotics was below 50%. Conversely, well above 50% of the isolates were resistant to amoxicillin (Amox), oxytetracycline (Oxytet), colistin, enrofloxacin (Enroflox), and gentamicin (Genta), in decreasing other.

The percentage resistance of bacterial isolates to some common poultry antibacterial drugs obtained from a diagnostic laboratory in the south-west Nigeria is presented in Figure 3. The result showed that the level of bacterial resistance was more against chloramphenicol (Chloramp) for all the bacterial isolates. Generally, this demonstrated a high level of antibacterial resistance, however, least resistance was observed against ciprofloxacin, except for *Avibacterium paragallinarum* (formally *Haemophilus paragallinarum*), the aetiologic agent of fowl coryza.

Table 1. Common bacterial infections in poultry and the respective antibiotics prescribed

Antibiotics	Disease condition				
	FTP	FCH	FCO	CRD	CBC
Ciprofloxacin	1	0	0	0	1
Enrofloxacin	1	0	0	1	0
Norfloxacin	0	0	1	0	1
Flumequine	0	0	1	0	1
Doxycycline	1	1	1	1	1
Oxytetracycline	1	1	1	1	1
Tylosine	0	0	1	1	0
Erythromycin	0	1	0	0	0
Gentamicin	1	1	0	0	1
Neomycin	0	1	0	0	1
Streptomycin	0	1	0	0	0
Amoxicillin	0	0	1	0	0
Penicillin	0	1	0	0	0
Chloramphenicol	1	0	0	0	0
Sulphonamides	0	0	1	0	0

Index: 0 (not prescribed); 1 (prescribed); FTP (Fowl typhoid);FCH (Fowl cholera); FCO (Fowl coryza); CRD (Chronic respiratory disease); CBC (Colibacillosis)

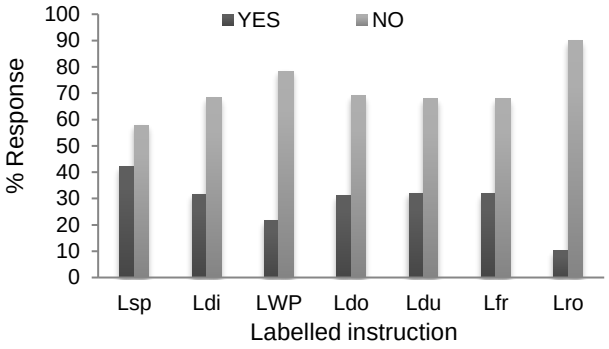

Figure 1. Adherence to the manufacturers labelled instructions on the drug products

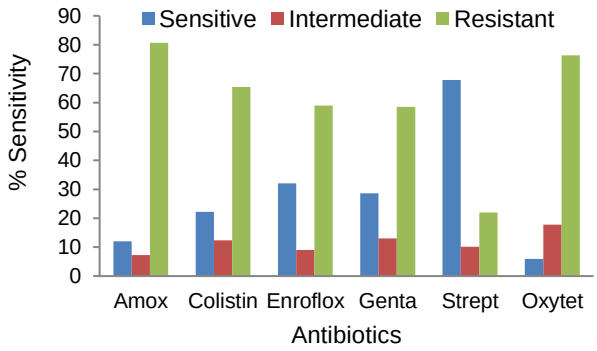

Figure 2. Level of antibiotic sensitivity tests on common poultry clinical isolates from a veterinary diagnostic laboratory insouth-west Nigeria

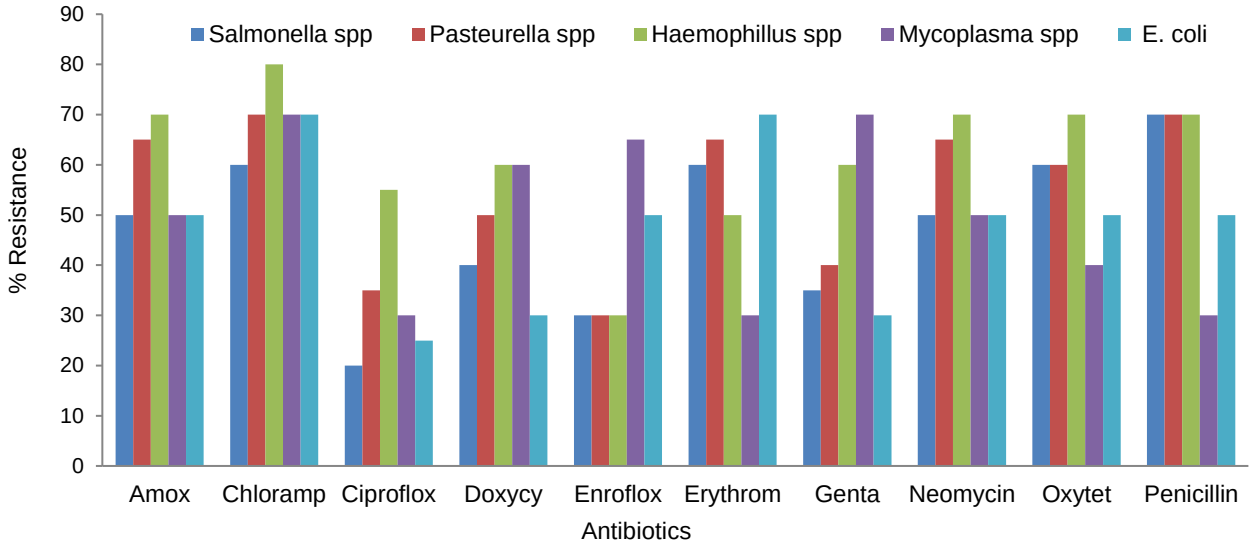

Figure 3. Levels of bacterial isolates' resistance to commonly used antibiotics obtained from a commercial diagnostic laboratory in south-west Nigeria.

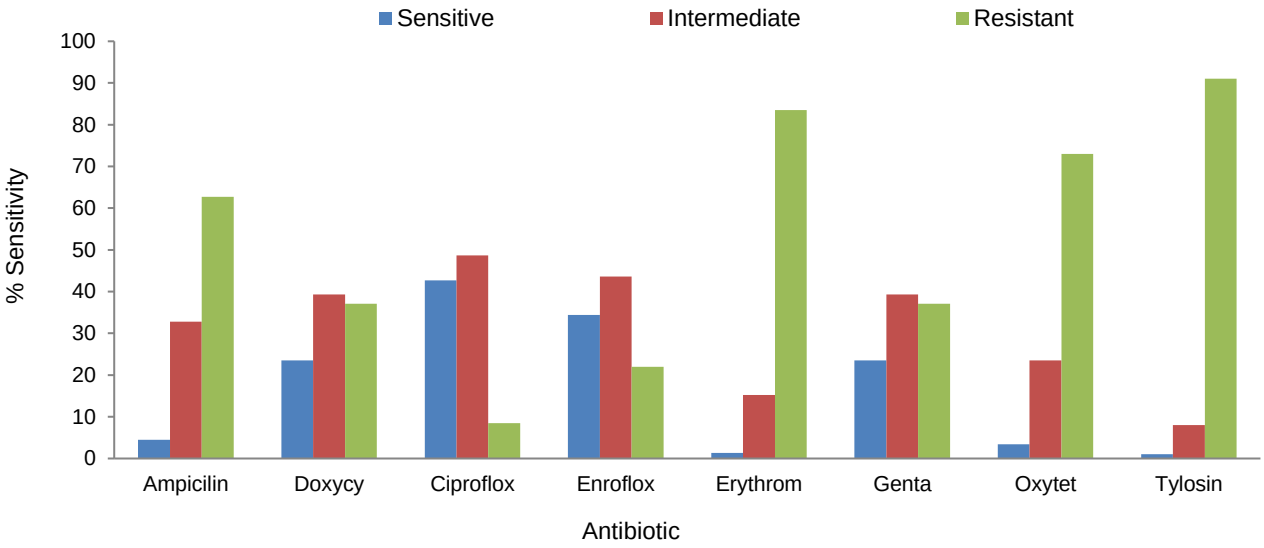

Figure 4. Antibiogram of poultry clinical isolates (Salmonella spp and E. coli) from a veterinary diagnostic laboratory in north-central Nigeria.

Figure 4 shows antibiogram for *Salmonella spp* and *E. coli* obtained from a commercial laboratory in the north-central Nigeria. This showed high bacterial resistance against ampicillin, oxytetracycline (Oxytet), erythromycin (Erythrom), and Tylosin, in increasing order. None of the poultry isolates recorded 50% sensitivity to the tested antibiotics. Nevertheless, the resistant levels to ciprofloxacin (Ciproflox), enrofloxacin (Enroflox), doxycycline (Doxycy), and gentamicin (Genta) in increasing order were below 50%.

DISCUSSION

This study demonstrated that fowl typhoid (FTP), fowl cholera (FCH), fowl coryza (FCO), chronic respiratory disease (CRD), and colibacillosis (CBC) caused by *Salmonella spp*, *Pasteurella spp, Avibacterium paragallinarum, Mycoplasma spp*, and *E. coli,* respectively are the common bacterial infections affecting poultry production in Nigeria. Among the commonly used antibiotics in poultry practice, doxycycline and oxytetracycline were frequently prescribed for chickens infected with any of those bacterial organisms. Oxytetracycline and doxycycline have been used against a large number of bacterial infections in animals, often indiscriminately due to their broad spectrum of antibacterial activity as well as the difficulties of accurate bacterial diagnosis in the field practice (8). Chickens diagnosed with CRD had the least number of antibiotics (enrofloxacin, doxycycline, oxytetracycline and tylosine) prescribed when compared with other poultry diseases. Extensive use of antibacterial agents in food-producing animals has been rated a major cause of this crisis (9). In addition, this study observed irrational use of antibacterial

agents by the stakeholders, including veterinarians. According to Cizman (3), an estimate of 20 to 50% of the total antibiotic use in human and animals is inappropriate. Central to the implications of inappropriate use of antimicrobial agents is the emergence of resistant pathogenic organisms, including bacteria organisms. It is imperative to underscore that any use of antimicrobial drug, even when appropriate and conservative, contributes to the development of resistance, however, wide spread unnecessary and excessive use make it worse (10).

More than 50% of the treatments with different antibiotics were at variance with the labeled instructions in respect to dosage regimen (dose, frequency, duration and route of administration), withdrawal period, indicated specie and disease condition. Antimicrobial resistance has recently been identified as one of the greatest threats to human health where the developing countries, including Nigeria, are the worst hit by this crisis (11). Same level of resistance was observed in clinical isolates from poultry to amoxicillin, oxytetracycline, streptomycin, colistin, enrofloxacin and gentamicin, in decreasing order in the south-west region of Nigeria.

Infectious coryza is a well-recognized and commonly encountered acute upper respiratory tract disease of chickens that is caused by the bacterium, *Avibacterium paragallinarum* (12). The disease occurs worldwide and causes economic losses due to an increased number of culls and a marked drop in egg production, particularly on multi-age farms (13). Results showed that well over 50% of the clinical *Avibacterium paragallinarum* isolates were resistant to all the commonly used antibiotics, except enrofloxacin. Fowl cholera is a highly contagious disease caused by *Pasteurella multocida, which* is characterized by high mortality with consequent significant economic losses in poultry production (14). This study revealed that ≥50% of the clinical *Pasteurella multocida* isolates were resistant to amoxicillin, chloramphenicol, doxycycline, oxytetracycline, erythromycin, neomycin, and penicillin, representing 70% (n=10) of the commonly used antibiotics for treating the infection. Atere et al. (15) reported high rate of antibiotics resistance in clinical isolates of *Pasteurella multocida*, particularly doxycycline, amoxicillin/clavulanate and tylosine in selected farms around Ekiti State, south-west Nigeria.

Fowl typhoid and pullorum diseases caused by *Salmonella gallinarum* and *Salmonella pullorum,* respectively are considered veterinary and public health problems of major importance, and among the most prevalent diseases in birds, causing high losses in poultry industry, with a corresponding high socio-economic impact (16). This study demonstrated that more than 50% of the clinical isolates of *Salmonella spp* from poultry showed resistance to erythromycin, tylosine, neomycin, streptomycin, ampicillin, and oxytetracycline. Enabulele *et al*. (17) reported 45% resistance to ampicillin from some selected farms in a state in the south-south region of Nigeria. However, 79.9% resistance was reported for ampicillin and amoxicillin in another state in the same region (18). According to Musa et al. (19), Salmonella organisms isolated from selected poultry farms in a state from northern Nigeria showed resistance to commonly used antibiotics, including gentamicin, chloramphenicol, ciprofloxacin, norfloxacin, amoxicillin, ampicillin, and tetracycline.

Escherichia coli has been reported to be the cause of some clinical conditions in poultry that are of economic importance in Nigeria, including colisepticemia, dead-in-shell embryos, salphingitis, omphalitis, and air sacculitis (20). This study showed that well over 50% of the clinical *Escherichia coli* isolates from poultry were resistant to oxytetracycline, penicillin, erythromycin, and enrofloxacin. This corroborates earlier report by Ojo et al. (21) that similar finding in free-range chickens in a south-western state of Nigeria for oxytetracycline, penicillin, amoxicillin, erythromycin, and enrofloxacin.

CONCLUSION

This study has demonstrated that most antibacterial agents used in poultry medicine in Nigeria are inappropriately prescribed/used, consequently explaining the high prevalence of bacterial resistance to common antibacterial agents. Therefore, the need for judicious antibacterial use in poultry practice is imperative in order to circumvent emergence of resistant bacteria organisms, public health implications, and economic losses in poultry production.

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