Journal of Advances in Medicine and Medical Research

28(10): 1-9, 2018; Article no.JAMMR.19559
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

The Pattern of Antimicrobial Use in Poultry Production and Its Public Health Implications in Aba and Umuahia Towns of Abia State, Nigeria

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Authors' contributions

This work was carried out in collaboration between the authors. Author CJO designed the work, interpreted the data and wrote the manuscript. Author IJO helped in designing the work and collected the data. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2018/19559
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Complete Peer review History: http://www.sdiarticle3.com/review-history/19559

Original Research Article

Received 02 January 2016
Accepted 18 March 2016
Published 13 February 2019

ABSTRACT

Aim: To investigate the type and dynamics of antimicrobial usage in Aba and Umuahia towns of Abia State Nigeria and the public health implications of their misuse.
Methodology: Structured questionnaires were administered to 33 and 41 poultry farmers in Aba, and Umuahia, respectively between April, 2014 and March, 2015. Data obtained were presented as percentages.
Results: Respondents made use of different antimicrobials in a reported 1305 drug applications. The usage of the drugs in their descending order was as follows: aminoglycosides- 27.1%, tetracycline – 23.2%, macrolides– 14.0%, polypeptides – 8.0%, quinolones – 7.3%, sulfonamides – 6.7%, chloramphenicol – 4.1%, nitrofurans – 2.5%. beta-lactams – 2.4%, Data showed that 75% of the total respondents were aware of drug withdrawal periods but 6.8% observed them while 13% of respondents were aware of banned drugs and 10.8% avoided their usage. Generally,

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antimicrobials were used for prophylaxis and chemotherapy and not as growth promoters. A 4.1% and 2.5% usage of the banned drugs chloramphenicol and furaltadone respectively were recorded. Respondents with tertiary education constituted 78.3%; however, in the misuse of drugs, there was no observable difference between them and those with basic or no education. Respondents that consulted veterinarians in disease management were 55.8% of the total number while the rest relied on their experiences and personal knowledge.

Conclusion: There was a high level of antimicrobial misuse and non adherence to withdrawal periods. A significant number of the farmers still use banned antimicrobials. There may be lack of regulations guiding the use of these drugs and this has a lot of serious health implications as regards antimicrobial therapy in man and animals.

Keywords: Antimicrobials; banned drugs; antibiotic misuse; antibiotic resistance; respondents; farmers.

1. INTRODUCTION

The global human population estimated currently at about seven billion is projected to rise to 9.3 billion by 2050 [1]. This will translate to increased demand of food supply and thus livestock and associated sources. Increased poultry production is one of the surest and quickest ways of bridging the animal protein intake gap in developing countries of the world. The poultry sector constitutes more than 57% of total livestock production in Nigeria [2] and many people have gone into poultry production either producing egg or meat or both. This large demand has necessitated the adoption of modern methods or intensive systems of production which aims at high production and better quality at low cost [3].

One of the side effects of intensive poultry production is the creation of a ready habitat for the proliferation of disease causing viruses, bacteria and fungi [4]. The control of these diseases has remained one of the greatest challenges to poultry producers. Such control requires the use of veterinary drugs and chemical inputs resulting in higher residue contamination; shedding of drug resistant bacteria and manure heavily laden with both chemicals and resistant pathogens [5]. Human and animals can easily acquire these pathogens and commensal bacteria simply by ingesting them through consumption of contaminated meat and food [6,7].

There is increasing evidence that farm use of antimicrobial agents is linked to the occurrence of spread of antimicrobial resistant gene system in human pathogens [8]. The threat of this antimicrobial usage in food producing animals to human has been estimated using microbial risk assessment models [9,10]. For instance, the emergence of fluoroquinoline resistant *Camphylobacter jejuni*, methicillin resistant *Staphylococcus* and highly resistant strains of *Salmonella, Enterococcus* and other strains of bacteria raises heightened concerns about livestock as potential reservoirs of zoonotic infections which on further evolution may become adapted to circulation within human population [11,12]. Antibiotic use in humans has already been shown to select antibiotic-resistant strains, and the same should be expected in livestock. The potential threat to human health resulting from the misuse of antibiotics can therefore be very significant as resistant pathogens propagated in these poultry livestock will eventually enter the food chain, [13,14]. Levy [15] had already established a link between prevalence of drug resistant organism and resistant genes to the collective pressure of antibiotics use in both clinical and agricultural settings. The ban of avoparcin and the subsequent rapid decline of prevalence of vancomycin resistant enterococci (VRE) in farm animals in Europe [16] give an insight into the harm inflicted to our ecosystem by the misuse of antimicrobials. Although the magnitude of the contributions of agricultural antibiotics to antibiotic resistance in humans has not been fully ascertained, the glaring threat cannot be overlooked. In fact [17] and [18] have linked antibiotics use in animal production to antibiotics resistance in humans.

These overwhelming evidence though may be considered plausible, have led to the large scale antibiotics ban in food animal as a precautionary measure and indeed by 2006, the European Union had banned the use of non-veterinary antibiotics in food animals [19].

An earlier work done by Amaechi [20] focused on a few popular antimicrobials like tetracycline, neomycin, erythromycin, and streptomycin, whereas other important ones like the quinolones and nitro furans which are significantly being used by the farmers and are perhaps of more human health importance were overlooked. In

the wake of the rising problem of drug resistance in humans, there is therefore a need carry out a more holistic evaluation of the antimicrobial usage in livestock production in a developing country like Nigeria where health parameters are often overlooked. This work was conducted to investigate the magnitude and direction of the problem in the poultry industry in two popular cities Southeast of Nigeria in other to highlight the inherent danger to the public health to both the consumer and regulatory authorities.

2. MATERIALS AND METHODS

2.1 Study Population

The study was conducted in Aba and Umuahia, the two most cosmopolitan towns with the highest concentration of poultry farms and poultry consumers in the state. A total of 33 farms were selected from Aba while 41 were selected from Umuahia using a simple random sampling method. The farm sizes ranged from small backyard poultry farms of 500 birds to large capacity farms of about 80,000 birds of replacement pullets and broiler chickens. The bulk of the population consisted of farms of 1500 to 10,000 birds' capacity while those of 50,000 capacities and above were the fewest in numbers.

2.2 Survey Questionnaire

Carefully structured open ended questionnaires were administered to the veterinarians and farm managers of the selected farms. Information relating to the type of antimicrobials used, adherence to drug withdrawal periods, awareness and avoidance of banned antimicrobials were requested for. Equally, reasons for antibiotic usage, length of time of application, educational status of personnel manning the farms, were sort for. The survey covered the period of April 2014 to March, 2015. The data obtained from the questions were subjected to descriptive statistics.

3. RESULTS

The results showed that different classes of antibiotics and non-antibiotic antimicrobials were being used by the farmers. Majority of them were marketed as combinations of different antimicrobials. The drugs and their active components are shown in Table 1 below.

Table 1. The antimicrobial agents in use by poultry farmers in Aba and Umuahia town and their active components

Trade name	Antimicrobial components
Intergendox	Gentamycin, Doxycycline
Agra-neodoxin	Neomycin, Doxycycline
Neotrent	Neomycin, Oxytetracycline
Doxy Gen 20:20	Doxycycline, Gentamycin
Doxygentavet	Doxycycline HCl, Gentamycin
Genteryl D	Gentamycin
NCO	Neomycin, Chloramphenicol, Oxytetracycline
Vendox	Neomycin, Oxytetracycline
Doxinoen	Doxycycline, Neomycin
Nemovit	Neomycin, Oxytetracycline
Colidox-sal	Colistin, Doxycycline
Gendox	Gentamycin, Doxycycline
Colisultrix	Colistin, Sulphadimidin, Trimethroprim
Oxytetracycline LA	Oxytetracycline 20mg
Oxytetracycline	Oxytetracycline 5mg
Bidox N	Neomycin, Doxycycline
Neoceryl Plus	Neomycin, Oxytetracycline
Oxyvet	Oxytetracycline
Vitoxy WSP	Oxytetracycline HCl
Megadox – N	Neomycin, Doxycycline
Ganadexil	Enrofloxacin
Kepflox	Enrofloxacin
Floxad	Enrofloxacin
Proxan – S	Ciprofloxacin
Ciprovet	Ciprofloxacin

Trade name	Antimicrobial components
Conflox	Enrofloxacin
Norflox	Norfloxacin
Norphis	Norfloxacin
Coliquin	Flumequin, Colistin sulphate
EST Mix	Erythromycin, Sulphamethazin, Trimethoprim
Panteryl	Erythromycin thiocyanate, Oxytetracycline HCl, Colistin sulphate Streptomycin sulphate
Keproceryl	Erythromycin thiocyanate, Oxytetracycline HCl, Colistin sulphate, Streptomycin sulphate
Interseryl WS	Erythromycin thiocyanate, Oxytetracycline HCl, Colistin sulphate, Streptomycin sulphate
Erythrate	Erythromycin thiocyanate
Tylocare	Tylosine tartrate
Tylodox	Tylosine tartrate
Tylo-Dox estra WSP	Tylosin tartrate, Doxycycline hydrate
Tiamuline	Tiamuline fumarate
Amoxil	Amoxicillin
Amoxy col	Amoxicillin trihydrate, Colistin sulphate
Amoxytin	Amoxicillin trihydrate, Colistin sulphate
Streptopenicillin	Streptomucin, Penicillin
Amcillin	Penicillin, Streptomycin
Agrar fural	Furaltadone
Furasol	Furaltadone
Agra-cox	Furaltodone, Sulphaquinoxaline Na, Sulphamerazine Na, Pyremethezine
Coxstop	Sulphaquinoxaline, Diaveridin, Amprolium
Embatreal	Sulphaquinoxaline, Diaveridin, Amproluim
Embarzin Forte	Sulphaquinoxaline, Diaveridin
Bio-Anticox	Sulphadimidine, Diaveridine
Koksidox	Amprolium, Sulphaquinoxaline
Procox WSP	Amprolium HCl, Sulphaquinoxaline
Diaziprim	Sulphadiazine, Trimethoprim
Zinaprim	Sulphamethazine, Trimethoprim
Amprol	Amprolium hydrochloride
Amprol-sul	Amprolium, Sulphaquinoxaline
Tolacox	Toltrazuril
Intracox	Toltrazuril
Center Dicox	Diclozuril
CTC	Chlortetracycline HCl

The respondents admitted to have used different antimicrobials at different times within a two month period for roughly 1305 times. Considering the fact that some of the farmers do not keep good records especially the small holder farms, this figure may be lower than the actual number of usage times. A table showing the number of times different antimicrobials or preparations containing them were used are presented in Table 2.

3.1 Usage of Antimicrobials, Dose Rate, Awareness of Withdrawal Periods and Banned Drugs

Result showed that 55.8% of the respondents consult veterinary doctors though some of the acclaimed veterinarians may actually be fraudulent or ignorant pretenders to the medical profession. The rest, 44.2% relied on their experience or followed the drug manufacturers instructions. On reasons for antimicrobial use, 89.2% of the farmers did so for prophylaxis whereas 10.8% of them used antibiotics when indicated.

All the respondents had the knowledge of the quantity of antimicrobial to use as they could read the manufactures' instructions. However 31.1% of them administered the drugs two or more days longer than specified; 63.5% were precise on the recommended length of time of administration while 5.4% often stopped administration as soon as they got favorable

results. Among those who used the drugs longer than specified, 65.2% of them did so to combat respiratory diseases while the rest were for other bacterial diseases. There was no report of daily use of antimicrobial or its administration in feed.

Whereas 75.7% of them were aware of drug withdrawal periods, only 6.8% admitted to observing them. On the other hand, just about 13.5% were aware of banned antimicrobials while 10.8% avoid their use. The reason for antibiotic usage in the study area surprisingly does not include growth promotion.

Only 35.1% of respondents ever made use of diagnostic services in disease management while 10.8% of them, mostly the big farms, consistently do this before major disease intervention.

3.2 Educational Status of Farmers

Investigations revealed that 21.6% of farmers had just basic education; 68.8% had first degrees while 13.5% had postgraduate qualifications. 30.8% of those with basic education, 34.2% and 12.5% of those with first degree and postgraduate respectively were aware of banned drugs. Less than 10% of the farmers with post degree qualifications had farm of more than 2000 birds' capacity while farm sizes were evenly distributed among farmers with basic education and first degree.

4. DISCUSSION

The present study investigated the prevailing pattern of antibiotics and antimicrobial usage in Aba and Umuahia towns of Abia state. The percentage usage of these drugs depends on a number of factors ranging from awareness, availability, cost and effectiveness of the drug.

The observation that oxytetracycline, a tetracycline, is the most widely used antibiotics in livestock production agrees with the findings of [20] and [21]. Not only are the tetracyclines relatively cheap and available, they are effective against *Mycoplasma* and a wide range of Gram positive and Gram negative organisms [22]. Additionally, they are used in the treatment of other non-microbial diseases. However, this wide application may open it to a large scale abuse

Table 2. Classes and frequency of most used members of antimicrobials within the study period

Class of antimicrobials	Most used drugs in the group	Number of times and percentage usage of antimicrobials
Aminoglycosides	Gentamicin, Neomycin, Streptomycin	147 (11.3%) 108 (08.2%) 99 (07.6%)
Macrolides	Erythromycin Tylosin	120 (09.2%) 63 (04.8%)
Tetracycline	Oxytetracycline Doxycycline Chlortetracycline	213 (16.3%) 84 (06.4%) 6 (00.5%)
Quinolones	Enrofloxacin Ciprofloxacin Norfloxacin Flumequin	39 (03.0%) 30 (02.2%) 18 (01.3%) 12 (00.9%)
Beta-lactames	Penicillin Amoxicillin	18 (01.3%) 15 (01.1%)
Polypeptide	Colistin	105 (08.0%)
Nitrofuran	Furaltadone	33 (02.5%)
Chloramphenicols	Chloramphenicol	54 (04.1%)
Sulfonamides	Sulphadimidine Sulphaquinoxaline Others Trimethoprim* Diaveridine**	39 (03.0%) 36 (02.8%) 12 (00.9%) 30 (02.3%) 24 (01.8%)

*(*Sulfonamide synergist, **Anticoccidial and antibacterial synergist)*

that will eventually translate to drug resistance and residue accumulation in poultry products. Subsequent drug resistance to hitherto tetracycline sensitive organisms among the consumers and loss of efficacy of the drug will be the likely outcome. The use of oxytetracycline in the near future predictably may plumate. Other antimicrobials with extensive application like the aminoglycosides, erythromycin, and colistin may equally be so affected. Keen and Montforts [23] and Nwiyi et al. [24], has reported very low resistance to the aminoglycosides, gentamicin and kanamycin to a number of poultry pathogens. Their bacteriocidal activities and cost effectiveness appears to have made them very popular in this area. The unchecked drug abuse and easy induction of drug resistance to prevailing disease problems have made them preferred choices over other antimicrobials like the sulfonamides. This could account for their high usage. Thus the later, which a number of other studies [25,22,21], hitherto found to be among the most widely used antimicrobials, may be becoming relatively unpopular in this environment as shown in this study. Secondly, the bulk of the farmers is educated and is informed on the negative impact of sulfonamides on egg laying. On the other hand, the high usage of colistin may be due to its effectiveness in combating Gram negative bacteria resistant to other available antimicrobial agents according [26]. It is also equally preferred in poultry producing eggs for human consumption.

The apparently low patronage of flouroquinolones despite possessing a broad spectrum of antibacterial activity and being relatively new could be due to a significantly higher cost of purchase compared to other antibiotics in the study areas. However, according [27], the use of flouroquinolones in farm animals has led to an increase in resistance in *Campylobacter* infecting humans, [27]. This fact is buttressed by the knowledge that countries like Finland and Australia where flouroquinolones are not allowed in animals have the least flouroquinolone resistant *Escherishia coli, Salmonella enteritidis* and *Campylobacter* indices in human population [28,29,30]. Such a ban may not be effective in this region if growing antimicrobial resistance to presently cheaper drugs renders them ineffective and the flouroquinolones become drugs of choice. Among the banned drugs in the poultry industry in the study areas, the nitrofurans and chloramphenicol are still very much in use. The usage of the later is still quite high at 4.1%. The lower usage of nitrofurans may probably be due to the carcinogenic and mutagenic effects [31], associated with it of which people are scared of, thus discouraging its supply, recommendation and usage. In addition, they have been shown to adversely affect fertility and reproductive activity of both male and female humans and animals. Nevertheless, the 2.5% recorded in this study is still significant and poses a serious health hazard to the human population.

The fact that most of the respondents were not making use of veterinarians in disease management will certainly result to gross misuse of antimicrobials with a concomitant rapid induction of drug resistance in the poultry industry. This situation is exacerbated by the finding that most of the respondents don't have recourse to laboratory diagnosis in disease treatment. Therefore, a lot of treatment will be based on "trial and error". The greater number of those that use antimicrobials longer than recommended comes from those treating for respiratory diseases as they can be stubborn to treatment. The consequence is that farmers use large quantities of different antimicrobials until they achieve results. Therefore aside drug resistance and residue accumulation in poultry products as noted by Junaidu [5], there is an attendant economic waste and loss of production efficiency. Quite a few number of farmers were aware of banned drugs in livestock and a fewer number even avoid their use most likely due to the afore-mentioned reasons. Even those that claimed to adhere to drug withdrawal periods or avoid the use of banned drugs may not be very truthful. The revelation that farmers in this region do not use antimicrobials as growth promoters is buttressed by their non inclusion in feed or daily administration through other routes. Although this may not be to their economic interest, it will go a long way in reducing the level of the residues in their products.

The lack of adherence to withdrawal periods which is largely associated with the unfavorable economic implications for the farmers and lack of enforcement by controlling bodies have been reported by many researchers [32,21,20]. The problem appears to be economical rather than lack of awareness. The implications are that a lot of drug residue will be found in poultry and poultry products in the study regions, an observation that has been made by Junaidu [5], Idowu et al. [33].

The regulation controlling the use of drug and veterinary drug residues in animal tissues in Nigeria was provided by Food and Drugs Decree (1974). This role has been transferred to NAFDAC [34] who has recently started implementation of WHO recommendation in this regard hence the ban on the use of nitrofurans drugs in livestock and poultry feed [35]. However, this ban is obviously not being well enforced from the result of this study.

It appeared that most of the farmers interviewed were educated; nonetheless, this fact has not made any significant change in the use of antimicrobials in the study region. The fact that the poultry industry is already struggling with disease problems, drug resistance, inadequate funding and low assessment of agricultural insurance have predisposed the learned and unlearned farmers to same unethical practice in a bid to survive at all cost. Therefore given the prevailing circumstance and the fact that other towns in the developing nations may have similar pattern of drug usage, the assertion made by Landers et al. [35] of a looming antibiotic crisis may not be farfetched.

5. CONCLUSION

From the survey, it can be concluded that there is a high level of drug misuse largely due to ineffective policy for use of antimicrobials in food producing animals. The use of banned antimicrobials with known harmful effects on humans is even more worrisome. It is therefore recommended that the issues of drug resistance involving antimicrobials used both in humans and animals, like the quinolones be evaluated in the study areas. A strong awareness as to the dangers of these practices should be created by the relevant bodies while government strengthens the existing controls on the production, distribution and use of these drugs especially the banned ones. There is also the need to create an agency to monitor the presence of antimicrobial residues and their metabolites in poultry and other animal products meant for human consumption. However, any policy or regulation in the face of harsh economic operating environment may not be effective. Thus the need to get the farmers to insure their farms and reduce the high risk posed by diseases in the industry may be a welcome development. If this is combined with proper disease evaluation before treatment and the use of veterinary personnel, there may be a significant reduction in the abuse of these drugs and its attendant consequences.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/19559