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An investigation of the practices of veterinarians and breeders in the prevalence of antibiotic resistance in poultry farms in Algeria.

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Abstract

The practices adopted by the breeder and the veterinarian are factors that influence resistance to antibiotics in poultry farms. The study aims to determine some of the applications of the veterinarian and the breeder. A survey was carried out among a group of 237 veterinarians in Algeria in the form of an interview and an online questionnaire. The pathologies affect the digestive system 37.87% and the respiratory system 35.95%, respecting the recent renewal of the litter 51.9%, food distribution conditions 51.48%, drinking water 45.15%, and ventilation 23.21%. Most veterinarians base their diagnosis on visual observation of symptoms and an autopsy. It only intervenes after a worsening of symptoms into 56.12%. The broad-spectrum antibiotic prescribed 56.54%. The case in which the first treatment was not effective 83.54%. The veterinarian is summoned more than once in the same herd 42.19% is that of 2 times per group. The treatment failure is resolved either by 28.27% of prolonging the duration of treatment or by 20.68% by increasing the dose. The human causes of antibiotic resistance in broiler chickens were identified; this allows proposing preventive measures, managing and reducing the risks of antibiotic resistance.

Keywords: Investigation; Veterinary; Breeder; Antibiotic; Antibiotic Resistance.

1. Introduction

Poultry farming is undeniably the branch of animal production that has recorded a remarkable development in Algeria in recent years [1]. The high prevalence of poultry diseases may be attributed to the low level of biosecurity, low vaccination coverage, unscientific poultry management practices, and almost absent poultry veterinary interventions across the country, particularly in the extensive poultry production system [2]. Antibiotics are unfortunately still sometimes used with a preventive purpose to treat healthy animals likely to be exposed to a risk factor for an infectious disease. All these methods of antibiotic use promote the selection of resistant bacteria in the digestive microbiota [3, 4]. The veterinarian is a major player in reducing the use of antibiotics through his skills in diagnosis and definition of a solution adapted to each animal health situation [5], He must give himself the means to make a reasoned choice based on his epidemiological knowledge, his sense of diagnosis and on additional examinations, particularly bacteriological [6]. The breeder uses antibiotics, according to the expected benefit. He is at the center of the decision, as he manages first-line the use of antibiotics for sick animals, and also through husbandry practices which can be risk factors for the onset of the disease [7].

The present study aims to conduct a field survey on the use of antibiotics in broiler chickens. Respondents are private and public, veterinarians. It is considered a veterinarian is able to fully understand the situation of the breeder in the face of the problem of antibiotic resistance, thanks to the skills acquired in his field of specialization and to the experience accumulated. The survey covers the state of health of poultry, the production practices of breeders, veterinary practices in terms of diagnosis and use of antibiotics.

2. Materials and methods:

Our survey targeted practicing veterinarians from Sidi Bel Abbès (North-Eastern) and other regions of Algeria, dealing with broilers, whether on an occasional or daily basis. By a questionnaire, where we

relied on both the interview and the online questionnaire.

The purpose of this survey is to provide a source of information on the situation and practices surrounding broiler farm.

The investigation is based on the recording of three axes, are necessary for our study only, the state of health of the poultry, the practices of the breeders in the production, the veterinary practices in the diagnosis and the use of antibiotics, the emergence of antibiotic resistance in bacteria.

3. Results

3.1. Frequent pathologies

In poultry farms, different types of pathologies have been encountered. The pathologies most often treated are digestive system 37.87%, respiratory system 35.95%, nutritional 17.28%, the nervous system 4.71% and locomotor system 4.19% (Figure 1).

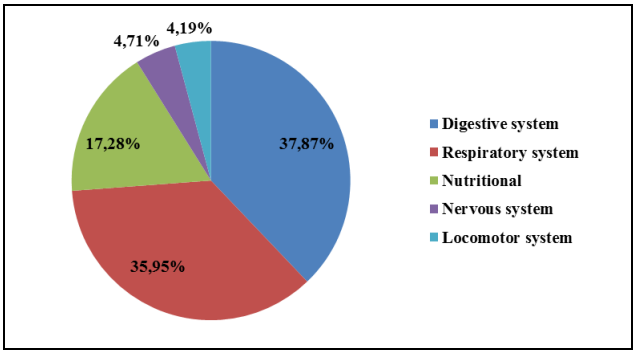

Figure 1: The main pathologies encountered

3.2. Digestive and respiratory pathologies

3.2.1. Digestive

According to the respondents, four main pathologies with clinical digestive expression are frequent: Coccidiosis, Colibacillosis, Salmonellosis and Enteritis with a rate of 89.45%, 73.42%, 68.35%, 68.35% respectively (Figure 2).

3.2.2. Respiratory

Respondents reported a multitude of important respiratory conditions: Mycoplasmosis, Bronchitis, Chronic respiratory, Laryngo-tracheitis, pneumonia, avian Flu with a rate of 78.90%, 73.42%, 71.73%, 61.18% respectively (Figure 2).

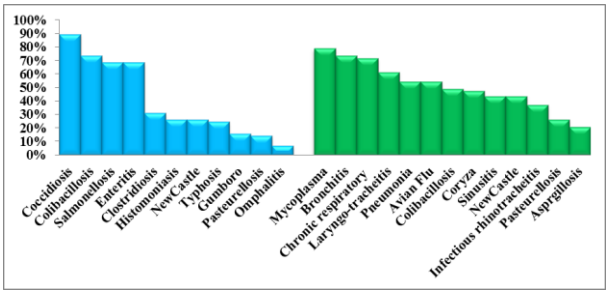

Figure 2: Types of diseases suspected in digestive and respiratory syndrome

3.3. Microbial contamination depending on the age of the chicken

The growth phase is characterized by a level of important bacterial infections 48.82%, compared to the starting phase of 33.33% and finishing phase 17.85% (Figure 3).

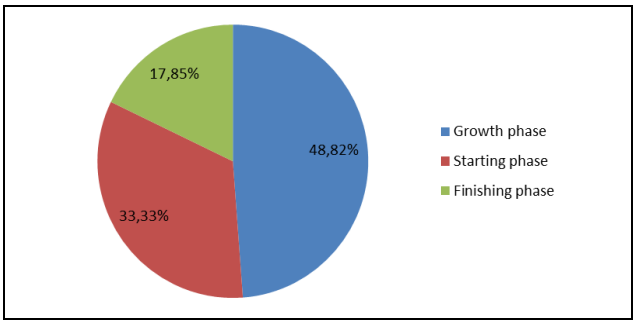

Figure 3: The microbial contamination during the chicken breeding phase

3.4. The state of stored food:

Field surveillance allows veterinarians to examine the condition of stored food and to judge its quality with the naked eye. The results are 41.43%, 22.12%, 19.94%, 16.51% for food stored a little damp, of good quality, moldy, of poor quality respectively (Figure 4).

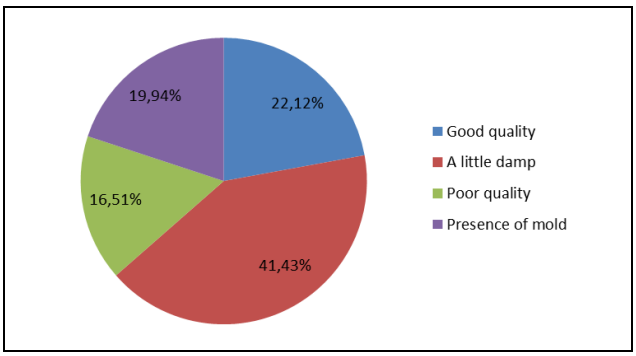

Figure 4: The state of stored food

3.5. The quality of the litter in the storage area and on the poultry living area

More than half of the veterinarians consider that the litter was wet in the storage area and the breeding unit of 52.99%, 51.06% respectively. While dust characterizes the litter in the storage area and the breeding unit of 25.21%, 30.21% respectively.

Mould characterizes the litter in the storage area and the breeding unit 23.08%, 19.57% respectively (Figure 5).

The litter is of good quality represented in the storage area and the breeding unit 17.09%, 22.98% respectively.

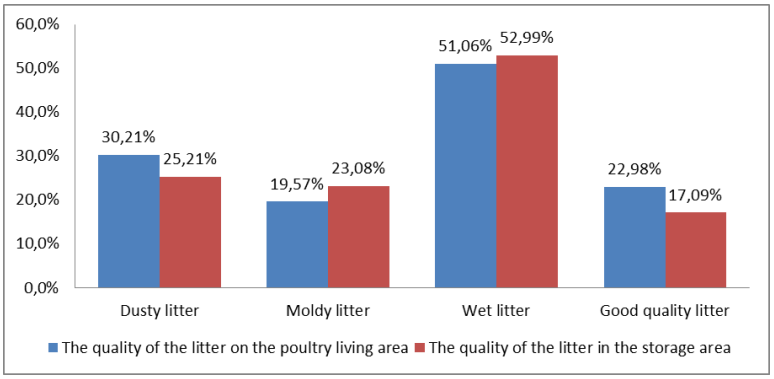

Figure 5: The quality of the litter in the storage area and on the poultry living area

3.6. The ambient components of buildings

Any component of the atmosphere in livestock buildings can have an impact on health, either directly or indirectly. The respected criteria which define the ambient conditions are given as a percentage by the surveys: The feeding 74.26%, Recent litter renewal 51.9%, Feed distribution conditions 51.48%, The temperature 48,95%, The lighting 45.99%, Drinking water 45.15%, The ventilation 23.21% (Figure 6).

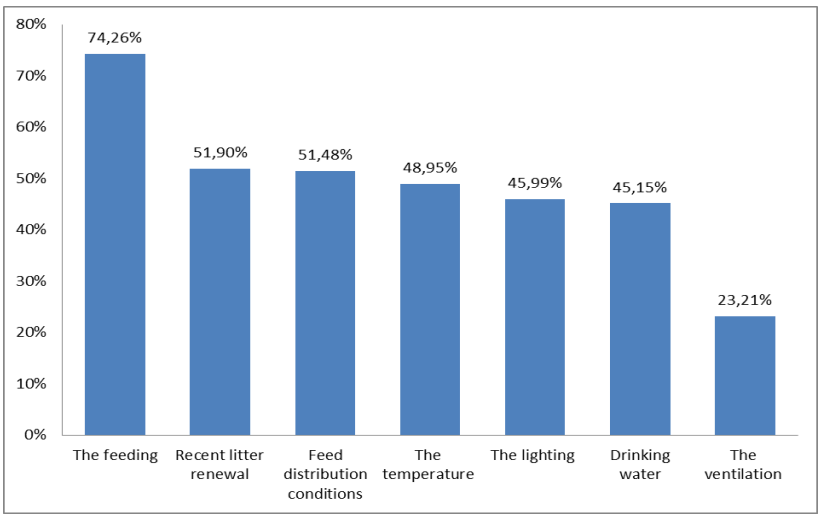

Figure 6: The respect of the conditions of breeding of hens by the breeder

3.7. Diagnostic means

In the veterinary field, diagnostic methods are essential for a simple, clear and precise diagnosis. All veterinarians rely on visual observation of symptoms in sick chickens. While 90.30% of veterinarians rely on the necropsy and visual observation of symptoms, while 14.77% rely on the diagnosis by referring to the laboratory to determine the type of germs causing the disease (Figure 7).

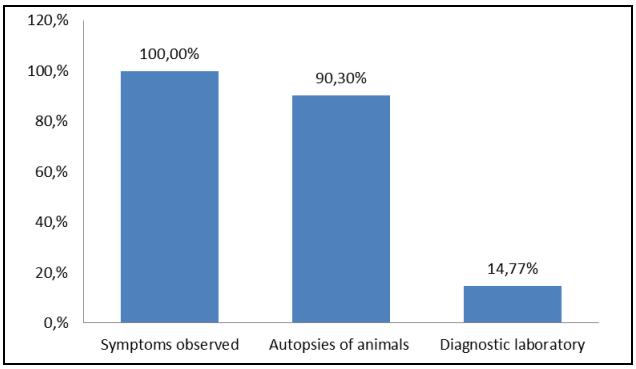

Figure 7: The veterinary means available to establish a diagnosis

3.8. The intervention phase

Veterinarians are solicited as soon as chickens show the first signs of disease 43.88%, while veterinarians who are not solicited only after symptoms worsen 56.12% (Figure 8).

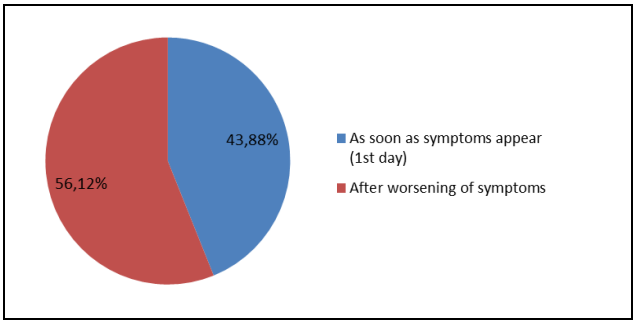

Figure 8: The generally requested time of veterinarian

3.9. Control of hygienic conditions

87.34% of the response cases state when implementing the treatment they perceive hygienic conditions in poultry farms (Figure 9).

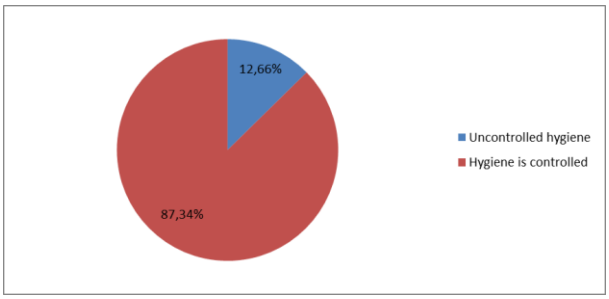

Figure 9: Control of hygienic conditions by veterinary

3.10. Determine the method of counting chickens for treatment

Veterinarians count the number of chickens in the barn and determine the total weight to determine the

dose needed for the flock. Weight a group of chickens to generalize it to the flock 36.71%. Estimated to the naked eye 25.74%. Consultation of the 21.52% broiler weight and mortality monitoring document. The document is prepared by the breeder at the start of raising the chickens. Use of the information provided orally by chicken farmers 9.28%.Count all the chicken 6.75% (Figure 10).

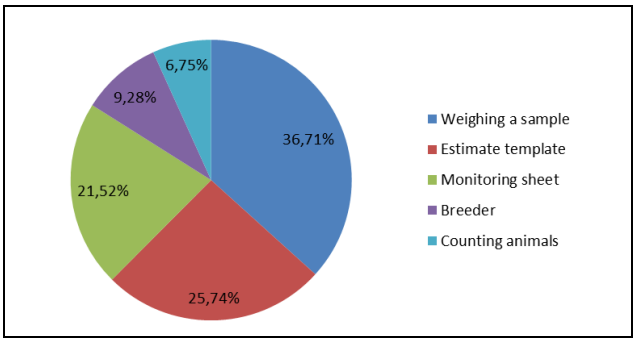

Figure 10: Method of counting chickens for treatment

3.11. Prescribing antibiotics:

In case of the endurance of the symptoms after the first treatment of pathology, veterinarians generally prescribe to breeders another molecule of antibiotic or make a combination of antibiotics according to the forecast of the healer.

The conduct of the respondents varies between the prescription of a broad-spectrum antibiotic adopted by 56.54% of the respondents, the prescription of a combination of antibiotics adopted by 43.46% of the respondents (Figure 11).

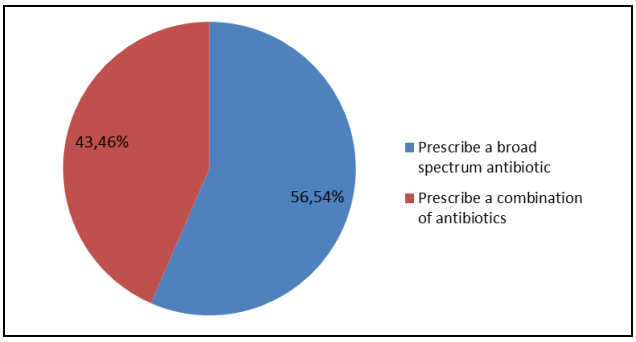

Figure 11: The conduct of the veterinarian

3.12. Managing the preparation of the drugs to be distributed

In regards to preparing the quantity of medicine to be distributed to animals, 83.54% of those surveyed said that they proceed a prepare the daily amount of antibiotic to be administered. 16.46% of them proceed a prepare the total amount sufficient for the duration of the treatment.

It seems that almost all practitioners are aware of the disadvantages that can bring long periods of the drug solution and its consumption by animals (Figure 12).

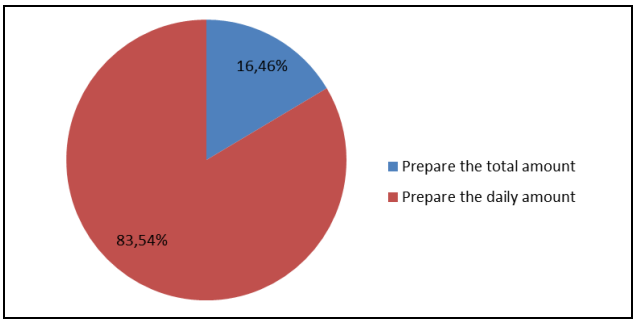

Figure 12: The method of administering the drug in drinking water

3.13. The person responsible for the administration of antibiotics

The breeder who administers the drugs, according to veterinary guidelines 70.04%. The veterinarian himself who, on the occasion of his visit to the holding in which disease had declared administered the product on the spot 29.96% (Figure 13).

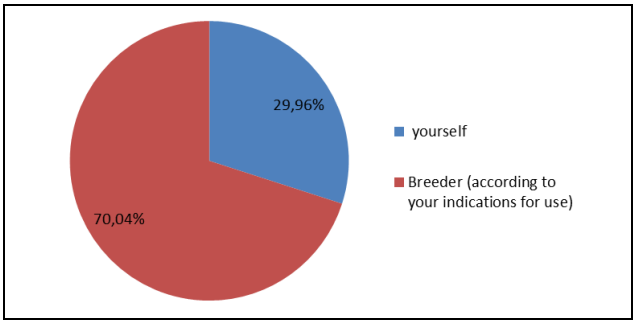

Figure 13: The drug administration manager

3.14. The route and the means of antibiotic administration:

The oral route is the only route of antibiotic administration. The means of administration of the antibiotic is reserved only for drinking water.

3.15. A first treatment failure

83.54% of those surveyed said they had encountered cases during which the first treatment did not give results (Figure 14).

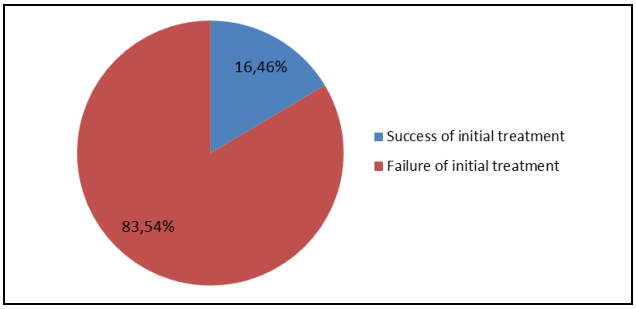

Figure 14: The frequency of antibiotic therapy failures

3.16. The interventions thérapeutic

79.32% of interviewees affirm that cases of therapeutic failure are frequent in the field, and this is what makes them summoned more than once to the same flock (Figure 15).

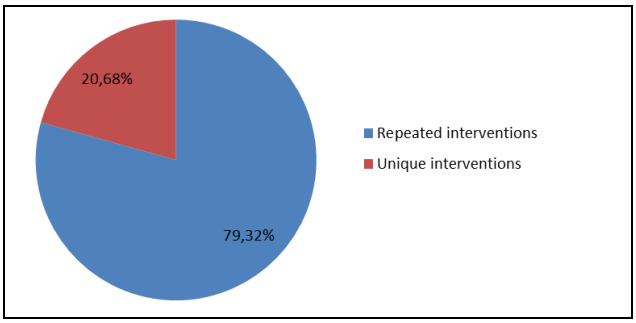

Figure 15: Therapeutic interventions

3.17. Frequency of therapeutic interventions

According to surveys, the same group of animals can be called several times for several pathological reasons. The respondents confirm their intervention in the same band, 22.36% from 1 time by the band, 42.19% from 2 times by band, 14.77% from 3 times by band. While 20.68% of the respondents confirm not their intervention in the same band (Figure 16).

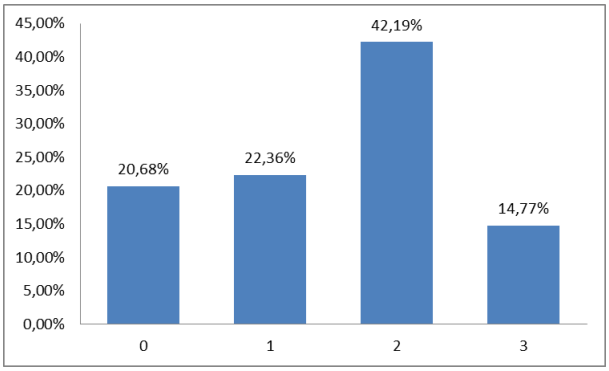

Figure 16: The frequency of therapeutic interventions

3.18. Management of antibiotic therapy failures

If symptoms persist after the first treatment of pathology, veterinarians administered different attitudes: 28.27% decide to extend the duration of the same treatment, 20.68% increase the dose of the same treatment, 18.99% prescribe another molecule in the case of persistence, 17.72% prescribe a combination of antibiotics, and 14.35% use the diagnostic laboratory.

Experience has shown that for certain antimicrobial active substances, higher dosages than those indicated in the approved package leaflet must be chosen to obtain sufficient efficacy (Figure 17).

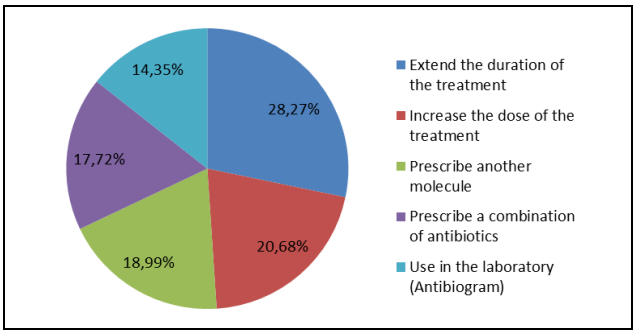

Figure 17: The attitude of a veterinarian in the face of antibiotic therapy failures after the first treatment

3.19. Stopping treatment of the antibiotic

81.86% of the veterinarians confirm a stop of treatment at the end of the recommended quantity of the drug, while 18.14% stop administering the drug as soon as the symptoms disappear even before the end of the indicated duration (Figure 18).

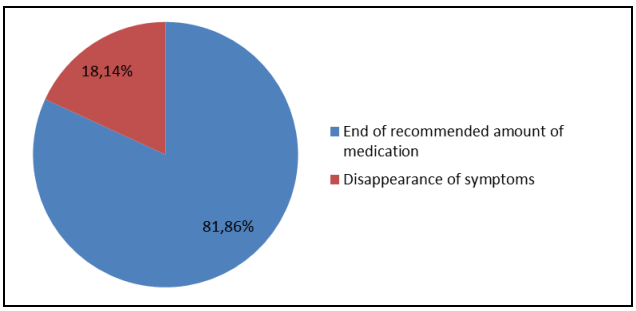

Figure 18: The moment to stop treatment

3.20. Contact with the regional laboratory (antibiogram)

Diagnostic laboratories are not a diagnostic confirmation tool for 74.68% of respondents, while 25.32% are attached to the regional veterinary laboratory (Figure 19).

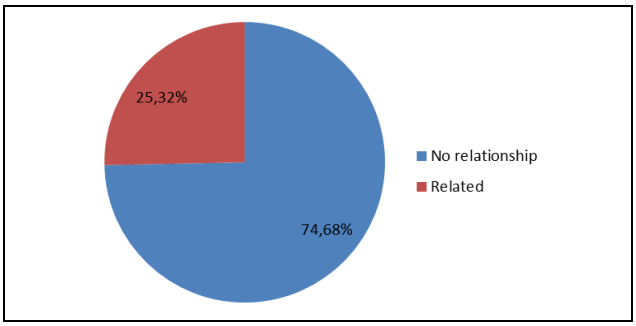

Figure 19: The relationship with the regional laboratory

3.21. The veterinarian's relationship with the client after the procedure

The relationship of the veterinarian with the breeder after the treatment is essential to monitor the status of the treatment. In addition to knowing the success of the treatment method.

Most veterinarians 87.76% are in contact with the breeder after the treatment. While 12.24% of vets do not contact the breeder after the treatment period (Figure 20).

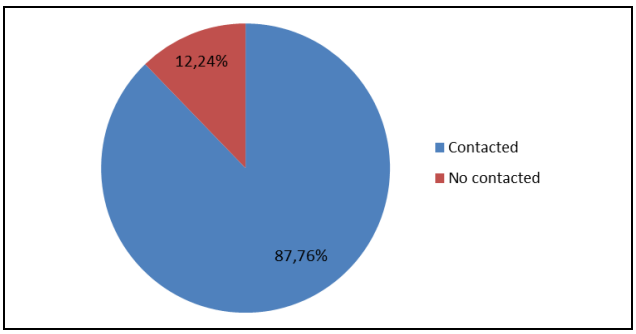

Figure 20: The contact with the customers after the start of treatment

3.22. The rate of use of antibiotics:

The rate of use of antibiotics by veterinarians during therapeutic interventions in poultry farms, 1 to 100% of all drug classes. The high percentage is given of 31.65% of respondents who use antibiotics from 40 to 60%, then 43.46% use the antibiotic from 1 to 40%, 21.52% declare their use to antibiotics from 60 to 80%, finally, the lowest percentage is 3.38% of respondents who use antibiotics from 80 to 100% (Figure 21).

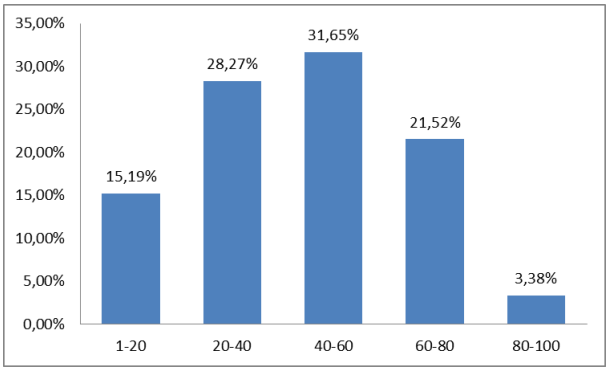

Figure 21: The approximate rate of antibiotic use

3.23. The effect of antibiotics

Depending on the dominant clinical, digestive or respiratory manifestations, the range of antibiotics used and their efficacy evaluation by veterinarians is represented in figure 22.

The following antibiotics have an efficacy of more than greater than 50% : Amoxycillin 75.95%, Tylosin 56.96%, Colistin 56.12%, Enrofloxacin 54.85%, Anti coccidian 51.90%.

While the Doxycycline 42.62%, Oxytetracycline 41.35%, Erythromycin 40.93%, Ampicilin 37.97%,

Trimethoprim 36.71%, Sulfadiazine 30.38% show good effectiveness on the ground varies between 30 to 50%.

While antibiotics: Neomycin 29.11%, Tilmicosin 29.11%, Sulfadimethoxine 27.85%, Flumequine 27.43%, Sulfadimidine 23.21%, Spectinomycin 21.10%, present a slightly poor efficacy on the field, varies between 20 to 30%.

But antibiotics: Gentamycin 19.83%, Difloxacin 19.83%, Sulfaquinoxaline 17.30%, Josamycin 13.92%, Chlortetracycline 13.50%, Oxolinic acid 13.08% present effectiveness badly to present a slightly poor efficacy in the field, varies between 10 to 20%.

Antibiotics remain: Ceftiofur 9.70%, Tiamulin 7.17%, Dihydrostreptomycin 5.49%, Fosfomycin 2.95%, Framycetin 2.95% which have very poor efficacy in the field inferior at 10%.

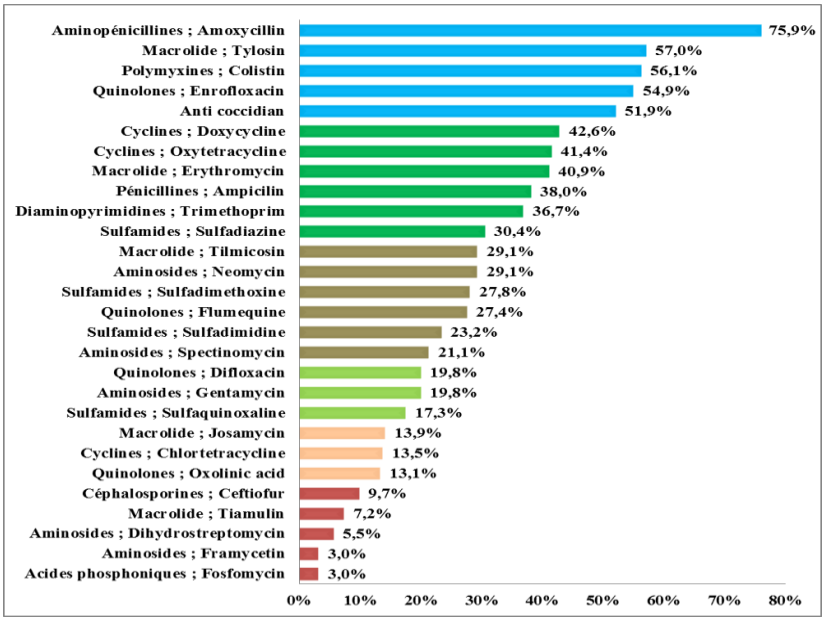

Figure 22: The opinion of veterinarians on the effect of antibiotics.

4. Discussion

4.1. Frequent pathologies

According to the observations collected by the National Network of Epidemiological Observations in Aviculture Avian Pathology in 2004, the frequencies of respiratory and digestive disorders were observed in broilers [8], which are among the most common diseases seen on farms, accounting for almost 70% of all cases seen in a diagnostic laboratory or on poultry farms [9].

While locomotor and nervous disorders are also dominant in avian pathology, these disorders concern 5 to 20% of animals, the integrity of nervous, muscular, joint and bone tissues must be ensured [10].

Nutrition-related diseases can be directly toxic products in food, and sometimes vitamin deficiency leads to reduced growth and increased susceptibility to viral and bacterial infections. While complex metabolic diseases result from the conjunction of deficiencies and degraded breeding or feeding conditions [10].

According to Berghiche *et al.* [11], they encountered 94.6% of bacterial diseases, 91.2% of viral diseases, 78.4%, 42.3%, and 9.6% for parasitic, metabolic, and other diseases, respectively.

The monkeys of Clinical of Newcastle (ND) affecting the neurological, gastrointestinal, reproductive, and respiratory systems [12]

4.2. Digestive and respiratory pathologies

4.2.1. Digestive

The digestive inflammation does cause tissue damage, the loss of functionality, reduce flock performance, increase morbidity [13, 14], while newly

hatched chicks lack digestive microflora and are highly susceptible to enteropathogen colonization and infection [15].

Several infectious microorganisms are capable of altering the digestive system, in particular; The protozoan belonging to the Eimeria genus, which causes Avian coccidiosis, they colonize and infect the intestinal tract [16-18]; E. coli (APEC) is a leading cause of morbidity and mortality which is known to Colibacillosis than refers specifically to a localized or systemic infection [19-21]; *Clostridium perfringens* causes necrotic enteritis (NE), imposing an economic burden on the poultry industry worldwide [22-24] *C. Perfringens* is also responsible for subclinical infections, associated with chronic damage of the intestinal mucosa [17, 25]; *H. meleagridis* cause the Lesions to trigger Histomoniasis, also known as "blackhead disease " or "enterohepatitis", is a parasitic disease. which are noticed as thickening of the caecal wall, bleeding in the mucosa and fibrinous masses in the lumen of the caecum [26-28]; the Newcastle disease virus (NDV) cause Newcastle disease (ND), is a serious contagious disease of domestic poultry [29, 30]. the Salmonella infection is one of the most important bacterial diseases in poultry causing mortality and reduced production [31, 32], colonize the intestinal tract of poultry can persist throughout the bird's lifespan [33]. *Salmonella enterica* serovar Gallinarum biovar Gallinarum (*S. Gallinarum*) causes fowl typhoid in commercial poultry, a disease characterized by acute systemic infection [34, 35]; Infectious bursal disease (IBD), infectious bursitis or Gumboro disease, is an acute and highly contagious viral disease in young chickens. Infection with IBD, leads to severe immunosuppression, this disease manifests as acute and subclinical forms in chicks [36-38]; In poultry, *Pasteurella. multocida* causes fowl cholera, which is a serious disease with clinical signs that include depression, ruffled feathers, fever, anorexia, mucous discharge from the mouth, diarrhoea, increased respiratory rate, septicaemia and death [39, 40]; Several bacteria causing omphalitis were isolated in a study carried by Jalob *et al.* [41] and Khan *et al.* [42]. Among these bacteria : *streptococcus*, *E.coli*, *proteus*, *pseudomonas*, *staphylococcus*, *Pasteurella*, *klebsiella*, *Enterococcus*, *Enterobacter spp*, *Clostridium spp* and *bacillus spp*. Such isolates may represent chicks which have been necropsied at the age of 4-5 days [41, 43, 44]

4.2.2. Respiratory

According to Berghiche *et al.*[11] The classification of viral diseases registered has been the subject of veterinary alerts, sufficiently explains the level of infection affecting the poultry farms such as Newcastle, Gumboro, and infectious bronchitis with a rate of 44, 31, and 18%, respectively. The study also revealed that the occurrence of zoonotic Avian Influenza (5%) and the emerging Infectious Rhinotracheitis (2%) was low in the region. Primary lesions of the epithelium of the upper respiratory tract caused by an infectious agent (infectious bronchitis virus, Newcastle disease virus, mycoplasmas) [45]. Respiratory infections are the most serious diseases affecting poultry and cause heavy economic losses. While acute diseases cause heavy mortalities, the subclinical and chronic cases lead to the production losses [46], various regions of respiratory tract viz., trachea, lungs and air sacs differ in their susceptibility to respiratory irritants and pathogens [47]. Respiratory syndrome requires the association of several physiological factors acting in combination or synergy. Primary lesions are due either to a mycoplasma, or a wild or vaccine virus (paramyxovirus, orthomyxovirus, coronavirus, metapneumovirus, etc.), then associated or not with the mycoplasma itself. These lesions are most often aggravated by superinfection by one or more bacteria from digestive or ambient media: colibacilli, pasteurelles, Ornithobacterium rhinotracïieale, staphylococci, Avibacteriurr (ex-Haemophilus) paragallinarum, Bordetella, streptococci [10, 48, 49]. In avian host, several microorganisms of the genus Pasteurella, Bordetella and haemophilus were involved in respiratory diseases complex [50]. Escherichia coli , Ornithobacterium rhinotracheale and *Aspergillus fumigatus* associated with respiratory infection in chickens has also been reported [51-54]. Bacteria have also been reported from cases of yolk sac infection in chicks including, *Escherichia coli*, *proteus* , *mixed infection*, *streptococci*, *klebsiella*, *salmonella*, *staphylococci*, *pseudomonas* , *pasteurella* , *yarseinia* and Chlamydia psittaci (C..psittaci) [55-57]. In many cases, the bacterial component of a respiratory disease

colonizes the respiratory system only after a primary viral or environmental insult. Colonization of the airsacs of a chicken by *Escherichia coli* following an infectious bronchitis virus infection is an example of secondary bacterial invasion. In other cases, the bacterial component of the respiratory disease is the primary initiating cause of the disease. The coryza and fowl cholera infections in the chicken are examples of primary bacterial respiratory diseases in poultry [58, 59]. Several avian viruses have a predilection for the respiratory tract of chickens: infectious bronchitis virus (IBV), Newcastle disease virus (NDV), infectious laryngotracheitis virus (ILTV), avian influenza virus (AIV), pneumovirus primarily infect the respiratory tract of chickens [31, 55, 60-63]. have been recognized as the most important pathogens in poultry [46] because of the tendency to change its antigenic properties [60, 64].

4.3. Microbial contamination depending on the age of the chicken

The recorded mortality rates are high (10 to 60%) and vary greatly according to age groups [65]. While start-up mortalities are likely linked to climatic conditions [66]. The proportion of farms infected with Salmonella is almost three times higher when the animals are older than 40 days, indicating an effect of age [67].

Prophylactic antibiotics administered for the age of the birds ranged from 4 to 32 weeks. In most cases, a prophylactic antibiotic is given usually weekly, and once every month or every three days [68], besides, the introduction of the antibiotic is due to the high risk of developing bacterial diseases early and throughout the breeding period.

4.4. The state of stored food

The duration and conditions of food storage are factors to be taken into consideration, rancid lipids, by fat oxidation, are responsible for serious organic disorders [69], and also micromycetes or molds develop from a nutrient substrate such as food [10] therefore the breeder must ensure that moldy or degraded feed should not be distributed [70]. In many cases, contaminated feed is the major source of Salmonella infections in poultry [71].

4.5. The quality of the litter in the storage area and on the poultry living area

The quality of rearing litter is defined in part by the physical characteristics of the excreta, due to their influence on the ease of handling excreta, on the risk of the appearance of lesions on the legs and keel, and on the spatial distribution (air, litter surface, litter depth) humidity in the breeding [72]. Litter contributes to the mood at start-up by acting as a thermal insulator and heat storage. It is composed of wood chips or chopped straw [73]. Litter is maintained by regularly adding small amounts of shavings or crushed straw and removing wet parts from leaking drinkers. Sufficient, well-maintained bedding is the first prevention against parasites (ascaris and coccidiosis) [73]. intestinal leakage caused by inflammation [74] causes liquid losses from broilers and diarrhea than increase litter moisture [75]. The litter isolates the chick from contact with the soil and absorbs moisture from the faeces which will then be removed by ventilation. Good litter is dry, healthy, not very fermentable, flexible, absorbent, insulating and thick [76].

4.6. The ambient components of buildings

Respect for hygiene practices is fundamental in the success of modern breeding because it reduces ambient microbism, therefore the impact of diseases and the use of anti-infectives [77], most of them of breeders do not apply the correct breeding rules [78].

Non-infectious factors, such as climatic conditions (e.g. inadequate ventilation, high ammonia levels, too high or too low temperature) can also help in disease progress [59]. The farmer must ensure that the water supplied is potable and inspect the cleanliness of the drinkers daily [70].

Good feed efficiency is one of the main factors for improving chicken production [79]. The breeder must ensure that each animal, from birth to slaughter, consumes 3 feeds during its growth, according to current conventional standards: 0-23d start; growth 23 to 35 days; finishing 35 to 56j [80]. Inadequate food storage conditions by breeders, lack of air conditioning, and adequate air circulation could help mold growth [81].

The effectiveness of old built-up litter as a sanitary procedure, which allows the prevention or control of coccidiosis and mortality [82, 83].

Temperature and lighting are considered the most important factors, as it has a direct impact on animals, often causing heat stress and affects broiler behaviors, production performance, and well-being [84, 85].

Ventilation allows the poultry to breathe well. It allows the elimination of odors and toxic gases, (resulting from the fermentation of the litter) [73, 76]. It ensures the elimination of dust released by litter when it is too dry and allows the spread of pathogenic germs. It also ensures the evacuation of the water eliminated by the birds in the form of vapor and in the droppings, or that of the drinkers (drying of the litter) [10, 73]. Finally, it allows the elimination of calories, that is to say of the heat given off by animals or absorbed by the building [73].

Poultry farmers invest little in their production tool (renovation of buildings, installation of equipment necessary to improve the atmosphere and health status, etc.) because they find the cost of these investments high [86].

The characteristics of the livestock building strongly condition the state of health and the zootechnical performance of the animals [87].

The components of the atmosphere in barns have a positive or negative influence on the health of chickens. The control of these factors leads to a standardized breeding. An imbalance of one parameter contributes to a problem with the breeding process.

4.7. Diagnostic means

The success of a clinical examination depends better on the knowledge and experience of the physician. In most cases, only one case is responsible for damage and malformations in the animal. Many doctors begin with a general examination that includes an extensive search for abnormalities. The information gained during the examination allows identifying the pathogen, type of lesion present and the organs involved [88, 89].

Careful postmortem examination supported by one or more antemortem laboratory tests can greatly assist in reaching a confirmatory diagnosis [90].

Berghiche *et al*. [11] confirms our results according to a study on an investigation on the predominant diseases, its diagnosis, and commonly used drugs in the poultry farms in the North-Eastern regions of Algeria, it was found that among the different diagnostic techniques, the laboratory diagnostic method is the least used (02%). Also, in the eastern region of Algeria, veterinarians often use clinical diagnosis (86%).

4.8. The intervention phase

The veterinary company only exists insofar as it responds to a demand from its customers [91], the latter determines the phase of the veterinarian's intervention.

The customer relationship in the veterinary environment must mainly be linked to relationships and the exchange of information [92] for a rapid and adequate intervention. In most cases, the veterinarian does not intervene very much, and the breeder sees no interest in turning to him to solve his problem [93]. While the veterinarian is not simply there to respond to a request, he can stimulate and guide it [93]. Health interventions are generally irregular and above all insufficient; which is one of the main causes of the high mortalities recorded within the farms [65].

Many breeders tend to rely on veterinarians when setting up animals. These provide health, prophylactic and therapeutic monitoring throughout the economic life of the herd [94].

4.9. Control of hygienic conditions

The most basic rules of hygiene were often neglected; corpses strewn around the area around the farm which lacked cleanliness and allowed the proliferation of pests, especially rats; the use of second hand soiled and never cleaned cells was also common practice; the breeding equipment (drinkers, hoppers) was not or was poorly maintained [95] , which the English team of Coates and Fuller showed that the growth of chickens is better in a new building or very clean than in an old uncleaned building [96]. It is noted that prevention is based on good hygiene and production practices and on a vaccination program [76].

4.10. Determination of the method of counting chickens for treatment

There is usually a heterogeneity in the weight of broiler chickens within the flock compared to the ideal weight required.

The prescription can take place after consultation with the patient (s) but also after the establishment of a

diagnosis based on the collection of a certain amount of information, insofar as the breeding concerned is the subject regular health monitoring and care provided by the prescribing veterinarian [97]. The dose to be administered often depends on the weight of the animal [98].

One of the first risky behaviors with respect to antibiotics is not to assess the weight of the animals, and therefore not to give the sufficient dose, or on the contrary to overdose [99].

- Prescribing antibiotics:

Narrow spectrum antibiotics are effective against only a few types of bacteria (Gram positive or Gram negative bacteria), while Broad spectrum antibiotics treat a wide range of infections [100, 101].

- Managing the preparation of the drugs to be distributed:

The stability of some drug molecules can be significantly affected over time when they are in solution. Ex: amoxycillin is not very stable in solution [102], and must therefore be quickly distributed after dissolution.

- The person responsible for the administration of antibiotics:

In approximately 98% of the selected farms, non-veterinary persons administered antibiotics to poultry birds [103]. Few animal raising householders are trained on veterinary practices; however, they are themselves in charge of most veterinary activities such as vaccination, animal prophylactic and treatment [104]. While the administration of antibiotics by such individuals could lead to under-dosing or over-dosing of birds [105]. Veterinarians are the authorized professionals responsible for diagnosis, prescriptions and administration of antibiotics to farm animals in many developed countries [106]. Only 4.16 per cent respondents treated their birds by Veterinarian [107]

- The route and the means of antibiotic administration:

The oral route is the most widely used route of administration 98% relative to injection food [11].

This preponderance of the oral route of antibiotics is explained by the almost systematic use of collective treatments in the avian sector [110]. Injection is, for obvious reasons, used exceptionally for antibiotic therapy, drinking water being the usual route which comes down to its convenience and responsiveness to intervention [97].

On chicken farms, antimicrobials were administered using water (100% of cases) [111]. Antibiotics can also be administered in form of injectable, tablet, bolus, drench, and bath, wash or added to feed and drinking water [112].

4.11. A first treatment failure

These high levels of antibiotic resistance can be explained by the misuse and unwise use of antibiotics in the prevention of avian diseases [113]. While a perfect knowledge of the infectious process and the pharmaco-dynamic and kinetic characters of the antibiotic as well as its fate in the organism, raising awareness among breeders about the management of their breeding pharmacy and the importance monitoring of the veterinarian's prescription are all means of combating the failure of anti-infectious therapy [99]. Where than a study conducted by Berghiche *et al.* [11] on Antibiotics Resistance in Broiler Chicken from the Farm to the Table in Eastern Algeria shows that 96% of failures, according to the surveyed veterinarians, are mainly due to the development of antimicrobial resistance [11].

4.12. The therapeutic interventions

During antibiotic treatment, resistant bacteria will be favored over sensitive bacteria. The duration of exposure (number of days of treatment) is a favorable factor for this selection [114]. The veterinarians have become only drug distributors with a great lack of health monitoring [11]

4.13. Frequency of therapeutic interventions

A higher frequency of resistance was seen in conventional farms, and this is due to conventional farms employ the regular use of antimicrobials [115].

The number of antibiotics used, depending on the case, in each production unit, semi-industrial and industrial is high from 1 to 6 times [104].

On chicken farms antimicrobials were administered for prevention of disease on 11 (73.3%) instances and for treatment on four occasions (26.7%) (due to respiratory disease) [111].

The frequency of administration should be adapted according to certain criteria such as age or species [116].

4.14. Management of antibiotic therapy failures

According to Berghiche *et al.* [11] Among various diagnostic techniques, the laboratory diagnosis method is least used (02%).

Before initiating antibiotic treatment, certain procedures must be followed, including the degree of damage to the general condition of the animal to be treated, to ensure a good treatment regimen. And also that the dose must guarantee a sufficient concentration in the affected tissues. The duration of treatment should be based on changes in the general condition of the animal and should continue for up to two days after the initiation of clinical improvement [116]. But the too long a treatment duration also represents a non-negligible risk of selection of resistance. too low a rate with a time-dependent antibiotic leads to therapeutic voids at the origin of a primary underdosing, secondarily leading to the selection of antibiotic resistant bacteria [99].

The dosages are therefore strongly recommended, especially for molecules with a narrow therapeutic margin (aminoglycosides and glycopeptides), the dosage of which is simple and rapid. For the other molecules said to have a wider therapeutic margin (b lactams), the dosages are to be carried out according to the pathophysiological state of the patient (renal or hepatic insufficiency, assisted ventilation, etc.), the interactions expected with other molecules , in the event of a high MIC requiring high dosages, insufficient therapeutic results, *etc*. These dosages should be undertaken as quickly as possible, from the first doses in order to optimize the treatment as quickly as possible. [117].

The most producers use antibiotics to prevent infection diseases not according to the prophylactic or therapeutic dosage, length of treatment and withdrawal time indicated on the product label, but most of them use a higher dosage and don't respect the recommendations of the drug producer [104, 118].

4.15. Stopping treatment of the antibiotic

Length of treatment and withdrawal time indicated on the product label, but most of them use a different dosage and don't respect the recommendations of the drug producer [104]

The choice of an anti-infective is conditioned by the etiology of the infectious process (sensitivity of germs), the location of the infection (bioavailability of the anti-microbial), the severity of the disease, the price of the intervention. The first-aid treatment can be modified after checking the causal germ and the sensitivity of an anti-infective against this germ [119].

The determination of the choice of an antimicrobial is based on the expected effectiveness of the treatment [120].

4.16. Contact with the regional laboratory (antibiogram)

Bacterial isolation, and even more so the antibiogram, are not routine analyzes required in the context of veterinary activity. They are generally reserved for the most severe cases and/or after treatment failure [121]. However, the antibiogram being a technique for evaluating sensitivity *in vitro*, it only makes it possible to predict the efficacy or, on the contrary, the clinical failure of the treatment undertaken in vivo [99]. Will help guide treatment. It therefore represents an essential step [122].

The veterinarian's relationship with the client after the procedure

Promoting animal health and welfare is often synonymous with engaging clients in animal management practices [123]

The dynamic relationship between the veterinarian and the client is the typical way of communicating. The predominant approach is mostly parenting, where the veterinarian sets the consultation agenda, takes on the role of the guardian and assumes that the client's values match their own, resulting in veterinarians contributing most of the talking and clients playing a passive role [124]

However, some veterinarians have difficulty communicating and proactively consulting [125], and to make matters worse are the many complexities of managing herd health by farmers [126].

In a medical context, good adherence can be described as strict adherence to the treatment prescribed on the doctor's prescription. This involves no addition or removal of medication from those already prescribed and no changing of the dose, number of times or duration as indicated on the prescription. [127]

The veterinarian should be aware of the strengths and weaknesses of the owner. Especially if the recommendations and treatments he prescribes are very expensive and the latter does not have the financial means to carry them out. In some cases, he must take on the role of teacher in order to teach the owner what he wants it to be applied.[128]

4.17. The rate of antibiotics use

Abuse of antibiotics is a common practice in the field of poultry farming in Algeria [118], and the use of antibiotics in veterinary medicine is the subject of much debate [129]. Between 40 to 80% of antibiotics are used for therapeutic purposes that can be questioned. Since 80% of veterinary antibiotics are used in prophylaxis or as a growth promoter [130]. Globally, an estimated 50% of all antimicrobials serve veterinary purposes [131].

4.18. The effect of antibiotics

The current benefits of continued antibiotic use in commercial production indicate improved mortality, morbidity, growth, and feed efficiency [132]. It appears that the primary goal of using antimicrobial agents for the treatment of infections is to eradicate the pathogen as quickly as possible with minimal adverse effects on the recipient [133]. A good eradication of the pathogen requires that the antibiotic must bind to a specific "active site" on the microorganism, on the one hand and on the other hand the concentration of the antimicrobial is sufficient to occupy a critical number of these sites. specific active agents on the microorganism and this for an adequate period of time [132].

Fosfomycin is used primarily for the treatment of infectious diseases of broilers [134]. While the treatment is mainly based on antibiotic therapy. The most commonly used antibiotics are sulfonamides, betalactamines, and quinolones [135]. A decrease in water consumption and the subsequent decrease in antibiotic absorption are generally interpreted as a lack of antibiotic efficacy [136].

Antibiotics prophylaxis administered to the birds were chloramphenicol (40/110), penicillin (20/110), doxycycline (20/110), gentamicin (10/110), neomycin (10/100) and a combination of chloramphenicol, ampicillin, penicillin and cloxacillin (10/100). These were administered either weekly (90/110), every 3 days (10/110) or monthly (10/100) [68].

5. Conclusion

The survey that we carried out is very important, as the information that we obtained through the participation of veterinarians, enabled us to understand the current situation faced by the breeders' farms of broiler chickens.

As it became clear to us that the real problem is that the farms operate without a license, and this is what makes them far from supervision by the competent authority.

Also, the chicken breeder does not care to involve the veterinarian in the first stages of his activity for several considerations, including reducing the cost of diagnosis, relying on the Chicken breeders, experienced in treating and diagnosing, which is often far from what is recommended by veterinarians.

In the absence of a prescription, antibiotics without prescribing to the breeder, as well as offering them in popular markets, it becomes easy to acquire these medicines, which the doctors does not recommend.

The veterinarian bears part of the responsibility when he does not submit a prescription, track farm cases, and keeps them in private documents, as the absence of archiving hinders tracking cases and understanding the situation over the years.

For the sake of proper flow and tracking of antibiotic consumption, we suggest count all informal farms and regularizing their legal status. As well as the introduction of digital information in order to inventory each private or public veterinarian of the practices he performs on farms.

Emphasis should be placed on continuing education for veterinarians and educating them and farmers on the need to limit the indiscriminate use of antibiotics.

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Conflict of Interest

The authors have no conflict of interest to declare.

References

[1] Meguenni N., Chanteloup N., Tourtereau A., Ahmed C. A., Bounar-Kechih S. *et al*., Virulence and antibiotic resistance profile of avian Escherichia coli strains isolated from colibacillosis lesions in central of Algeria, Veterinary World, 12 (11) (2019 (:1840. DOI: 10.14202/vetworld.2019.1840-1848.

[2] Asfaw Y., Ameni G., Medhin G., Alemayehu G., Wieland B., Infectious and parasitic diseases of poultry in Ethiopia: a systematic review and meta-analysis, Poultry science, 98 (12) (2019): 6452-6462. DOI: 10.3382/ps/pez521.

[3] Chardon H., Brugere H.; Usages des antibiotiques en élevage et filières viandes, Centre d'Information des Viandes, (2014). Available online: https://www.veterinaire.fr/fileadmin/user_upload/images/CRO/Languedoc-Roussillon/actualites/AB_Usage_antibiotiques_elevage_CIV_2014_H_Chardon-H_Brugere_-_copie.pdf. Accessed on 10/11/2020

[4] Fleury M., Impact de traitements antibiotiques sur la flore digestive du porcelet : Etude in vivo et développement d'une approche en système de fermentation in vitro. Médecine humaine et pathologie. Université Rennes 1, 2015. Français. ⟨NNT : 2015REN1B002⟩. ⟨tel-01156521⟩.

[5] Ducrot C., Adam C., Beaugrand F., Belloc C., Bluhm J., *et al.*, Apport de la sociologie à l'étude de la réduction d'usage des antibiotiques, INRA Productions Animales, Paris: INRA, 31 (4) (2019): 307-324. Available online: https://hal.archives-ouvertes.fr/hal-02101571/document Accessed on 15/12/2020

[6] Sanders P., Bousquet-Mélou A., Chauvin C., Toutain P.-L., Utilisation des antibiotiques en élevage et enjeux de santé publique, Institut National de la Recherche Agronomique Productions Animales, 24 (2) (2011): 199-204. https://doi.org/10.20870/productions-animales.2011.24.2.3254

[7] Lhermie G., Sans P., Ferchiou A., Raboisson D., Perspective socio-économique des politiques publiques encourageant l'usage raisonné des antibiotiques en élevage, Innovations Agronomiques, 77 (2019): 85-90. dx.doi.org/10.15454/19tm-q942

[8] Souillard R., Toux J., Le Bouquin S., Michel V., Le RNOEA: Réseau National d'Observations Epidémiologiques en Aviculture Pathologie aviaire en 2004, Bulletin Epidémiologique-AFSSA, 24 (2007): 6-7. Available online: https://be.anses.fr/sites/default/files/BEP-mg-BE24-art3.pdf Accessed on 15/12/2020

[9] Shivaprasad H. L., Differential Diagnoses for Diseases of Poultry Based on Organ Systems and other outlines, T. B. S. o. V. M. California Animal Health and Food Safety Laboratory System, University of California, Davis, Editor. 2014. p. 74.

[10] Guérin J.-L., Balloy D., Villate D., Maladies des volailles. 2012: Edition France Agricole. ISBN 10 : 285557210X / ISBN 13 : 9782855572109

[11] Berghiche A., Khenenou T., Labiad I., Antibiotics resistance in broiler chicken from the farm to the table in Eastern Algeria, Journal of World's Poultry Research, 8 (4) (2018): 95-99. Available online: http://jwpr.science-line.com

[12] Miller P. J., Afonso C. L., El Attrache J., Dorsey K.M., Courtney S.C. *et al.*, Effects of Newcastle disease virus vaccine antibodies on the shedding and transmission of challenge viruses, Developmental & Comparative Immunology, 41 (4) (2013): 505-513. DOI: 10.1016/j.dci.2013.06.007.

[13] Jiminez J. A., Uwiera T. C., Inglis G. D., Uwiera R. R., Animal models to study acute and chronic intestinal inflammation in mammals, Gut pathogens, 7 (1) (2015): 29. DOI: 10.1186/s13099-015-0076-y.

[14] Lee K., Lee S., Lillehoj H., Li G., Jang S., *et al.*, Effects of direct-fed microbials on growth performance, gut morphometry, and immune characteristics in broiler chickens, Poultry Science, 89 (2) (2010): 203-216. DOI: 10.3382/ps.2009-00418.

[15] Nurmi E., Rantala M., New aspects of Salmonella infection in broiler production, Nature, 241 (5386) (1973): 210-211. DOI: 10.1038/241210a0.

[16] Blake D. P., Tomley F. M.,. Securing poultry production from the ever-present Eimeria challenge, Trends in parasitology, 30 (1) (2014): 12-19. DOI: 10.1016/j.pt.2013.10.003.

[17] Shojadoost B., Vince A. R., Prescott J. F., The successful experimental induction of necrotic enteritis in chickens by Clostridium perfringens: a critical review, Veterinary research, 43 (1) (2012): 74. DOI: 10.1186/1297-9716-43-74.

[18] Haug A., Gjevre A.-G., Thebo P., Mattsson J. G., Kaldhusdal M., Coccidial infections in commercial broilers: epidemiological aspects and comparison of Eimeria species identification by morphometric and polymerase chain reaction techniques, Avian pathology, 37 (2) (2008): 161-170. DOI: 10.1080/03079450801915130.

[19] Chansiripornchai N., Comparative efficacy of enrofloxacin and oxytetracycline by different administration methods in broilers after experimental infection with avian pathogenic Escherichia coli, The Thai Journal of Veterinary Medicine, 39 (3) (2009): 231-236. https://he01.tci-thaijo.org/index.php/tjvm/article/view/35850

[20] Guabiraba R., Schouler C., Avian colibacillosis: still many black holes, FEMS microbiology letters, 362 (15) (2015): fnv118. DOI: 10.1093/femsle/fnv118.

[21] Robineau B., P.-Y., Moalic. Une maladie d'actualité en production aviaire: la colibacillose, 2010. Bulletin de l'Académie vétérinaire de France. 163 (3) (2010): 207-212. https://doi.org/10.4267/2042/48050

[22] Wade B., Keyburn A., The true cost of necrotic enteritis, PoultryWorld, 31 (7) (2015): 16-17. [Text version]. https://www.poultryworld.net/Meat/Articles/2015/10/The-true-cost-of-necrotic-enteritis-2699819W/

[23] Cooper K. K., Songer J. G., Uzal F. A., Diagnosing clostridial enteric disease in poultry, Journal of Veterinary Diagnostic Investigation, 25 (3) (2013): 314-327. DOI: 10.1177/1040638713483468.

[24] Gaucher M.-L., "*Étude de l'impact de deux traitements, dont un sans antibiotiques, sur la santé digestive et les populations de Clostridium perfringens dans des élevages de poulets de chair*", Ph.D Thesis, Vetirinary sciences, Montreal university, Canada, 2016. p333. Available online: https://papyrus.bib.umontreal.ca/xmlui/handle/1866/13372

[25] Skinner J. T., Bauer S., Young V., Pauling G., Wilson J., An economic analysis of the impact of subclinical (mild) necrotic enteritis in broiler chickens, Avian diseases, 54 (4) (2010): 1237-1240. DOI: 10.1637/9399-052110-Reg.1.

[26] Liebhart D., Ganas P., Sulejmanovic T., Hess M., Histomonosis in poultry: previous and current strategies for prevention and therapy, Avian Pathology, 46 (1) (2017): 1-18. DOI: 10.1080/03079457.2016.1229458.

[27] Tyzzer E. E., Studies on Histomoniasis, or "Blackhead" Infection, in the Chicken and the Turkey. in Proceedings of the American Academy of Arts and Sciences, 69 (5) (1934): 191-212. JSTOR. https://doi.org/10.2307/20023041

[28] Patra G., Prasad H., Lalsiamthara J., Kataria J., Malsawmkima D. *et al.*, Prevalence of Histomonas meleagridis in broiler chicken in different parts of Mizoram, India, Int. J. Poult. Sci, 12 (2013): 98-101. https://dx.doi.org/10.3923/ijps.2013.98.101

[29] Alexander D. J., Aldous E. W., Fuller C. M., The long view: a selective review of 40 years of Newcastle disease research, Avian pathology, 41 (4) (2012): 329-335. DOI: 10.1080/03079457.2012.697991.

[30] Aldous E., Alexander D., Newcastle disease in pheasants (Phasianus colchicus): a review, The Veterinary Journal, 175 (2) (2008): 181-185. DOI: 10.1016/j.tvjl.2006.12.012.

[31] Haider M., Hossain M., Hossain M., Chowdhury E., Das P. *et al.*, Isolation and characterization of enterobacteria associated with health and disease in Sonali chickens, Bangladesh Journal of Veterinary Medicine, 2 (1) (2004): 15-21. https://doi.org/10.3329/bjvm.v2i1.1928

[32] Yang J., Gao S., Chang Y., Su M., Xie Y. *et al.*, Occurrence and Characterization of Salmonella Isolated from Large-Scale Breeder Farms in Shandong Province, China, BioMed Research International, 2019 (2019): 8159567. DOI: 10.1155/2019/8159567.

[33] WHO, Risk assessments of Salmonella in eggs and broiler chickens. Vol. 1; 2002: World Health Organization.

[34] Penha Filho R. A. C., Ferreira J. C., Kanashiro A. M. I., Darini A. L. d. C., Berchieri A. Junior, Antimicrobial susceptibility of Salmonella Gallinarum and Salmonella Pullorum isolated from ill poultry in Brazil, Ciência Rural, 46 (3) (2016): 513-518. https://dx.doi.org/10.1590/0103-8478cr20150398

[35] Barrow P., Salmonella control-Past, Present and Future, Avian Pathology, 22 (4) (1993): 651-669. https://doi.org/10.1080/03079459308418954

[36] Sellaoui S., Alloui N., Mehenaoui S., Djaaba S., Evaluation of size and lesion scores of bursa cloacae in broiler flocks in Algeria, J. World's Poult. Res, 2 (2012): 37-39. Available online: http://jwpr.science-line.com/attachments/article/13/JWPR,%20B8,%2037-39,%202012,.pdf. Accessed on 28/07/2020

[37] Mahgoub H. A., An overview of infectious bursal disease, Archives of virology, 157 (11) (2012): 2047-2057. DOI: 10.1007/s00705-012-1377-9.

[38] Müller H., Islam M. R., Raue R., Research on infectious bursal disease—the past, the present and the future, Veterinary microbiology, 97 (1-2) (2003): 153-165. https://doi.org/10.1016/j.vetmic.2003.08.005

[39] Rhoades K., Rimler R., Pasteurella multocida colonization and invasion in experimentally exposed turkey poults, Avian diseases, 34 (2) (1990): 381-383. https://doi.org/10.2307/1591423

[40] Boyce J. D., Harper M., Wilkie I., Adler B., (2010). Pasteurella. In Pathogenesis of bacterial infections in animals; John Wiley & Sons. p. 325-346. https://doi.org/10.1002/9780470958209.ch17

[41] Jalob Z. K., Farhan W. H., Ibrahiem Z. Y., Bacteriological and Pathological Study of Omphalitis in Broiler Chicks, Kufa Journal For Veterinary Medical Sciences, 6 (2) (2015): 17-26. Available online: https://www.iasj.net/iasj/article/126818. Accessed on 01/11/2020

[42] Khan K. A., Khan S. A., Aslam A., Rabbani M., Tipu M. Y., Factors contributing to yolk retention in poultry: a review, 2004. Available online: https://hal.archives-ouvertes.fr/hal-00179202/document

[43] Cortés C. R., Isaías G. T., Cuello C. L., Flores J. M. V., Anderson R. C. *et al.* Bacterial isolation rate from fertile eggs, hatching eggs, and neonatal broilers with yolk sac infection, Revista latinoamericana de microbiologia, 46 (1-2) (2004): 12-16. Available online: https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=1158

[44] Ulmer Franco A. M., "Yolk sac infections in broiler chicks: studies on Escherichia coli, chick acquired immunity, and barn microbiology". 2011. Ph.D thesis, Animal science, Alberta University, Canada. https://doi.org/10.7939/R3WH37

[45] Ler Catherine S., Rosine D. D. D., *Escherichia colt*, une bacterie ubiquiste et versatile. Neuviemes Journees de la Recherche Avicole, Tours, France, 29 et 30 mars 201. [Ninth Aviculture Research Days, Tours, France, March 29 and 30, 2011]. [Text version]

[46] Roussan D., Haddad R., Khawaldeh G., Molecular survey of avian respiratory pathogens in commercial broiler chicken flocks with respiratory diseases in Jordan, Poultry science, 87 (3) (2008): 444-448. DOI: 10.3382/ps.2007-00415.

[47] Nighot P., Kolte G., Ghalsasi G., Physiopathology of avian respiratory diseases-Respiratory diseases are often complex and multi-factorial but understanding the important factors can help in disease control, Poultry International, 41 (9) (2002): 24-29.

[48] Nassik S., Rahmatallah R., Fassi Fehri O., EL houadfi M., Séroprévalence de Mycoplasma gallisepticum et de Mycoplasma synoviae dans les élevages reproducteurs type poulet de chair au Maroc de 1983 au 2005, Revue Marocaine des Sciences Agronomiques et Vétérinaires, 1 (3) (2013): 32-34. Available online: https://www.agrimaroc.org/index.php/Actes_IAVH2/article/view/307

[49] Maho A., Mbeurnodji L., Ndobale B., Dominantes pathologiques aviaires à N'Djaména: étude de quinze fermes, Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 50 (4) (1997): 277-280.

https://doi.org/10.19182/remvt.9556
[50] Hafez H. M., Diagnosis of Ornithobacterium rhinotracheale, Int. J. Poult. Sci, 1 (5) (2002): 114-118. https://dx.doi.org/10.3923/ijps.2002.114.118
[51] El-Sukhon S. N., Musa A., Al-Attar M., Studies on the bacterial etiology of airsacculitis of broilers in northern and middle Jordan with special reference to *Escherichia coli*, *Ornithobacterium rhinotracheale* and *Bordetella avium*, Avian diseases, 46 (3) (2002): 605-612. DOI: 10.1637/0005-2086 (2002)046[0605:SOTBEO]2.0.CO;2.
[52] Vandamme P., Segers P., Vancanneyt M., Van Hove K., Mutters R. *et al.*, *Ornithobacterium rhinotracheale* gen. nov., sp. nov., isolated from the avian respiratory tract, International Journal of Systematic and Evolutionary Microbiology, 44 (1) (1994): 24-37. DOI: 10.1099/00207713-44-1-24.
[53] Ahad A., Rabbani M., Mahmood A., Kuthu Z. H., Muhammad A. A. *et al.*, Zoonosis Update on H9N2 Avian Influenza Virus, Pakistan Veterinary Journal, 33 (3) (2013): 272-276. Available on: http://www.pvj.com.pk/archive/Volume_33_Issue_3_2013.htm
[54] Van Veen L., Van Empel P., Fabri T., *Ornithobacterium rhinotracheale*, a primary pathogen in broilers, Avian Diseases, 44 (4) (2000): 896-900. https://doi.org/10.2307/1593063
[55] Beeckman D. S. A., Vanrompay D. C., Biology and intracellular pathogenesis of high or low virulent Chlamydophila psittaci strains in chicken macrophages, Veterinary microbiology, 141 (3-4) (2010): 342-353. DOI: 10.1016/j.vetmic.2009.09.032.
[56] Iqbal M., Shah I., Ali A., Khan M., Jan S., Prevalence and in vitro antibiogram of bacteria associated with omphalitis in chicks, Pakistan Veterinary Journal, 26 (2) (2006): 94-96. Available online: http://pvj.com.pk/pdf-files/26_2/94-96.pdf. Accessed on 25/11/2020
[57] Melese K., Esatu W., Abayneh T., Isolation and characterization of bacteria associated with yolk sac infection (Omphalitis) in chicken from three hatcheries in Bishoftu, Ethiopia, African Journal of Microbiology Research, 11 (43) (2017): 1551-1557. https://doi.org/10.5897/AJMR2017.8363
[58] Glisson J. R.,, Bacterial respiratory disease of poultry, Poultry science, 77 (8) (1998): 1139-1142. DOI: 10.1093/ps/77.8.1139.
[59] Umar S., " Avian influenza and co-infections: investigation of the interactions in the poultry models ", Doctorat dessimination, 2017, Toulous universitym France. Available online: https://oatao.univ-toulouse.fr/19547/1/Umar_Sajid.pdf. Accessed on 11/12/2020
[60] Villegas P., Viral diseases of the respiratory system, Poultry science, 77 (8) (1998): 1143-1145. DOI: 10.1093/ps/77.8.1143.
[61] Oldoni I., García M., Characterization of infectious laryngotracheitis virus isolates from the US by polymerase chain reaction and restriction fragment length polymorphism of multiple genome regions, Avian Pathology, 36 (2) (2007): 167-176. DOI: 10.1080/03079450701216654.
[62] H. Bourogâa H., Miled K., Larbi I., Nsiri J., Gribâa L. *et al.*, La bronchite infectieuse aviaire en tunisie: seroprevalence, pathogenicite et etude de compatibilite vaccin-isolats, Archives de l'Institut Pasteur de Tunis, 86 (1-4) (2009): 75-83. [Text version]
[63] Ducatez M. F., Martin A. M., Owoade A. A., Olatoye I. O., Alkali B. R. *et al.*, Characterization of a new genotype and serotype of infectious bronchitis virus in Western Africa, Journal of General Virology, 90 (11) (2009): 2679-2685. DOI: 10.1099/vir.0.012476-0.
[64] Shankar B., Common respiratory diseases of poultry, Veterinary World, 1 (7) (2008): 217-219. Available online: http://www.veterinaryworld.org/2008/No.7.html
[65] Ouedraogo S., Zoundi S., Approvisionnement de la ville de Ouagadougou en poulets de chair. p67. In Agriculture urbaine en Afrique de l'Ouest: une contribution à la sécurité alimentaire et à l'assainissement des villes = Urban agriculture in West Africa: contributing to food security and urban sanitation. 1999. Ed. CRDI, Otawa, Ontario, Canada/ACP-UE, Wageningen, Netherlands, e-ISBN 1552502619. [HTML version]. https://www.idrc.ca/sites/default/files/openebooks/261-9/index.html
[66] Diaw M. T., Dieng A., Mergeai G., Sy M., Hornick J.-L., Effets de la substitution du tourteau d'arachide par la fève de coton conventionnel en production de poulet de chair au Sénégal, Tropicultura, 28 (3) (2010): 139-147. Available online: https://orbi.uliege.be/bitstream/2268/80637/1/28-3-139.pdf
[67] Chaiba A., Filali F. R.,. Prévalence de la contamination par Salmonella des élevages de poulet de chair au Maroc, Cahiers Agricultures, 25 (3) (2016): 35007. https://doi.org/10.1051/cagri/2016017
[68] Arhin R. E., Hackman H. K., Sa-eed A., Antibiotic prophylaxis and cloacal carriage of resistant zoonotic bacteria in commercially-bred poultry, European Journal of Animal Health, 1 (1) (2019): 1-13. https://doi.org/10.47672/ejah.424
[69] Bac N., Biagianti S., Bruslé J., Etude cytologique ultrastructurale des anomalies hepatiques du loup, de la daurade, et de l'anguille, induites par une alimentation artificielle. In Bases biologiques de l'aquaculture, Montpellier, 12-16 decembre 1983. Ifremer Proceedings, (1983): 473-484. Available online: https://archimer.ifremer.fr/recordview
[70] Dutertre C., Le label rouge en production porcine: état des lieux et perspectives, Techni-porc, 24 (3) (2001): 13-18. Available online: https://www.ifip.asso.fr/sites/default/files/pdf-documentations/tp2001n3dutertre.pdf. Accessed on 12/11/2020
[71] Al-Natour M. Q., Alshawabkeh K. M., Using varying levels of formic acid to limit growth of Salmonella gallinarum in contaminated broiler feed, Asian-australasian journal of animal sciences, 18 (3) (2005): 390-395. https://doi.org/10.5713/ajas.2005.390
[72] Carré B., De Monredon F., Melcion J.-P., Gomez J., Qualité de la litière en aviculture. Aliments et caractéristiques physiques des excretas, INRA Productions animales, 8 (5) (1995): 331-334. Available online: https://doi.org/10.20870/productions-animales.1995.8.5.4146
[73] Dayon J. F., Arbelot B., Guide d'élevage des volailles au Sénégal, Dakar: DIREL, 1997. Available online: . Accessed on 26/08/2020
[74] Awad W. A., Hess C., Hess M. M., Enteric pathogens and their toxin-induced disruption of the intestinal barrier through alteration of tight junctions in chickens, Toxins, 9 (2) (2017): 60. https://dx.doi.org/10.3390/toxins9020060
[75] Song J., Xiao K., Ke Y., Jiao L., Hu C. *et al.*, Effect of a probiotic mixture on intestinal microflora, morphology, and barrier integrity of broilers subjected to heat stress, Poultry science, 93 (3) (2014): 581-588. DOI: 10.3382/ps.2013-03455.

[76] Jacquet M., (2007). Guide pour l'installation en production avicole. 2 eme partie. La production de poulets de qualité différenciée: mise en place et résultats. Gembloux (Belgique):[en-ligne] accès internet: FACW, Accès internet: www.facw.be/dossierstechniques/guide-l-installation-2-me-partie.pdf. Accessed on 14/10/2020

[77] Cardinale E., Dieng C., Pene G., Wade I., Diallo A., Tall F., Kane P., Konte M., Les pratiques hygiéniques des aviculteurs sénégalais, Impact sur la productivité, 4ème Journées de la Recherche Avicole, Nantes, France, (2001): 333-336.

[78] Abba H., Somda M. K., Antipas B.-b. B., Barro N., Traore A. S., Prévalence et susceptibilité aux antibiotiques des souches de Salmonella spp. non typhiques isolées de la viande de poulets au Tchad, International Journal of Biological and Chemical Sciences, 11 (1) (2017): 107-117. https://doi.org/10.4314/ijbcs.v11i1.9

[79] Barea R., Fantinati P., Piva A., Effects of a microencapsulated feed additive on growth performance and sanitary status of broiler chickens [Conference poster], Actes des 11ème Journées de la Recherche Avicole et Palmipèdes à Foie Gras, Tours, France, les 25 et 26 mars 2015, (2015): 600-605.

[80] Baratou J., Vachel. J.-P. , X--Valeur alimentaire chez le poulet dans les conditions pratiques de l'élevage. In Annales de zootechnie. 1971. Available online: https://hal.archives-ouvertes.fr/hal-00887145 Acessed on 2/12/20

[81] Saleh K., Sarhan M. A., Clastogenic analysis of chicken farms using micronucleus test in peripheral blood, Journal of Applied Sciences Research, 3 (12) (2007): 1646-1649. Available online: http://www.aensiweb.com/old/jasr/jasr/2007/1646-1649.pdf. Accessed on 23/08/2020

[82] Chinivasagam H., Tran T., Blackall P., Impact of the Australian litter re-use practice on Salmonella in the broiler farming environment, Food Research International, 45 (2) (2012): 891-896. https://doi.org/10.1016/j.foodres.2011.06.014

[83] Kennard D., Chamberlin V., Growth and mortality of chickens as affected by the floor litter, Poultry Science, 30 (1) (1951): 47-54. https://doi.org/10.3382/ps.0300047

[84] Parvin R., Mushtaq M., Kim M., Choi H., Light emitting diode (LED) as a source of monochromatic light: a novel lighting approach for behaviour, physiology and welfare of poultry, World's Poultry Science Journal, 70 (3) (2014): 543-556. https://www.tandfonlinecom/doi/full/10.1017/S0043933914000592

[85] Thornton P. K., Van de Steeg J., Notenbaert A., Herrero M., The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know, Agricultural systems, 101 (3) (2009): 113-127. https://doi.org/10.1016/j.agsy.2009.05.002

[86] Mahmoudi N., Yakhlef H., Thewis A., Caractérisation technico-socio-professionnelle des exploitations avicoles en zone steppique (wilaya de M'sila, Algérie), Cahiers Agricultures, 24 (3) (2015): 161-169. https://doi.org/10.1684/agr.2015.0752

[87] Le Menec M., Les bâtiments d'élevage de volailles, L'aviculture française. Informations techniques des Services Vétérinaires du Ministère de l'Agriculture, Paris, France, (1988): 81-119.

[88] Frandson R., Wilke W., Fails A., Anatomy and physiology of the mammary glands, Anatomy and Physiology of Farm Animals, 7th Wiley-Blackwell, Iowa, USA, 20 ISBN : 978-0-8138-1394-3 09.

[89] Ballard B., Rockett J., Restraint & Handling for Veterinary Technicians & Assistants, Cengage Learning 2009. ISBN 1435453581, 9781435453586

[90] Bello A., Umaru M., Baraya Y., Adamu Y., Jibir M. *et al.*, Postmortem procedure and diagnostic avian pathology, Scientific Journal of Zoology, 229 (1305) (2012): 1-5. Available online: https://sjournals.com/index.php/sjz/article/view/1186

[91] Koleilat N., L'intérêt du marketing des services en clientèle vétérinaire: Etude des attentes clients et fiches techniques. 2010.

[92] Henry J., La communication dans la relation client: analyse des pratiques des vétérinaires équins à partir d'une enquête. 2014. Available online: https://oatao.univ-toulouse.fr/10924/

[93] Faroult B., Référentiel pour la définition de plans de traitement des infections mammaires en troupeau laitier, Bull. Acad. Vét. de France, 155 (2002): 135-138. available online: http://documents.irevues.inist.fr/handle/2042/61515

[94] Lhermie G., Raboisson D., Krebs S., Dupraz P., Facteurs déterminants et leviers de réduction de l'usage des antibiotiques en productions animales, Économie rurale, (4) (2015): 3-22. https://doi.org/10.4000/economierurale.4671

[95] Cardinale E., Arbelot B., Kaboret Y., Dayon J.-F., Biaou C. *et al.*, La maladie de Gumboro dans les élevages semi-industriels de la région de Dakar, Revue d'élevage et de médecine vétérinaire des pays tropicaux, 51 (4) (1998): 293-296. Avaialable online: https://agritrop.cirad.fr/475731/

[96] Corpet D. E., Mechanism of antimicrobial growth promoters used in animal feed, Revue de Médecine Vétérinaire, 151 (2) (2000): 99-104. Available online: https://www.revmedvet.com/artdes-us.php?id=918

[97] Rossigneux R., Balloy D., Traçabilité du médicament vétérinaire-registre d'élevage: particularités de la filière volailles, Bull. Acad. Vét. France; 156 (4) (2003): 13-16. Available online: http://documents.irevues.inist.fr/handle/2042/47666

[98] Guillemot D., Usages vétérinaires des antibiotiques, résistance bactérienne et conséquences pour la santé humaine. 2006; Raport. p. 214. Available online: https://www.vie-publique.fr/sites/default/files/rapport/pdf/074000079.pdf. Accessed on 02/07/2020

[99] Chatellet M.-C., "*Modalités d'utilisation des antibiotiques en élevage bovin: enquête en Anjou*". Thèse de doctorat, Faculté de médecine de Créteil, Créteil, France, 2007. Avaialble online : http://theses.vet-alfort.fr/telecharger.php?id=138

[100] Adzitey F., Antibiotic classes and antibiotic susceptibility of bacterial isolates from selected poultry; a mini review, World Vet. J., 5 (3) (2015): 36-41. dx.doi.org/10.5455/wvj.20150853

[101] Faure S., "*Transfert d'un gène de résistance aux beta-lactamines blaCTX-M-9 entre Salmonella et les entérobactéries de la flore intestinale humaine: influence d'un traitement antibiotique*". Ph.D Thesis [French], Rennes University, France, 2009. p191. Available online: https://tel.archives-ouvertes.fr/tel-00449376

[102] Mogenet L., Bezille P., Guyonnet J., Karembe H., Comparaison de la flumequine (flumisol) a l'amoxicilline (vetrimoxin poudre orale) dans deux modes d'administration par voie orale, en traitement de la colibacillose du poulet: approche pharmacodynamique et clinique, Revue de médecine vétérinaire, 148 (10) (1997): 793-804. Avaialble online: https://www.revmedvet.com/artdes-fr.php?id=208

[103] Boamah V. E., Agyare C., Odoi H., Dalsgaard A., Practices and factors influencing the use of antibiotics in selected poultry farms in Ghana, Journal of Antimicrobial Agents, 2 (2) (2016): 2-8. https://doi.org/10.4172/2472-1212.1000120

[104] Kim D. P., Saegerman C., Douny C., Dinh T. V., Xuan B. H. *et al.*, First survey on the use of antibiotics in pig and poultry production in the Red River Delta region of Vietnam, Food Public Health, 3 (5) (2013): 247-256. [HTML version]. http://article.sapub.org/10.5923.j.fph.20130305.03.html

[105] Maron D. F., Smith T. J., Nachman K. E., Restrictions on antimicrobial use in food animal production: an international regulatory and economic survey, Globalization and health, 9 (1) (2013): 48. https://doi.org/10.1186/1744-8603-9-48

[106] Mainda G., Bessell P. R., Muma J. B., McAteer S. P., Chase-Topping M. E. *et al.*, Prevalence and patterns of antimicrobial resistance among Escherichia coli isolated from Zambian dairy cattle across different production systems, Scientific reports, 5 (2015): 12439. p11. https://dx.doi.org/10.1038%2Fsrep12439

[107] Kisku J., Oraon J., Pandey A., Singh B. K., Chandraker K., Study of Adoption Level and Constraints Faced by Rural Women in Backyard Poultry Farming, Journal of AgriSearch, 6 (Special) (2019): 101-103. Available online: https://jsure.org.in/journal/index.php/jas/article/view/607/473

[108] Guillemot D., Maugendre P., Chauvin C., Sermet C., Consommation des antibiotiques en France, Numéro thématique : Résistance aux antibiotiques «Résistance à la résistance», Bulletin Epidémiologique Hebdomadaire (InVs), 32-33 (2004): 144-147. Available online: https://www.santepubliquefrance.fr

[109] Méheust D., Chevance A., Moulin G., Suivi des ventes de médicaments vétérinaires contenant des antibiotiques en France en 2015. Rapport annuel. Anses, 2016. p108. Avaialable online: https://www.anses.fr/fr/system/files/ANMV-Ra-Antibiotiques2016.pdf

[110] Chevance A., Moulin G., Suivi des ventes de médicaments vétérinaires contenant des antibiotiques en France en 2008. Volumes et estimation de la consommation d'antibiotiques chez les animaux. Edition scientifique, Rappor AFSA-ANVM, 2009. p81. Available online: https://hal-anses.archives-ouvertes.fr/anses-01081630/document

[111] Nguyen N.T., Nguyen H.M., Nguyen C.V., Nguyen T.V., Nguyen M.T. *et al.*, Use of colistin and other critical antimicrobials on pig and chicken farms in southern Vietnam and its association with resistance in commensal Escherichia coli bacteria, Applied and environmental microbiology, 82 (13) (2016): 3727-3735. https://doi.org/10.1128/AEM.00337-16

[112] Clement M., Olabisi M., David E., Issa M., Veterinary pharmaceuticals and antimicrobial resistance in developing countries. in Veterinary Medicine and Pharmaceuticals; 2019, IntechOpen. https://doi.org/10.5772/intechopen.84888

[113] Wegener H. C., Antibiotics in animal feed and their role in resistance development, Current opinion in microbiology, 6 (5) (2003): 439-445. https://doi.org/10.1016/j.mib.2003.09.009

[114] Sanders P., Bousquet-Mélou A., Chauvin C., Toutain P.-L., Utilisation des antibiotiques en élevage et enjeux de santé publique, INRA Productions Animales, 24 (2) (2011): 199-204. https://doi.org/10.20870/productions-animales.2011.24.2.3254

[115] Siemon C. E., Bahnson P. B., Gebreyes W. A., Comparative investigation of prevalence and antimicrobial resistance of Salmonella between pasture and conventionally reared poultry, Avian Diseases, 51 (1) (2007): 112-117. https://doi.org/10.1637/0005-2086(2007)051[0112:ciopaa]2.0.co;2

[116] Espinasse J., Antibiothérapie et antibioprévention chez les bovins, Rec.Méd.Vét, 159 (6) (1983): 549-559.

[117] Garraffo R., Lavrut T., Signification clinique des corrélations pharmacocinétique/pharmacodynamie des antibiotiques chez les patients de réanimation, Réanimation, 14 (4) (2005): 264-275. https://doi.org/10.1016/j.reaurg.2005.04.006

[118] Goossens H., European strategies to control antibiotic resistance and use, Annals of Clinical Microbiology, 2014; 17 (1) (2014): 1-8. http://dx.doi.org/10.5145/ACM.2014.17.1.1

[119] Navetat H., Rizet C., (2000). Diarrhées néonatales, quand faut-il recourir à l'antibiothérapie ? In Proceeding of the 'Journées Nationales GTV/INRA: antibiothérapie et antibiorésistance", Nantes, France, 26-28/05/1999. pp. 107-112.

[120] Anthony F., Acar J., Franklin A., Gupta R., Nicholls T. *et al.*, Antimicrobial resistance: responsible and prudent use of antimicrobial agents in veterinary medicine, Revue Scientifique et Technique-Office International des Epizooties, 20 (3) (2001): 829-837. https://doi.org/10.20506/rst.20.3.1318

[121] Gay E., Chazel M., Danielle M., Haenni M., Calavas D. *et al.*, Apport du Résapatha la problématique de l'antibiorésistance en santé animale: analyse des données recueillies en 2008 sur Escherichia coli dans les différentes filieres animales, Bulletin Epidémiologique AFSSA, 36 (2010): 6-9. Available online: https://hal-anses.archives-ouvertes.fr/hal-00486913. Accessed on 15/11/2020

[122] Wagner N., Ceroni D., Niederer A., Ritz N., Relly C., Prise en charge des infections ostéo-articulaires aigües de l'enfant, PAEDIATRICA, 28 (1) (2017): 7-11. Available online: https://archive-ouverte.unige.ch/unige:107702

[123] Bard A. M., Main D. C., Haase A. M., Whay H. R., Roe E. J. *et al.*, The future of veterinary communication: Partnership or persuasion? A qualitative investigation of veterinary communication in the pursuit of client behaviour change, PLoS One, 12 (3) (2017): e0171380. DOI: 10.1371/journal.pone.0171380.

[124] Shaw J. R., Bonnett B. N., Adams C. L., Roter D. L., Veterinarian-client-patient communication patterns used during clinical appointments in companion animal practice, Journal of the American Veterinary Medical Association, 228 (5) (2006): 714-721.

[125] Jansen J., Steuten C., Renes R., Aarts N., Lam. T., Debunking the myth of the hard-to-reach farmer: effective communication on udder health, Journal of Dairy Science, 93 (3) (2010): 1296-1306. DOI: 10.3168/jds.2009-2794.

[126] LeBlanc S., Lissemore K., Kelton D., Duffield T., Leslie K., Major advances in disease prevention in dairy cattle, Journal of dairy science, 89 (4) (2006): 1267-1279. DOI: 10.3168/jds.S0022-0302 (06)72195-6.

[127] Valleteau de Moulliac J., Jouini O., Albonico V., Chevallier B., Observance médicamenteuse chez l'enfant: enquête par questionnaire auprès de 100 familles venues consulter aux urgences hospitalières, Medecine & enfance, 22 (8) (2002): 465-468. [HTML version]. https://www.lesjta.com/article_ar_id_456.html. Accessed on 11/12/2020

[128] Friendship R., Noncompliance: A problem for swine practitioners, The Compendium on continuing education for the practicing veterinarian (USA), 1989.

[129] DuPont H. L., Steele J. H., Use of antimicrobial agents in animal feeds: implications for human health, Reviews of infectious diseases, 9 (3) (1987): 447-460. https://doi.org/10.1093/clinids/9.3.447

[130] Wise R., Hart T., Cars O., Streulens M., Helmuth R. *et al.*, Antimicrobial resistance. Is a major threat to public health, BMJ: British Medical Journal, 317 (7159) (1998): 609. https://doi.org/10.1136/bmj.317.7159.609

[131] Teuber M., Veterinary use and antibiotic resistance, Current Opinion in Microbiology, 4 (5) (2001): 493-499. doi: 10.1016/s1369-5274 (00)00241-1

[132] Phillips I., Casewell M., Cox T., De Groot B., Friis C. *et al.*, Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data, Journal of Antimicrobial Chemotherapy, 53 (1) (2004): 28-52. https://doi.org/10.1093/jac/dkg483

[133] Capitano B., Nightingale C., Optimizing antimicrobial therapy through use of pharmacokinetic/pharmacodynamic principles, Mediguide to Infectious Diseases, 21 (2001): 1-8.

[134] Falagas M. E., Vouloumanou E. K., Samonis G., Vardakas K. Z., Fosfomycin, Clinical microbiology reviews, 29 (2) (2016): 321-347. DOI: 10.1128/CMR.00068-15.

[135] Stordeur P., Mainil J., La colibacillose aviaire, Annales de Médecine Vétérinaire, 146 (2002): 11-18. Available online: http://www.facmv.ulg.ac.be/amv/resume.php?type=fr&id=34

[136] Saif Y. M., Fadly A. M., Glisson J. R., McDougald L. R., Nolan L. K. *et al.*, Diseases of Poultry.; 2008. p. 43, Iowa State University Press. ISBN10: 0813807182 / ISBN13: 9780813807188