CHAPTER N0.

19

Common Bacterial Diseases of Poultry: Diagnosis, Treatment and Control

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Summary: Bacterial infections pose a significant impact on the global meat production industry in the form of economic issues, due to improper development leading to a high rate of mortality. Major contribution of bacterial diseases in poultry diseases comes from Salmonella spp., Escherichia coli, Pasteurella multocida, Mycoplasma gallisepticum and Avibacterium paragallinarum (infectious coryza). Apart from bacterial infections other managemental issues also contribute towards poor growth of meat industry. Major management issues are poor biosecurity, improper feeding and watering standards, overcrowding, and inadequate sanitation are frequently associated with these illnesses. Diagnosis of bacterial infections needs proper history and clinical examination that consists of observation, post-mortem investigation, bacterial culture, and sophisticated molecular techniques like PCR and ELISA. After a confirmatory diagnosis proper treatment plan is required that consists of the proper selection of Antibiotics as well as completion of antibiotics course is necessary. For proper antibiotic selection antibiotic sensitivity disc method is utilized and it also describes the resistance against any antibiotic present. Proper diagnosis and then treatment lead to improvement in the growth of meat/poultry industry. As far as disease prevention is concerned, it requires proper implementation of preventive measures, such as enhanced management, vaccination and strict biosecurity. For improvement in the meat industry molecular diagnostic kits provision, vaccinations and proper selection of antibiotics are recommended for proper growth of the poultry industry.
Keywords: Poultry diseases, Management, Disease Control, Diagnosis

INTRODUCTION

By 2050, there will be 10 billion people on the planet, which would result in a 70% increase in demand for food production. The World Health Organization (WHO) estimates that to meet the 525 million tons of meat required to feed the world's expanding population, yearly meat production would need to rise by an extra 200 million tons (Falcon et al., 2022). The objective of creating a wholesome, healthy, reasonably priced, and sustainable food supply will need agricultural scientists and food producers to work together to achieve this demand. Furthermore, the next generation's shifting economic circumstances and growing urbanization are probably going to need the use of safe, wholesome food products. Animal husbandry is constantly under pressure to provide high-quality protein in order to fulfil the world's food demand, but it confronts a number of obstacles, including environmental pollution, political instability, animal welfare, and industrial mechanization and automation (Jianping et al., 2010).

Because of science-based genetic selection and dietary sub-therapeutic supplementation of antibiotics and growth promoters, animal husbandry has improved the growth potential of animals in recent years, resulting in improved feed efficiencies and the ability of agricultural animals to grow (Berri & Collen, 2016). The use of antibiotics in the production of livestock is, however, regulated due to the rise in antibiotic resistance in both people and animals. Farmers in intensive farming systems are finding it more difficult to meet output objectives because of the implemented prohibition and consumer pressure on meat production without antibiotics (Parker et al., 2018).

Poultry health and productivity are always in danger from infectious illnesses, which can have serious negative effects on welfare and the economy. This is covered in several infectious disease-focused book chapters as well as many review papers (Humphrey, 2006; Leibler et al., 2009; Serbessa et al., 2023). Similarly, specialized literature and research papers recommend certain diagnostic methods for identifying infectious illnesses in chickens. The management of Pullorum illness was the first instance of a successful combination of pathogen detection, preliminary characterization, and screening program execution. According to a detailed analysis by the National Poultry Improvement Plan (NPIP) in the USA was made possible by the concerted efforts of several stakeholders and serves as an example of effective collaboration between science, government, and industry (Clements & Casani, 2016).

Some nations have effectively eradicated the disease, while others continue to rely on a vaccine, which was created in the middle of the previous century. In some countries, the avian leucosis virus was successfully eradicated from primary broiler breeder flocks by blocking vertical transmission, a major disease dissemination pathway (Witter & Fadly, 2001).

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This further emphasizes the tight collaboration of stakeholders. On a large scale, however, eradication is far less successful, and poultry health now faces both new and old illnesses that are frequently referred to as (re-emergent) (Phillips et al., 2009).

Economic losses from disease outbreaks are continuously rising as farms and flocks get larger, yet precise statistics are sometimes unavailable, particularly for endemic illnesses (Perry et al., 2013). Additionally, in some regions, the epidemiology of specific diseases and/or disease incidence are influenced by ethical considerations pertaining to management techniques, bird breeds (such as fast- vs slow-growing broilers), or husbandry (cage versus free-range) (Collett et al., 2020). Finally, given the significance of birds maintained under lax biosecurity for the transmission of pathogens, diagnostic tests should be carried out to explain illness etiology, even if backyard poultry is sometimes not regulated by the same laws that apply to commercial poultry (Ayala et al., 2020).

One of the most prevalent and significant health issues impacting chicken flocks globally is bacterial illness. To minimize production losses, enhance flock health, and lower the danger of zoonotic transmission, prompt and precise diagnosis and appropriate treatment are essential (Saraiva et al., 2022).

LABORATORY DIAGNOSTIC TECHNIQUES

Bacteriological Culture and Identification

Bacteriological studies have been significantly impacted in recent years by the expansion of diagnostic instruments in clinical microbiology labs. Generally speaking, there is a tendency to use proteomics and molecular approaches to supplement or replace traditional bacteriology (Váradi et al., 2017). The purpose of the next chapter is to emphasize the importance of traditional bacteriology while simultaneously highlighting the role that novel methods have played in expanding our understanding of pertinent bacteria in poultry medicine. Frequently, post-mortem results and clinical pictures cannot be linked to a particular bacterium or fungus. Isolating the pathogen is thus one of the primary objectives of bacteriological and fungal testing in diagnostics. Some surveillance schemes, like the Salmonella surveillance program, which is based on the isolation of live bacteria, need bacterial culture in addition to illness diagnosis.

Material can be extracted directly from the surroundings or afflicted organs for culture. Either the material is initially placed into broth cultures and then streaked out on solid medium, or the streak plate approach is used, which involves several dilutions to get single colonies. To allow or encourage the development of certain bacteria or fungi, the culture medium often employed in diagnostic labs must be supplemented with a variety of nutrients and components. Blood agar with varying quantities of sheep or horse blood is used to identify picky bacteria and is also useful for evaluating hemolytic activity. A well-known medium for isolating Gram-negative Enterobacterales is MacConkey agar mixed with bile salts and crystal violet, which inhibits the development of most Gram-positive bacteria.

Serological Tests

One way to track vaccine effectiveness is using serological methods that identify certain antibodies, such as ELISA (Vidic et al., 2017). ELISA can process many samples and is reasonably priced. Although the formation of the protective cell-mediated response is expected to coincide with the creation of antibodies, antibodies are not believed to play a part in the development of protective immunity. Therefore, the presence of antibodies following vaccination indicates that the birds have contracted the infection and are probably immune. Agglutination methods provide quicker and more accurate field diagnosis because they primarily detect IgM antibodies that appear in the early stages of illness. Rapid serum agglutination and slide agglutination are two of these assays (Niloofa et al., 2015). They are useful even if they are slightly less sensitive than ELISA, especially when laboratory resources are scarce. Hemagglutination inhibition assays, commonly employed for viruses, may also aid in the study of bacterial infections by detecting antibodies that impede antigen-mediated red blood cell clumping.

Molecular Techniques

Modern day diagnostics technologies rely on molecular techniques to diagnose complicated diseases and these techniques help in the detection of foreign agent DNA that helps in accurate diagnosis (Vidic et al., 2017). Following molecular techniques used nowadays to detect diseases.

Restriction fragment length polymorphism: In essence, restriction enzymes are used to extract and cut the genome of an isolated microbe into pieces of a certain nucleotide sequence. Following electrophoresis in agarose gel, the resultant DNA fragments are visualized using ethidium bromide. Nucleic acid fingerprinting, also known as restriction fragment length polymorphism (RFLP) analysis, has been used to characterize a number of bacterial and viral diseases. Epidemiological research may employ RFLP analysis. In this instance, it might be used to identify variations or parallels between isolates of the same serotype. This will allow for the epidemiological tracking of isolates within a nation or across nations, as well as the documentation of a specific isolate's participation in a disease epidemic.

DNA probes: DNA is heated or chemically processed until the two strands split to create a probe. A DNA strand with complementary nucleotide bases will be recognized and bound by each single strand. A DNA probe will 'search' the sample for a pathogen's complementary nucleotide sequence. Radioactive 32P is typically used to mark the DNA probe's single strand to ascertain whether binding (hybridization) has taken place. After being extracted from the sample, denatured DNA is bound to a solid support system such as nitrocellulose or nylon membranes. The target DNA of the clinical sample and the probe's DNA sequence will hybridize if they are complementary.

Polymerase chain reaction: Many different target nucleic acid amplification techniques have been created since the polymerase chain reaction was first described in 1985. Enzymatic activity is necessary for nucleic acid replication in vivo. On the other hand, in vitro replication is quite easy and frequently involves just one enzyme or enzymatic activity. After full realization of PCR's promise, it was concurrent with the commercialization of two essential PCR components: 1) The ability of DNA polymerase to withstand high temperatures without diminishing its activity and 2) production of the oligonucleotides needed for the reaction's primers. The method made it possible to analyze nucleic acids (DNA or RNA) from any kind of source. Even in cases when only a tiny percentage of host cells are infected, PCR is an extremely sensitive method for identifying infectious agents in host tissues and vectors. However, it doesn't distinguish between organisms that are viable and those that aren't.

Antimicrobial Sensitivity Testing

In addition to being used to treat illnesses, antibiotics are further added to feeds in greater quantities to boost feed conversion, accelerate growth, and prevent sickness. Because antibiotics alter birds' immunity, they can be used to safeguard their health (Kuper et al., 2009). Antimicrobial resistance, or AMR, is becoming a major worldwide problem for the health of people, animals, and the environment. This is because multidrug-resistant (MDR) bacteria, sometimes known as "superbugs," have emerged, proliferated, and remained persistent. The overuse of antibiotics in humans and animals (food, pets, and aquatic), over-the-counter antibiotics, increased international travel, inadequate sanitation and hygiene, and the release of non-metabolized antibiotics or their residues into the environment through manure or feces are all conceivable causes of antimicrobial resistance (AMR).

Currently, there are several variables contributing to the complex etiology of antibiotic resistance (Agunos et al., 2012). These include poor regulations and imprecise usage, a lack of knowledge about best practices that leads to excessive or ineffective use of antibiotics, the use of antibiotics to promote the growth of poultry and livestock instead of controlling infections, and internet marketing that has made low-grade antibiotics widely available. Additionally, routine testing helps track trends in resistance, which leads to modifications in treatment regimens and antibiotic stewardship. All things considered, the foundation for precise diagnosis and efficient treatment of bacterial illnesses in poultry is the combination of molecular and serological diagnostics with antimicrobial sensitivity.

TREATMENT OF BACTERIAL DISEASES

The goals of treating bacterial infections in poultry are to boost the immune system of afflicted birds, prevent the spread of infection, and eradicate or lessen the bacterial burden. Whenever feasible, sensitivity testing and laboratory confirmation should serve as the foundation for treatment.

The cornerstone of controlling bacterial diseases in poultry is still antibiotic treatment (Wernicki et al., 2017). Tetracyclines, fluoroquinolones, aminoglycosides, macrolides, and sulfonamides are examples of frequently used antibiotics. The results of laboratory sensitivity testing should be used to inform antibiotic selection. To reach therapeutic levels and prevent the emergence of resistance, it is critical to adhere to the proper dose, administration method, and treatment duration. Alongside antibiotics, supportive care helps improve recovery rates. This includes providing electrolytes and vitamins to combat dehydration and stress. Improving ventilation and temperature to reduce respiratory distress is also part of supportive therapy. Reducing stocking density and ensuring access to clean feed and water (Abreu et al., 2023).

Birds showing advanced disease signs or poor response to treatment should be culled to prevent the spread of infection to healthy flock members. This is particularly important for fast-spread infections like fowl cholera (Sparrey et al., 2014). Treatment should always be accompanied by strict biosecurity measures, including limiting visitor access, disinfecting equipment and houses, and controlling vectors such as rodents and wild birds. Dead birds must be disposed of properly to prevent contamination of the environment.

COMMON BACTERIAL DISEASES OF POULTRY

Bacterial diseases in poultry can be classified according to the organ systems or body regions they primarily affect. A detailed description of bacterial disease based on the systems involved are given in Table 1 (Mak et al., 2022). This system-based classification helps in diagnosis, treatment, and management strategies by focusing on clinical signs and pathological lesions related to specific body systems.

Table 1. Bacterial diseases classification based on the systems involved

System	Bacterial Disease	Description
Respiratory	Mycoplasmosis	Chronic respiratory infection causing airsacculitis, sinusitis, and coughing.
	Fowl Cholera	Acute or chronic infection causing nasal discharge, swollen wattles, death.
	Infectious Coryza	Facial swelling, nasal discharge, and conjunctivitis in affected birds.
	Bordetellosis	Respiratory distress in turkeys with sneezing and coughing.
Digestive	Salmonellosis	Diarrhea, lethargy, and mortality; includes pullorum disease and fowl typhoid.
	Colibacillosis	Enteritis or systemic infection caused by E. coli, often secondary infection.
	Necrotic Enteritis	Intestinal necrosis is caused mainly by Clostridium perfringens.
Systemic /Septicemia	Colibacillosis (Septicemic)	Generally, infected airsacculitis, pericarditis, and septicemia.
	Fowl Cholera (Systemic)	Septicemia with swollen joints and edema.
	Pullorum Disease	White diarrhea, nodules in organs, especially in young chicks.
Musculoskeletal	Mycoplasma synoviae	Infectious synovitis causes swollen joints and lameness.
	Bacterial Arthritis	Joint inflammation is often secondary to systemic infection.
Skin and Soft Tissue	Cellulitis	Localized skin infection, swelling, often post-injury or trauma.

Colibacillosis (*Escherichia coli* infection)

One of the most important and financially devastating bacterial illnesses affecting poultry is colibacillosis, which is brought on by avian pathogenic *Escherichia coli* (APEC) (Rahman et al., 2004; Panth, 2019; Kika et al., 2023). Birds at every stage of production are susceptible to this pathogen, which can cause serious health and productivity problems and vary from localized to systemic sickness. The main cause of colibacillosis is APEC strains of E. coli, which enter and multiply in the body of the bird after immunosuppression, inadequate care, or coexisting illnesses. The illness frequently follows respiratory insults that harm the respiratory mucosa and permit bacterial invasion, such as Newcastle disease, infectious bronchitis, inadequate ventilation, and elevated ammonia/dust levels. Acute septicemia, airsacculitis, pericarditis, peritonitis, salpingitis, cellulitis, omphalitis (in females), and enlarged head syndrome are typical signs of the condition. Depression, ruffled feathers, decreased feed intake, coughing, vocalization changes, and poor development or production are typical symptoms. Layers may get salpingitis and peritonitis, whereas young chicks may exhibit omphalitis. Necropsy reveals thicker membranes, hazy air sacs, and yellowish exudates around the liver, heart, and air sacs.

Mycoplasmosis (*Mycoplasma gallisepticum*)

In poultry like chickens and turkeys, a bacterium called *Mycoplasma gallisepticum* (MG), which lacks a cell wall, causes persistent respiratory illnesses (Shoaib, 2019). The pathogen causes inflammation, cell damage, and ciliostasis by adhering to respiratory epithelial cells. It transmits both vertically (from infected hens to offspring via eggs) and horizontally (from bird to bird through respiratory secretions). Stress, co-infections with other respiratory diseases, and inadequate flock management all exacerbate the condition. Reduced production performance results from MG infection, which also affects respiratory function.

Clinical symptoms of respiratory distress in infected birds include conjunctivitis, coughing, sneezing, nasal discharge, and difficulty breathing. Although death varies and is often low unless additional illnesses arise, morbidity is typically significant. More serious symptoms including sinusitis and enlarged infraorbital sinuses are seen in turkeys. Weight loss, decreased feed intake, decreased egg production, and poor development can all result from chronic illness. Common lesions include pericarditis, perihepatitis, catarrhal or fibrinous sinusitis, and airsacculitis, which is characterized by swollen, hazy air sacs that contain exudate. There is inflammation in the trachea, along with exudate and cilia loss. Fibrosis and adhesions inside the air sacs may be seen in chronic instances.

Fowl Cholera (*Pasteurella multocida*)

Both domestic and wild birds can contract fowl cholera, an infectious illness brought on by the *Pasteurella multocida* bacteria. Acute, subacute, and chronic versions are all possible (Christensen et al., 2008). The germs quickly spread throughout the body after entering through the respiratory system, skin wounds, or mucous membranes. Direct touch, tainted water, feed, or fomites can all spread the extremely deadly illness. Outbreaks are predisposed by stress, inadequate treatment, and coexisting infections. The bacteria induce septicemia that involves several organs due to vascular injury and inflammation.

Birds with acute chicken cholera may pass away unexpectedly and without warning symptoms. Listlessness, anorexia, ruffled feathers, mucoid secretion from the mouth and nose, elevated respiratory rate, cyanosis (bluish discoloration) of the wattles and comb, watery or greenish diarrhea, and high mortality are all symptoms of clinical instances. Pneumonia is prevalent in turkeys. Localized infections resulting in swollen and caseous wattles, joints, tendons, footpads, and sternal bursae are seen in chronic instances. Pharyngitis, lameness, and exudative conjunctivitis are noted. Infections that spread to the middle ear or meninges can cause neurological symptoms including torticollis.

The kind of illness determines the postmortem lesions. Vascular congestion, enlarged liver and spleen, petechial and ecchymosis hemorrhages, particularly on subepicardial and serosal surfaces, fibrinous pericarditis, perihepatitis, and increased body cavity fluids are all present in acute instances. Multiple necrotic foci in the liver and spleen are seen in subacute patients. Chronic chicken cholera is characterized by necrotic lung lesions, respiratory tract inflammation, cellulitis, myositis, and fibrinous or caseous exudates in the wattles, joints, and air sacs. Wattles may develop skin gangrene.

Salmonellosis (*Salmonella spp.*)

Salmonellosis, which is caused by non-typhoidal Salmonella enterica serotypes (serotypes other than *S. typhi and S. paratyphi),* is a major public health concern worldwide. It is usually characterized by a self-limiting gastroenteritis syndrome (which manifests as fever, diarrhea, and abdominal pain), with an incubation period of 4 to 72 hours and a rare mortality rate. The digestive tracts of animals that produce food are the primary reservoir of non-typhoidal Salmonella in developed nations, and this may easily contaminate a variety of foods. Therefore, food-borne salmonellosis is the most pertinent source with a high worldwide impact on human health, regardless of other sources (such as contact with animals or reptiles, the environment, or person-to-person). Non-typhoidal Salmonella is thought to be responsible for around 93.8 million infections and 155,000 fatalities annually globally (Tariq et al., 2022).

Moribund and dead birds in the incubator are clinical indicators of pullorum and chicken typhoid fever in chicks and poults. Huddling together, drooping wings, dehydration, labored breathing, diarrhea, ruffled feathers, weakness, sadness, anorexia, and adhesion of feces to the vent are some of the symptoms that birds may exhibit (Shivaprasad, 2000). In certain instances, non-specific clinical symptoms such as a decrease in feed consumption, a drooping look, ruffled feathers, and pale and shrunken combs may be seen in addition to the clinical signs of pullorum and chicken typhoid fever (Shivaprasad, 2000). Friable liver with bronze discoloration, white focal necrosis on the liver, congested, hemorrhagic, and discolored egg follicles with stalk formation, hemorrhagic to catarrhal enteritis, severely congested pneumonic lungs, and an enlarged and discolored spleen are the typical gross lesions seen in birds with salmonellosis.

Fowl Typhoid (*Salmonella gallinarum*)

Salmonella belongs to the Enterobacteriaceae family of facultative anaerobes and rod-shaped, Gram-negative bacteria. The two main species that make up the genus Salmonella are *Salmonella enterica and Salmonella bongori*. More than 2500 serovars of S. enterica have been identified globally to date, and many of these serovars may infect people and animals (Berhanu & Fulasa, 2020). Pale comb and wattles, ruffled feathers, diarrhea, depression, and decreased feed and water intake are all signs of infection in birds. Some may have swelling joints, respiratory discomfort, and reduced egg production. Within a few days after infection, mortality may be high. Carriers may shed the pathogen without exhibiting any symptoms because of persistent infections. Huddling beneath a heat source, anorexia, despair, and white feces pasted around their vents are the most typical clinical indications of pullorum sickness in birds. For birds that are two to three weeks old, the death rate is high, up to 100%. Unabsorbed yolk, white nodes all throughout the lungs, and localized liver and spleen necrosis are characteristic abnormalities.

Pullorum Disease (*Salmonella pullorum*)

Salmonella enterica subspecies enterica serovar Gallinarum biovar Pullorum (Salmonella pullorum) is the causative agent of Pullorum disease, an acute systemic sickness in chickens (Halder et al., 2021). Although it mostly affects newborn chicks, adult chickens and other domestic poultry may also be impacted. The bacteria spread horizontally among chicks through contaminated environments and direct contact, and vertically from infected parent birds to offspring through the egg. High death rates result from the widespread septicemia caused by Salmonella pullorum, which is adapted to birds and particularly affects birds under three weeks of age. Additionally, chronic carrier birds contribute to the persistence of infection in flocks.

Clinically, the disease presents with depression, weakness, inappetence, white pasty diarrhea (often called "bacillary white diarrhea"), vent pasting, closed eyes, loud chirping, gasping, and sometimes lameness in young chicks. Mortality can be very high in young birds, often reaching nearly 100%. In older birds, signs may be less pronounced, but decreased egg production, poor hatchability, and some mortality can occur. Postmortem lesions commonly include grey-white nodules on lungs, liver, gizzard wall, and heart, inflammation of the intestines or ceca, splenomegaly, and presence of cecal cores. Urate crystals may be found in ureters. Necrotic foci and widespread organ congestion consistent with septicemia are typical.

Infectious Coryza (*Avibacterium paragallinarum*)

The Gram-negative bacterium *Avibacterium paragallinarum* is the cause of the acute contagious respiratory illness known as infectious coryza in chickens (Deresse et al., 2022). This pathogen mostly colonizes the nasal passages and infraorbital sinuses when it infects the upper respiratory system. Direct touch and aerosolized respiratory secretions are the routes of transmission, which are frequently made worse by stress, inadequate ventilation, and crowding. The bacteria causes inflammation, the production of exudate, and blockage of the sinuses by upsetting the respiratory mucosa. Coinfections with other pathogens, such as Gallibacterium species, might exacerbate lesions and clinical results.

Affected birds show rapid onset of respiratory signs including sneezing, nasal discharge (often mucopurulent), swollen and edematous face and infraorbital sinuses, conjunctivitis, loss of appetite, depression, and reduced egg production (5-10% drop). In more severe or chronic cases, facial swelling can cause distortion and respiratory distress. Mortality is usually low but morbidity can be high, leading to economic losses in broiler and layer flocks. Gross lesions include swelling of periorbital tissues and infraorbital sinuses filled with mucopurulent or caseous exudate, obstruction of nasal turbinates, and rhinitis. Histopathology reveals diffuse necrotizing and granulomatous rhinitis and sinusitis, tracheal epithelial hyperplasia, loss of cilia, and glandular atrophy. Co-infections can cause more extensive respiratory and reproductive tract lesions, including salpingitis and peritonitis.

TRANSMISSION AND EPIDEMIOLOGY

The spread of infectious pathogens both inside and between flocks of poultry birds is referred to as transmission. There are two primary ways it might happen: vertical transmission and horizontal transmission (Elmberg et al., 2017). When diseases are transferred from the parent bird to its young, either through the egg or during hatching, this is known as vertical transmission. Certain bacterial and viral diseases, including Salmonella pullorum, *Mycoplasma gallisepticum,* and Avian leucosis virus, frequently spread along this pathway. The pathogen can be transferred by the egg yolk, albumen, or eggshell, producing infected chicks that serve as carriers of the illness throughout the flock (Agunos et al., 2012). Within the same generation, birds can spread horizontally. It can happen through direct or indirect touch and is the most used method in chicken production.

Pecking, respiratory secretions, or droppings are examples of physical contact between infected and healthy birds (Levison, 2016). Contaminated feed, water, litter, equipment, clothes, or vehicles can all spread the disease indirectly. In respiratory illnesses including avian influenza, Newcastle disease, and infectious bronchitis, where the virus spreads by droplets or dust particles, airborne or aerosol transmission is important. Since insects like flies, mosquitoes, and mites may spread infections mechanically or physiologically, vector-borne transmission also affects poultry. Furthermore, rats and wild birds serve as significant virus vectors and reservoirs between chicken farms.

RISK FACTORS AND SOURCES OF INFECTION

The risk of infection in chicken flocks is influenced by several factors. Disease transmission is largely caused by poor biosecurity procedures, such as insufficient washing and disinfection, unregulated farm access, and a lack of quarantine regulations for new birds (Wang et al., 2013). Conditions that encourage the spread of respiratory infections are created by overcrowding and inadequate ventilation. The environment and other flocks may get contaminated if dead birds and trash are improperly disposed of. Poultry's immune systems are weakened by concurrent illnesses, stress from handling or transportation, and nutritional inadequacies, making them more vulnerable to illness (Téllez-Isaías, 2023). Environmental elements that contribute to the survival and growth of infections include excessive humidity, temperature fluctuations, and inadequate litter management. Birds may potentially be defenseless against common disease pathogens due to inadequate immunization efforts or incorrect vaccine delivery.

There are two types of causes of infection in poultry: internal and external (Antao et al., 2008). Birds that are carriers or diseased and release infections through their eggs, respiratory secretions, or feces are examples of internal sources. Contaminated feed, water, trash, equipment, and people travelling between flocks without adequate cleanliness are examples of external sources. Important external sources that frequently introduce or disseminate infections throughout farms are wild birds, rodents, and insects. If correct testing and hygiene protocols are not followed, hatcheries can potentially act as a place of origin for vertically transmitted illnesses.

Understanding the distribution, causes, and dynamics of illnesses within chicken populations is the goal of epidemiology of poultry diseases. The interplay of the pathogen, host, and environment determines the development of disease in chicken (Gompo et al., 2019). The degree of biosecurity, management techniques, flock density, and weather all have a significant impact on how illnesses spread and last. When the number of afflicted birds within a flock or area suddenly rises, infectious illnesses in poultry sometimes manifest as outbreaks. Depending on the degree of migration between farms and the pathogen's ease of transmission, outbreaks can be localized or widespread. Large-scale outbreaks of highly infectious illnesses, including Newcastle disease and avian influenza, can result in significant economic losses because of their high mortality rates, decreased egg production, and trade restrictions (Nwanta et al., 2008). In farms with poor management, other illnesses like salmonellosis and chicken cholera can become endemic and return on a regular basis because of insufficient biosecurity and disinfection procedures.

Finding the source of infection, figuring out how the disease got into the flock, and evaluating the variables that contributed to its spread are all parts of epidemiological research into chicken outbreaks (Gupta et al., 2021). Infected birds, contaminated equipment, contaminated feed, or contaminated people are common entry points. Strict biosecurity enforcement, immunization, cleaning of impacted sites, and the isolation and culling of sick birds are the main control approaches. Patterns of poultry illness are also influenced by seasonal variations (Ssematimba et al., 2013). For instance, parasite infections rise during warmer months with more humidity, but viral respiratory disorders often peak during cold and humid weather. Global trade, live bird migration, and migratory wild birds all play a role in the transboundary spread of diseases like avian influenza. Strict biosecurity, vaccination campaigns, and ongoing surveillance are still essential for controlling the epidemiology of chicken illnesses and averting further outbreaks.

CONCLUSION

Bacterial infections are still reported to be a huge concern in the poultry business and cause significant economic losses due to reduced production, retarded growth and increased mortality. The major bacterial diseases which affect poultry are infectious coryza, colibacillosis, salmonellosis, chicken cholera and mycoplasmosis. Lack of biosecurity, hygiene, overcrowding underpowered feed or water and wrong vaccination method are often associated with these instructions. To succeed in controlling and managing bacterial poultry infections, an accurate and rapid diagnosis is a requirement. Diagnosis is made based on clinical findings, post-mortem examination features, bacteriological culture, biochemical testing and highly sensitive molecular techniques such as polymerase chain reaction (PCR). The prompt sample and laboratory confirmation are necessary to establish the etiology and give an appropriate antibiotic therapy. Diagnosis is made based on clinical findings, post-mortem examination features, bacteriological culture, biochemical testing and highly sensitive molecular techniques such as polymerase chain reaction (PCR). The prompt sample and laboratory confirmation are necessary to establish the etiology and give an appropriate antibiotic therapy. As well as supportive management such as improved nutrition, sanitation and environmental practice, treatment mainly involves appropriate antimicrobial drugs based on sensitivity testing. However, misuse or overuse of antibiotics can lead to antimicrobial resistance (AMR) which is a significant threat to public health and more specifically, poultry health. The implementation of antimicrobial stewardship programs in poultry production is essential to minimize resistance and ensure the responsible use of antibiotics. Promising approaches for long-term management include genetic selection for disease-resistant chicken breeds and research into creating efficient vaccinations against newly emerging bacterial diseases. Additionally, using digital health monitoring systems and precision farming can enhance flock health management by assisting in the early detection of disease outbreaks. To sum up, preventing bacterial illnesses in chickens necessitates a comprehensive strategy that incorporates biosecurity, prudent antibiotic usage, sound husbandry techniques, and cutting-edge diagnostic tools. The sustainability and productivity of the poultry business in the future will depend on ongoing research, farmer education, and cooperation between veterinarians, researchers, and legislators.

REFERENCES

Abreu R, T Semedo-Lemsaddek, E Cunha et al., 2023. Antimicrobial drug resistance in poultry production: Current status and innovative strategies for bacterial control. Microorganisms 11:953.

Agunos A, D Léger & C Carson, 2012. Review of antimicrobial therapy of selected bacterial diseases in broiler chickens in Canada. The Canadian Veterinary Journal 53:1289.

Antao E-M, S Glodde, G Li et al., 2008. The chicken as a natural model for extraintestinal infections caused by avian pathogenic Escherichia coli (APEC). Microbial Pathogenesis 45:361-9.

Ayala AJ, MJ Yabsley & SM Hernandez, 2020. A review of pathogen transmission at the backyard chicken–wild bird interface. Frontiers in Veterinary Science 7:539925.

Berhanu G & A Fulasa, 2020. Pullorum disease and fowl typhoid in poultry: a review. British Journal of Poultry Science 9:48-56.

Berri M & PN Collen, 2016. Green algal sulfated polysaccharides: a natural alternative to antibiotics via modulation of the intestinal immune response. In: 2. International Symposium on Alternatives to Antibiotics (ATA), Dec 2016, Paris, France, 2016.

Christensen JP, AM Bojesen & M Bisgaard, 2008. Fowl cholera. Poultry Diseases 6:149-54.

Clements BW & J Casani, 2016. Disasters and public health: planning and response. Butterworth-Heinemann.

Collett SR, JA Smith, M Boulianne et al., 2020. Principles of disease prevention, diagnosis, and control. In: Diseases of Poultry (Swayne DE, M Boulianne, CM Logue et al., Eds.): John Wiley & Sons, Hoboken, USA, pp: 1-78.

Saraiva MMS, K Lim, DFM do Monte et al., 2022. Antimicrobial resistance in the globalized food chain: A One Health perspective applied to the poultry industry. Brazilian Journal of Microbiology 53:465-86.

Deresse G, L Tesfaw, E Asefa et al., 2022. A review on infectious coryza disease in chicken. International Invention of Scientific Journal 6:17-25.

Elmberg J, C Berg, H Lerner et al., 2017. Potential disease transmission from wild geese and swans to livestock, poultry and humans: a review of the scientific literature from a One Health perspective. Infection Ecology and Epidemiology 7:1300450.

Falcon WP, RL Naylor & ND Shankar, 2022. Rethinking global food demand for 2050. Population and Development Review 48:921-57.

Gompo T, U Pokhrel, B Shah et al., 2019. Epidemiology of important poultry diseases in Nepal. Nepalese Veterinary Journal 36:8-14.

Gupta SD, G Fournié, MA Hoque et al., 2021. Factors influencing chicken farmers' decisions to implement prevention and control measures to reduce avian influenza virus spread under endemic conditions. Transboundary and Emerging Diseases 68:194-207.

Halder S, S Das, SK Nath et al., 2021. Prevalence of some common bacterial diseases in commercial poultry farm. Ukrainian Journal of Veterinary and Agricultural Sciences 4:44-51.

Humphrey T, 2006. Are happy chickens safer chickens? Poultry welfare and disease susceptibility. British Poultry Science 47:379-91.

Jianping W, V Squires & Y Lian, 2010. Improved animal husbandry practices as a basis for profitability. In: Towards Sustainable Use of Rangelands in North-West China (Squires V, L Hua, G Li et al., Eds). Springer, Singapore, pp: 207-32.

Kika TS, S Cocoli, DLPelić et al., 2023. Colibacillosis in modern poultry production. Journal of Agronomy, Technology and Engineering Management 6:975-87.

Kuper KM, DM Boles, JF Mohr et al., 2009. Antimicrobial susceptibility testing: a primer for clinicians. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy 29:1326-43.

Leibler JH, J Otte, D Roland-Holst et al., 2009. Industrial food animal production and global health risks: exploring the ecosystems and economics of avian influenza. EcoHealth 6:58-70.

Levison ME, 2016. Diseases transmitted by birds. Microbiology Spectrum 3:IOL5-0004-2015.

Mak PH, MA Rehman, EG Kiarie et al., 2022. Production systems and important antimicrobial resistant-pathogenic bacteria in poultry: a review. Journal of Animal Science and Biotechnology 13:148.

Niloofa R, N Fernando, NL de Silva et al., 2015. Diagnosis of leptospirosis: comparison between microscopic agglutination test, IgM-ELISA and IgM rapid immunochromatography test. PLoS One 10:e0129236.

Nwanta J, P Abdu & W Ezema, 2008. Epidemiology, challenges and prospects for control of Newcastle disease in village poultry in Nigeria. World's Poultry Science Journal 64:119-27.

Panth Y, 2019. Colibacillosis in poultry: A review. Journal of Agriculture and Natural Resources 2:301-11.

Parker C, F Haines & L Boehm, 2018. The promise of ecological regulation: the case of intensive meat. Jurimetrics 59:15.

Perry BD, D Grace & K Sones, 2013. Current drivers and future directions of global livestock disease dynamics. Proceedings of the National Academy of Sciences 110:20871-7.

Phillips CJ, AM Harrington, TL Yates et al., 2009. Global disease surveillance, emergent disease preparedness, and national security. Museum of Texas Tech University, Lubbock, TX, USA.

Rahman M, M Samad, M Rahman et al., 2004. Bacterio-pathological studies on salmonellosis, colibacillosis and pasteurellosis in natural and experimental infections in chickens. Bangladesh Journal of Veterinary Medicine 2:1-8.

Serbessa TA, YG Geleta & IO Terfa, 2023. Review on diseases and health management of poultry and swine. International Journal of Avian and Wildlife Biology 7:27-38.

Shoaib M, 2019. Mycoplasmosis in poultry, a perpetual problem. The Journal of Microbiology, Biotechnology and Food Sciences 8:1271.

Sparrey J, D Sandercock, N Sparks et al., 2014. Current and novel methods for killing poultry individually on-farm. World's Poultry Science Journal 70:737-58.

Ssematimba A, T Hagenaars, J De Wit et al., 2013. Avian influenza transmission risks: analysis of biosecurity measures and contact structure in Dutch poultry farming. Preventive Veterinary Medicine 109:106-15.

Tariq S, A Samad, M Hamza et al., 2022. Salmonella in poultry; an overview. International Journal of Multidisciplinary Sciences and Arts 1:80-4.

Téllez-Isaías G, 2023. Poultry Farming: New Perspectives and Applications. Intech Open, London, USA.

Váradi L, JL Luo, DE Hibbs et al., 2017. Methods for the detection and identification of pathogenic bacteria: past, present, and future. Chemical Society Reviews 46:4818-32.

Vidic J, M Manzano, C-M Chang et al., 2017. Advanced biosensors for detection of pathogens related to livestock and poultry. Veterinary Research 48:11.

Wang Y, Z Jiang, Z Jin et al., 2013. Risk factors for infectious diseases in backyard poultry farms in the Poyang Lake area, China. PLoS One 8:e67366.

Wernicki A, A Nowaczek & R Urban-Chmiel, 2017. Bacteriophage therapy to combat bacterial infections in poultry. Virology Journal 14:179.

Witter R & A Fadly, 2001. Reduction of horizontal transmission of avian leukosis virus subgroup J in broiler breeder chickens hatched and reared in small groups. Avian Pathology 30:641-54.