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Research Article

Outbreak Investigation and Antimicrobial Resistance in Broiler Colibacillosis: A Case Report

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ABSTRACT

On July 23, 2025, a sudden outbreak characterized by respiratory distress, diarrhoea, and increased mortality occurred in a four-week-old broiler flock at the University of Maiduguri Veterinary Teaching Hospital (UMVTH). The study aimed to determine the cause, antimicrobial resistance pattern, and effective control measures for the outbreak. Comprehensive diagnostic procedures were conducted, including clinical assessment, postmortem examination, bacteriological culture, serology, parasitology, and antimicrobial susceptibility testing. Blood, cloacal swabs, and tissue samples (liver, heart, spleen) were collected from affected and dead birds. Isolates were serotyped at the National Veterinary Research Institute (NVRI), Vom. Pure colonies of *Escherichia coli* exhibiting a metallic green sheen were isolated on Eosin Methylene Blue agar. Lesions consistent with colibacillosis, airsacculitis, fibrinous pericarditis ("bread and butter" appearance), hepatomegaly, splenomegaly, and pulmonary congestion were observed. Parasitological screening detected minimal coccidial oocysts and no helminths, while serology was negative for Infectious Bursal Disease and positive for protective Newcastle Disease titres, excluding major viral and parasitic co-infections. The isolates showed multidrug resistance to ampicillin, tetracycline, and sulfamethoxazole-trimethoprim but remained sensitive to ciprofloxacin. Serotyping confirmed avian pathogenic *E. coli* (APEC) serotypes O78, O2, and O1. Prompt diagnosis and targeted antimicrobial therapy effectively contained the outbreak. The findings highlight the significance of early laboratory investigation, strict biosecurity, and rational antimicrobial use to manage colibacillosis and limit the spread of resistant *E. coli* strains in poultry farms.

Keywords: Antimicrobial resistance; Biosecurity; Broiler chickens; Colibacillosis; *Escherichia coli;* Poultry health management

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INTRODUCTION

Avian colibacillosis, caused by avian pathogenic *Escherichia coli* (APEC), remains a major cause of morbidity, mortality, and economic losses in poultry worldwide (Kathayat *et al*., 2021; Joseph *et al*., 2023). The disease manifests in several clinical forms, including septicemia, airsacculitis, pericarditis, perihepatitis, and cellulitis (Mehat *et al*., 2021). Beyond its veterinary importance, colibacillosis threatens food security and public health through its zoonotic potential and contribution to antimicrobial resistance (AMR) (McIver *et al*., 2020; Sevilla-Navarro *et al*., 2022; Bhattarai *et al*., 2024).

In intensive broiler systems, outbreaks are often triggered by stressors such as overcrowding, poor ventilation, inadequate biosecurity, and immunosuppression from concurrent infections or poor vaccination (Vandekerchove *et al*., 2004; Joseph *et al*., 2023; Watts and Wigley, 2024). Although vaccines are available and increasingly recommended, many flocks particularly in resource-limited areas remain unvaccinated and vulnerable to severe outbreaks (Śmiałek *et al*., 2020; Biström *et al*., 2024).

Emerging APEC strains frequently harbor multiple virulence-associated genes (VAGs) responsible for adhesion, invasion, toxin production, iron acquisition, and protection against host defenses (Kathayat *et al*., 2021). Their pathogenicity is further intensified by the rise of multidrug-resistant (MDR) *E. coli* linked to the misuse of antimicrobials in poultry production (Abreu *et al*., 2023; Agusi *et al*., 2024). The dissemination of resistant strains and resistance genes from poultry to humans through food or the environment poses a critical One Health challenge (Sharma *et al*., 2024).

This case study documents a severe colibacillosis outbreak in a broiler flock, detailing the clinical and pathological findings, microbiological features of the causative strains, and their antimicrobial resistance profiles. It underscores the need for preventive vaccination, rational antimicrobial use, and strict biosecurity to mitigate disease impact.

Given the rising global concern over sustainable poultry production, food security, and AMR, this report contributes to understanding outbreak dynamics and highlights the need for integrated, One Health–based control strategies applicable to both commercial and backyard poultry operations.

Case Presentation and History

On July 23, 2025, the University of Maiduguri Veterinary Teaching Hospital (UMVTH) received a report from a small-scale poultry farmer concerning sudden morbidity and mortality in a broiler flock. The flock consisted of 500 mixed-sex broilers, six weeks old, raised for meat production. Birds had appeared healthy until three days before presentation, when they began showing respiratory distress, reduced feed intake, lethargy, and whitish chalky diarrhoea with vent soiling. Affected birds exhibited weakness and huddling behavior.

The flock had been vaccinated against Infectious Bursal Disease (IBD) and Newcastle Disease (ND) following UMVTH guidelines at weeks 2 and 3, with booster doses at weeks 4 and 5. They also received a prophylactic antimicrobial (Careceryl®; antibiotic-vitamin combination). Despite these preventive measures, illness spread rapidly, affecting about 150 birds (30% morbidity), with 50 deaths (10% mortality).

Considering the vaccination history and antimicrobial use, major viral diseases such as ND and IBD were deemed less likely. The rapid course and mortality pattern indicated an acute bacterial etiology, possibly exacerbated by high stocking density or suboptimal management. This outbreak emphasizes the susceptibility of market-age broilers to opportunistic bacterial infections even under standard preventive programs.

Flock Diagnostic Approach: Farm Assessment

An immediate on-site evaluation of the poultry farm was carried out following the disease outbreak to assess management practices, environmental conditions, and potential predisposing factors. The investigation revealed severe overcrowding, with stocking densities of about 15 birds per square meter far above recommended standards thereby increasing physiological stress and promoting rapid disease transmission.

Ventilation was markedly poor, as evidenced by strong ammonia odors indicating inadequate air exchange and accumulation of harmful gases. Such conditions compromise respiratory health and immune function, heightening infection susceptibility. Water provision was also grossly inadequate; small chick drinkers were used despite the birds' advanced age and flock size. This likely contributed to dehydration, stress, and reduced productivity. At this production stage, larger troughs are essential to ensure proper hydration and maintain homeostasis.

Hygiene and biosecurity practices were found to be substandard. The litter was thick, damp, and contaminated with faeces and feed residues, creating a favourable environment for pathogen proliferation. No structured cleaning, disinfection, or sanitation protocols were in place, allowing infectious agents to persist and spread unchecked.

Flock Clinical Examination and Observed Clinical Signs

A comprehensive physical examination was carried out on representative birds from the affected broiler flock to assess the clinical manifestations of the outbreak. Affected birds appeared markedly depressed with drooping wings, ruffled feathers, and partially closed eyes, indicating systemic illness. Respiratory distress was pronounced, with open-mouth breathing, panting, wheezing, and occasional coughing, suggestive of significant respiratory compromise. Abdominal distension and reluctance to move were observed in several birds, reflecting the severity of the condition.

Diarrhoea was a consistent finding, leading to soiled vent feathers, dehydration, and progressive weakness. Pallor of the combs and wattles indicated possible anaemia or poor peripheral perfusion. Overall flock activity and feed consumption were markedly reduced, with progressive weight loss and stunted growth performance.

Tentative Diagnosis

Based on the acute onset of signs, epidemiological trends, and farm conditions, the tentative diagnosis for this outbreak was colibacillosis (*Escherichia coli* infection) in broilers. The diagnosis was supported by the following findings:

Clinical presentation

Affected birds showed severe respiratory distress (open-mouth breathing, panting, wheezing), lethargy, drooping wings, diarrhoea with vent soiling, pale combs and wattles, and general weakness. These manifestations are characteristic of systemic and respiratory colibacillosis involving septicemia and respiratory compromise.

Epidemiological profile

Rapid morbidity (≈30%) and mortality (≈10%) in a six-week-old flock vaccinated against IBD and ND indicated an opportunistic bacterial infection rather than a viral one. The sudden course and overlapping signs further supported bacterial involvement.

Predisposing factors

Farm assessment revealed overcrowding, poor ventilation with ammonia accumulation, contaminated litter, inadequate water supply, and lack of biosecurity conditions known to favour pathogenic *E. coli* proliferation and predispose birds to colibacillosis.

Exclusion of other causes

Common viral diseases such as ND and IBD were considered less likely due to the vaccination history and the predominance of respiratory and systemic symptoms rather than typical viral lesions.

Taken together, the acute clinical course, flock-level mortality, and environmental and management deficiencies strongly suggest colibacillosis, warranting confirmatory laboratory diagnosis through bacteriological culture and antimicrobial susceptibility testing.

Laboratory Investigations

A comprehensive diagnostic approach was employed to confirm the etiology and characterize the outbreak in the affected broilers. Blood samples (2–3 mL) were aseptically collected via brachial venipuncture from symptomatic birds for bacterial isolation, identification, and serology. Cloacal swabs were concurrently taken for the detection of enteric bacterial pathogens. Postmortem examinations were conducted on moribund and freshly dead birds, and tissue samples (liver, heart, and spleen) were aseptically harvested for bacteriological evaluation.

To exclude parasitic and viral co-infections, faecal samples were examined for helminth ova and protozoan oocysts, while serum samples were analysed for antibodies indicative of common immunosuppressive viral infections. Randomly selected *E. coli* isolates were further subjected to serotyping. This integrated approach enabled accurate identification of the primary causative agent and exclusion of possible concurrent infections.

Postmortem Findings

Gross pathological examination of the recently deceased broilers revealed a spectrum of lesions consistent with systemic *Escherichia coli* infection. The air sacs were uniformly thickened and opaque, with serous exudate indicative of air sacculitis (Plate 1). The pericardium exhibited a prominent fibrinous exudate, producing the classical “bread and butter” appearance characteristic of fibrinous pericarditis (Plate 2). Haemorrhagic lesions were observed throughout the intestinal mucosa, accompanied by the presence of blood within the intestinal lumen (Plates 3a and 3b). The tracheal lining displayed multifocal hemorrhages and areas of necrosis (Plates 4a and 4b).

Marked hepatomegaly was evident, with livers appearing enlarged, pale, and containing multifocal necrotic foci (Plate 6). The spleen was similarly enlarged, exhibiting a mottled gross appearance (Plate 5). Pulmonary examination revealed congestion and edema of the lungs (Plates 7a and 7b). Diffuse congestion and inflammatory changes were also noted in the intestinal mucosa; however, no cecal cores were identified, excluding the presence of typical coccidial lesions.

The distribution, severity, and nature of these gross lesions provide strong pathological evidence supporting a diagnosis of colibacillosis in the affected broilers.

Differential Diagnosis Considerations

The diagnosis of colibacillosis in the affected broilers was established based on consistent clinical signs, characteristic gross lesions at postmortem, and confirmatory isolation of *Escherichia coli*. Infectious bronchitis (IB) was initially considered because of its respiratory involvement but was ruled out due to the absence of nephropathic lesions typical of nephropathogenic strains and negative viral detection results. Salmonellosis was excluded owing to the lack of distinctive lesions such as caseous caecal cores and granulomatous inflammation in visceral organs. Coccidiosis was also investigated but dismissed following negative faecal flotation results for coccidial oocysts. These collective findings confirmed *E. coli* infection as the definitive cause of the outbreak.

Microbiological Findings

Pure cultures of *Escherichia coli* were isolated from blood, cloacal swabs, and necropsy tissues (liver, heart, and spleen). The isolates produced characteristic metallic green sheen colonies on Eosin Methylene Blue (EMB) agar, confirming *E. coli* identity (Plate 8). Antimicrobial susceptibility testing revealed marked sensitivity to ciprofloxacin (Plate 9) but multidrug resistance to ampicillin, tetracycline, and sulfamethoxazole-trimethoprim, indicating the emergence of a concerning resistance profile within the flock.

Serological Findings

Serological assays showed negative titres for Infectious Bursal Disease (IBD) and protective antibodies ($\log_2 128$) against Newcastle Disease (ND), confirming effective vaccination and ruling out viral involvement in the observed outbreak. These results point toward a bacterial etiology consistent with colibacillosis.

Parasitological Findings

Faecal examination revealed absence of helminth eggs and only few coccidian oocysts, with minimal burden insufficient to explain the acute mortalities. Hence, helminthiasis and clinically significant coccidiosis were excluded as primary causes of the outbreak.

Flock Management and Treatment

Following the microbiological confirmation of *Escherichia coli* from blood, cloacal swabs, and necropsy tissues (liver, heart, and spleen), immediate control measures were implemented to limit morbidity and mortality in the affected broiler flock. Based on antimicrobial susceptibility testing, ciprofloxacin was selected as the treatment of choice and administered via drinking water at 10 mg/kg body weight for five consecutive days.

Supportive management practices were concurrently instituted to enhance flock recovery. These included strict litter and ventilation management to reduce ammonia accumulation, reinforcement of biosecurity measures to prevent disease spread, and nutritional supplementation with vitamins A, C, and E to boost immune function. Farm workers were also retrained on hygiene and biosecurity protocols, emphasizing hand hygiene, disinfection of equipment, and restricted access to poultry houses.

Given the multidrug-resistant (MDR) profile of the isolates particularly against ampicillin, tetracycline, and sulfamethoxazole-trimethoprim all antimicrobial use was conducted judiciously in line with prudent antimicrobial stewardship principles.

Confirmation of Colibacillosis

To confirm colibacillosis, twelve (12) randomly selected *Escherichia coli* isolates were aseptically transported under chilled conditions to the Bacteriology Laboratory, National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria, for serotyping. Serological identification was performed using standard tube and slide agglutination tests targeting the O (somatic) and H (flagellar) antigens. The isolates were predominantly avian pathogenic *E. coli* (APEC) serotypes O78 and O2, with occasional O1 strains serogroups commonly implicated in broiler colibacillosis. This serological confirmation established a direct link between the observed clinical and pathological findings and infection with APEC strains, thereby substantiating the diagnosis.

Follow-up Report

Clinical monitoring during and after treatment showed a marked decline in respiratory distress, depression, and ruffled feathers within 48–72 hours of initiating ciprofloxacin therapy. Mortality, initially at 8%, dropped below 1% by day five, indicating effective therapeutic response. Post-treatment bacteriological assessment revealed no *E. coli* growth from cloacal swabs or necropsied organs, suggesting bacterial clearance. Feed intake and weight gain progressively normalized, and no relapse occurred within three weeks post-treatment. Improved biosecurity compliance and reduced environmental bacterial loads were also recorded, reflecting enhanced flock management.

Prognosis

The flock exhibited a favourable prognosis following targeted antimicrobial therapy and improved management. Prompt intervention, coupled with strengthened biosecurity, environmental hygiene, and nutritional support, effectively controlled the outbreak. Although multidrug resistance was initially suspected, the isolates' ciprofloxacin susceptibility ensured rapid recovery and minimized losses. The event underscores the need for continuous antimicrobial resistance surveillance, prudent antibiotic use, and preventive strategies such as vaccination and probiotic supplementation to sustainably mitigate colibacillosis in broiler production systems.

Plate 1. Cloudy air sac with serous fluid accumulation in the thoracic cavity of affected broiler

Plate 2. Fibrinous pericarditis showing white fibrin deposits on the surface of the heart.

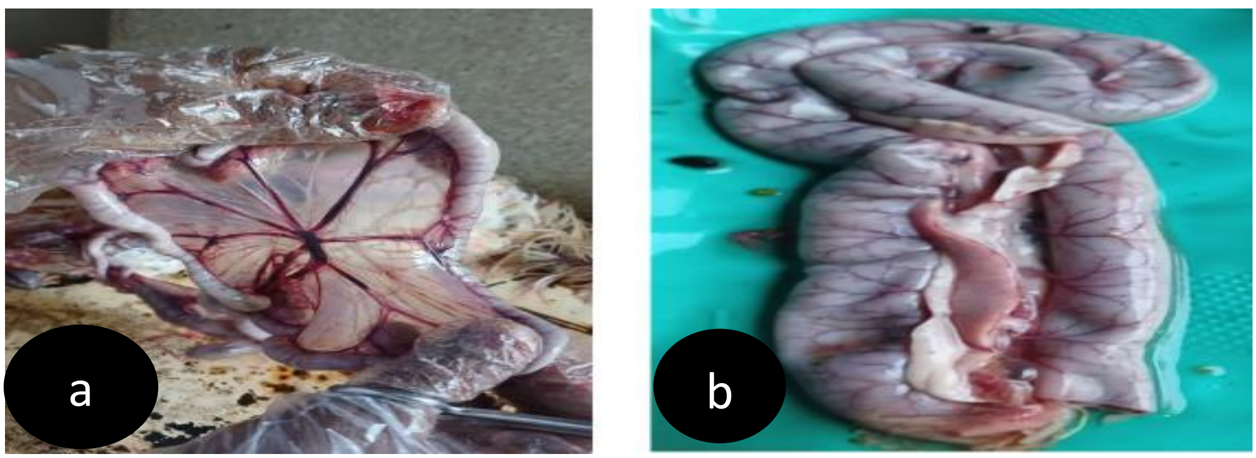

Plate 3 (a & b). Presence of blood in the intestines, with hemorrhagic lesions on the mucosa

Plate 4 (a & b). Haemorrhages and necrosis in the lining of the trachea

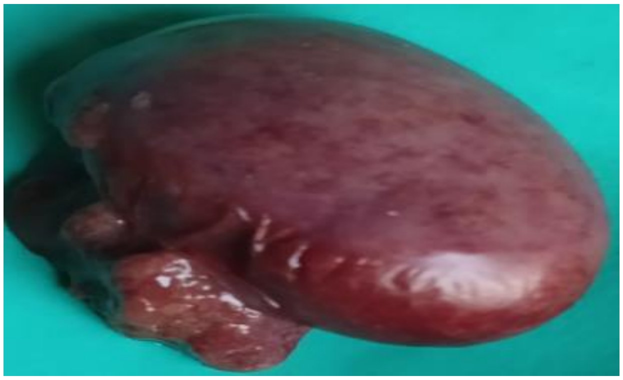

Plate 5. Gross enlargement of the spleen with irregular surface mottling

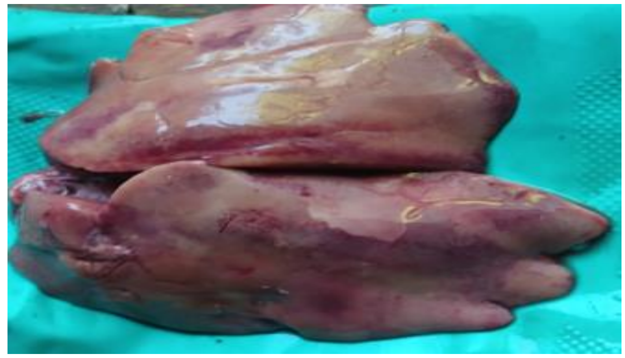

Plate 6. Multifocal necrotic lesions on the liver of affected bird

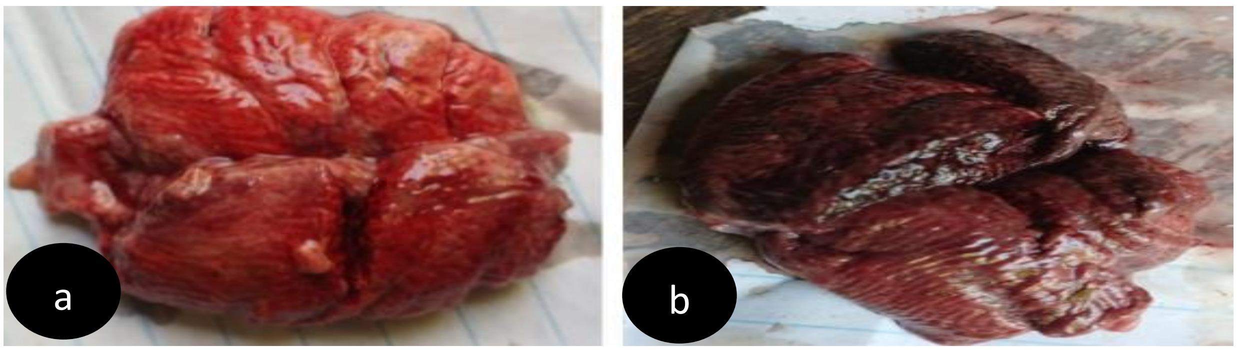

Plate 7 (a & b). Congested and edematous lungs

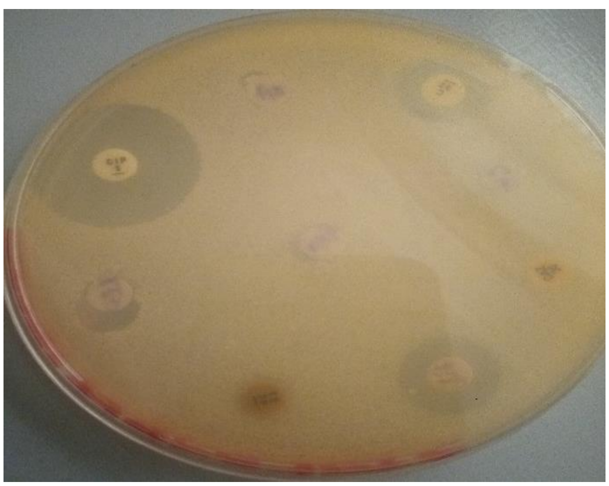

Plate 8. Metallic green sheen colonies of *Escherichia coli* on EMB agar

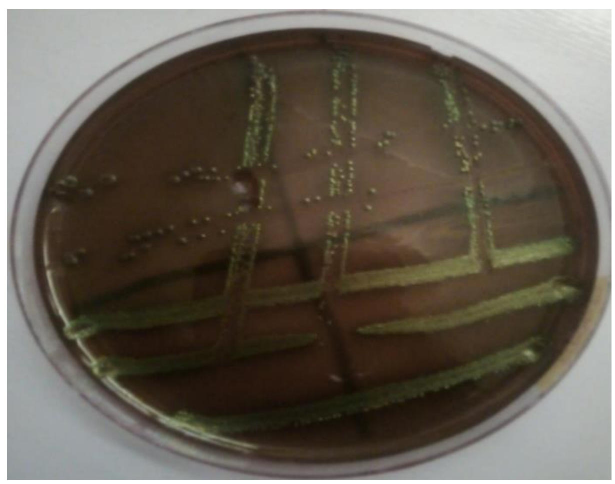

Plate 9. Antibiogram showing *E. coli* susceptibility to Ciprofloxacin

DISCUSSION

This case underscores the severe impact of colibacillosis caused by pathogenic *Escherichia coli* (*E. coli*) in broiler chickens reared under suboptimal management conditions. The outbreak's high morbidity (30%) and mortality (10%) within three days emphasize the need for robust preventive health and biosecurity strategies in poultry systems.

Colibacillosis remains a major bacterial disease of economic significance in poultry, leading to high treatment costs, poor feed conversion, carcass downgrading, and increased mortality (Joseph *et al*., 2023). The clinical manifestations observed were respiratory distress, diarrhoea, anorexia, and weakness align with previous reports of acute avian colibacillosis (Kathayat *et al*., 2021). Postmortem findings such as airsacculitis, fibrinous pericarditis, hepatomegaly, and splenomegaly further supported the diagnosis, reflecting systemic dissemination via septicemia (Fancher *et al*., 2020; Khairullah *et al*., 2024).

The present case report overcrowding, poor ventilation, wet litter, and inadequate biosecurity likely facilitated infection. Numerous studies affirm that environmental stressors and poor husbandry enhance *E. coli* pathogenicity (Fancher *et al*., 2020; Akinyemi and Adewole, 2021; Kathayat *et al*., 2021; Pokharel *et al*., 2023; Khairullah *et al*., 2024). The flock's high stocking density (15 birds/m²), exceeding the 10 birds/m² standard, likely induced immunosuppression and accelerated pathogen transmission (Sugiharto, 2022; Thema *et al*., 2022; Joseph *et al*., 2023). Similarly, elevated ammonia from poor ventilation and wet litter compromised mucociliary clearance, predisposing birds to respiratory infections (Liu *et al*., 2020; Oladokun & Sharif, 2024).

Microbiological findings confirmed *E. coli* from multiple organs, with characteristic growth on EMB agar validating its etiological role. Alarmingly, antimicrobial susceptibility testing revealed multidrug resistance (MDR) to ampicillin, tetracycline, and sulfamethoxazole-trimethoprim antibiotics frequently used in poultry, while retaining sensitivity to ciprofloxacin. This resistance pattern mirrors global trends showing increasing antimicrobial resistance (AMR) among avian pathogenic *E. coli* (APEC), particularly in low- and middle-income countries with weak antimicrobial stewardship (Aberkane *et al*., 2023; Bhattarai *et al*., 2024; Pilati *et al*., 2024; Lúcio *et al*., 2025).

The emergence of multidrug-resistant (MDR) *Escherichia coli* in poultry production represents a significant threat to both animal and public health due to the zoonotic potential of resistant strains (Agusi *et al*., 2024; Nyolimati *et al*., 2025). Unregulated antimicrobial use, coupled with the environmental persistence of pathogens, remains a major driver of resistance selection and dissemination (Mudenda *et al*., 2023; Matheou *et al*., 2025). In the present outbreak, although prophylactic antibiotics were reportedly administered, environmental contamination and possible antecedent misuse of antimicrobials on the farm likely contributed to the establishment of a resistant bacterial reservoir. This underscores the multifactorial nature of antimicrobial resistance (AMR) ecology and reinforces the need for an integrated One Health strategy to address the challenge (Velazquez-Meza *et al*., 2022; Cella *et al*., 2023).

From a differential diagnostic perspective, common viral and parasitic diseases known to cause broiler mortality such as Infectious Bursal Disease (IBD), Newcastle Disease (ND), and coccidiosis were systematically evaluated and excluded. Serological analysis revealed a negative antibody response to IBD virus, confirming the absence of active or recent infection. In contrast, antibody titres against ND virus were protective ($\log_2$ 128), consistent with effective vaccination and flock immunity. These findings exclude IBD and ND as etiological contributors, indicating that viral agents were not implicated in this outbreak.

Parasitological assessment further identified only scant coccidian oocysts, with counts below pathogenic thresholds. The absence of intestinal lesions typical of clinical coccidiosis and the low oocyst burden confirm that *Eimeria* infection was not clinically relevant. Consequently, coccidiosis was ruled out as a primary or secondary factor influencing the observed mortality pattern.

The exclusion of major viral and parasitic diseases supported by serological and parasitological evidence strongly indicates a bacterial etiology, with *Escherichia coli* identified as the principal causative agent of the outbreak. This conclusion aligns with the clinical and postmortem manifestations typical of colibacillosis in broiler chickens (Matin *et al*., 2017; Apostolakos *et al*., 2021).

Serological confirmation of *E. coli* isolates as avian pathogenic *E. coli* (APEC) serotypes O78, O2, and O1 provides compelling evidence that the outbreak represented a classic case of colibacillosis. These serogroups are globally recognized as the predominant APEC types associated with the disease in broilers (Khairullah *et al*., 2024; Watts and Wigley, 2024). The identification of O78 and O2, in particular, concurs with prior reports describing their dominance in both localized and systemic infections, including airsacculitis, pericarditis, and septicemia (Joseph *et al*., 2023).

The epidemiological significance of serotypes O78 and O2 lies in their possession of well-defined virulence determinants such as adhesins, iron acquisition systems, and toxins—that facilitate respiratory colonization and systemic invasion (Kathayat *et al*., 2021). Their frequent recovery from colibacillosis cases underscores their adaptation to avian hosts and extraintestinal pathogenic potential. The occasional detection of O1 corroborates previous findings implicating this serotype in sporadic outbreaks (Koutsianos *et al*., 2022).

Confirmation of these APEC serotypes validates both the clinical diagnosis and pathological findings, while underscoring the endemic nature of APEC infections in intensive poultry systems within developing countries. Such persistence may be attributed to inadequate biosecurity, environmental stressors, and poor management practices that increase flock susceptibility (Nawaz *et al*., 2024). Furthermore, the coexistence of multiple serotypes within a single outbreak suggests ongoing horizontal gene transfer and antigenic variation among *E. coli* strains, which complicates disease diagnosis and control (Kazimierczak *et al*., 2025).

This case highlights the urgent need for integrated control strategies. Chief among these is the inclusion of *E. coli* vaccination in routine flock health programs. Commercial vaccines such as Poulvac® *E. coli* have demonstrated significant efficacy in reducing morbidity and enhancing flock resilience (Galal *et al*., 2021; Paudel *et al*., 2024). Incorporating such vaccines into standard biosecurity and management protocols can substantially mitigate economic losses from bacterial infections.

Equally critical are stringent biosecurity practices including routine sanitation, controlled farm access, and effective disinfection protocols which can markedly reduce pathogen load and transmission risk (Dhaka *et al*., 2023; Kovács *et al*., 2025). These practices should not only be applied reactively during outbreaks but maintained as part of a continuous prevention framework to ensure long-term flock health.

Environmental management plays a pivotal role in mitigating respiratory diseases and secondary bacterial infections in poultry. Ensuring adequate ventilation, maintaining optimal stocking densities, and preserving dry litter conditions are fundamental to reducing respiratory stress and subsequent infection risks. Optimizing these factors significantly minimizes respiratory insults and, consequently, the incidence of secondary infections such as colibacillosis.

Equally important is antimicrobial stewardship in combating antimicrobial resistance (AMR). The judicious use of antibiotics guided by culture and sensitivity testing should be a mandatory practice to ensure precise drug selection and therapeutic efficacy. Such an approach aligns with international antimicrobial use guidelines and curtails the emergence and spread of resistant bacterial strains (Majumder *et al*., 2020; Giamarellou *et al*., 2023). This strategy is crucial for sustaining the long-term effectiveness of available antimicrobials and safeguarding public health.

Integrating comprehensive control measures including vaccination, strict biosecurity, sound environmental management, and prudent antimicrobial use enables poultry producers to manage and prevent colibacillosis outbreaks effectively, thereby enhancing flock health and productivity.

Furthermore, the case underscores the importance of early detection and timely intervention. Early recognition of clinical signs and prompt veterinary consultation could have substantially reduced morbidity and mortality. Routine flock health surveillance, supported by continuous farmer education, remains vital to early disease control.

Ultimately, this case illustrates the interdependence of farm management practices, pathogen ecology, and antimicrobial resistance in poultry health. Future directions should prioritize integrated disease surveillance systems, AMR monitoring frameworks, and farmer capacity-building programs. Research into alternative therapeutic strategies such as probiotics, prebiotics, organic acids, and bacteriophage therapy presents promising adjuncts to conventional antimicrobial treatments and warrants further investigation (Subramanian, 2024; Yarahmadi *et al*., 2025).

Conclusion

The diagnostic investigation confirmed *Escherichia coli* serotypes O78, O2, and O1 as the etiological agents of colibacillosis in the affected broiler flock. Combined postmortem, bacteriological, serological, and parasitological analyses conclusively ruled out other infectious causes. The characteristic lesions, such as fibrinous pericarditis, air sacculitis, hepatomegaly with necrotic foci, and splenomegaly were pathognomonic for systemic colibacillosis. Isolation and serotyping of *E. coli* from multiple organs validated the diagnosis. Antimicrobial susceptibility profiling revealed retained sensitivity to ciprofloxacin but multidrug resistance to ampicillin, tetracycline, and sulfamethoxazole-trimethoprim, indicating the circulation of resistant strains within the flock. Recovery following ciprofloxacin therapy, supported by improved biosecurity, litter management, and nutrition, underscores the effectiveness of prompt, evidence-based intervention.

Recommendations

The sustainable control of colibacillosis in broiler production demands an integrated, preventive approach that combines vaccination, management, and responsible antimicrobial use. Routine immunization against prevalent avian pathogenic *E. coli* (APEC) serotypes, complemented by vaccines targeting major respiratory and enteric pathogens, should be prioritized. Strict biosecurity practices—such as all-in/all-out flock management, effective litter disposal, regular disinfection, and restriction of human and vehicle movement are essential to minimize pathogen introduction and spread. Good husbandry practices, including proper stocking density, adequate ventilation, dry litter maintenance, and nutritionally balanced feeding, are critical to reducing stress and enhancing disease resistance.

Judicious antimicrobial use, guided by culture and sensitivity testing, must be enforced to preserve drug efficacy and ensure compliance with withdrawal periods. Strengthening farmer education through veterinary extension programs will promote early disease reporting and rational drug administration. Furthermore, continuous antimicrobial resistance (AMR) surveillance within poultry farms and diagnostic laboratories is vital for informed therapeutic decisions and policy formulation. Collectively, these coordinated strategies will reduce disease recurrence, improve productivity, and safeguard public health through prudent antimicrobial stewardship.

Conflict of Interest: Authors declare no conflict of interest in publishing this work.

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