A Monthly e Magazine
ISSN:2583-2212
Popular article
July, 2026 Vol.6(7), 2169-2179

Antimicrobial Resistance in Poultry: A Silent Threat to One Health

Manoharan Azhaguraja[1*], Geeta[2], Manish Pandey[3], M.B.Chaudhary[4], Da U Ruhi Pde[5], Arunjyoti Baruah[6], Bornalee Handique[7]
[1*, 3, 4,5, 6 &7] ICAR-Indian Agricultural research Institute, Gogamukh, Dheamaji, Assam-787035
[2] ICAR- Central Avian Research Institute, Izatnagar, Bareilly, U.P -243122
[1]*corresponding author: azhagurajamano@gmail.com
doi.org/10.5281/ScienceWorld.21824649

Abstract

Antimicrobial resistance (AMR) has emerged as one of the most serious global health challenges, threatening animal health, human health, food safety and environmental sustainability. In poultry production, antibiotics play a vital role in the treatment and prevention of bacterial diseases, however, their indiscriminate and irrational use has accelerated the emergence and spread of antimicrobial-resistant bacteria. Resistant pathogens such as *Salmonella enterica*, *Campylobacter* spp., *Escherichia coli*, *Enterococcus* spp. and methicillin-resistant *Staphylococcus aureus* (MRSA) can be transmitted through the food chain, posing significant public health risks. This article highlights the causes and consequences of AMR in poultry, explains its relevance within the One Health framework and discusses practical strategies to reduce antibiotic dependence. Emphasis is placed on responsible antimicrobial use, improved biosecurity, balanced nutrition, probiotics, bacteriophages, antimicrobial peptides and good husbandry practices. Adopting these science-based interventions will help safeguard poultry health, ensure food safety, preserve antibiotic effectiveness, and promote sustainable poultry production.

Key words: AMR, Poultry, Antibiotics, One Health, Bacteriophage

Introduction

Antimicrobial resistance (AMR) has become one of the most serious health challenges worldwide. It is driven by the excessive and improper use of antibiotics in humans, animals and agriculture. Poultry farming deserves special attention because it is one of the fastest-growing livestock sectors and produces large quantities of affordable meat and eggs to meet the increasing food demand. While antibiotics are important for treating bacterial diseases in poultry, their indiscriminate use can promote the development of resistant bacteria. These resistant bacteria can spread between animals, humans and the environment, making AMR a

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 30/07/2026

major concern under the One Health approach (Gaonkar and Huber, 2025). Antimicrobial resistance (AMR) is the ability of microorganisms such as bacteria to survive the action of antimicrobial drugs that were once effective against them (Tang *et al*., 2023). As antibiotics are used repeatedly over time, some microorganisms undergo natural changes that help them survive the treatment. Although this is a natural process, the unnecessary, excessive or incorrect use of antibiotics greatly speeds up the development of resistance. Consequently, resistant bacteria multiply and spread rapidly among animals, humans, and the environment, making infections more difficult and expensive to treat. In food-producing animals, including poultry, antibiotics are primarily used for the treatment of bacterial diseases, disease control during outbreaks and disease prevention in high-risk situations. However, the indiscriminate or excessive use of antibiotics promotes the emergence and spread of antimicrobial-resistant bacteria, reducing the effectiveness of these valuable medicines and threatening both animal and public health (Ayoub *et al*., 2025).

AMR occurs when bacteria, viruses, fungi or parasites develop the ability to survive medicines that once effectively killed them. As a result, infections become more difficult to treat, increasing disease burden, treatment costs, and mortality. The World Health Organization (WHO) recognizes AMR as one of the top global health threats, affecting not only humans but also animals, agriculture, and the environment. Therefore, combating AMR requires a coordinated One Health approach that recognizes the close connection between animal health, human health, and environmental health.

Antibiotics in poultry production

Antibiotics have played an important role in livestock and poultry production for over 50 years. They are commonly used to treat sick animals, control disease outbreaks within a flock, and prevent infections during stressful periods. In the past, some antibiotics were also used to improve growth and feed efficiency. Although these medicines have greatly benefited animal production, their excessive and improper use has contributed to the development of antibiotic-resistant bacteria in poultry and other livestock. These resistant bacteria can persist and spread, posing a serious threat to animal health, public health, and the environment (Al Sattar *et al*., 2023.)

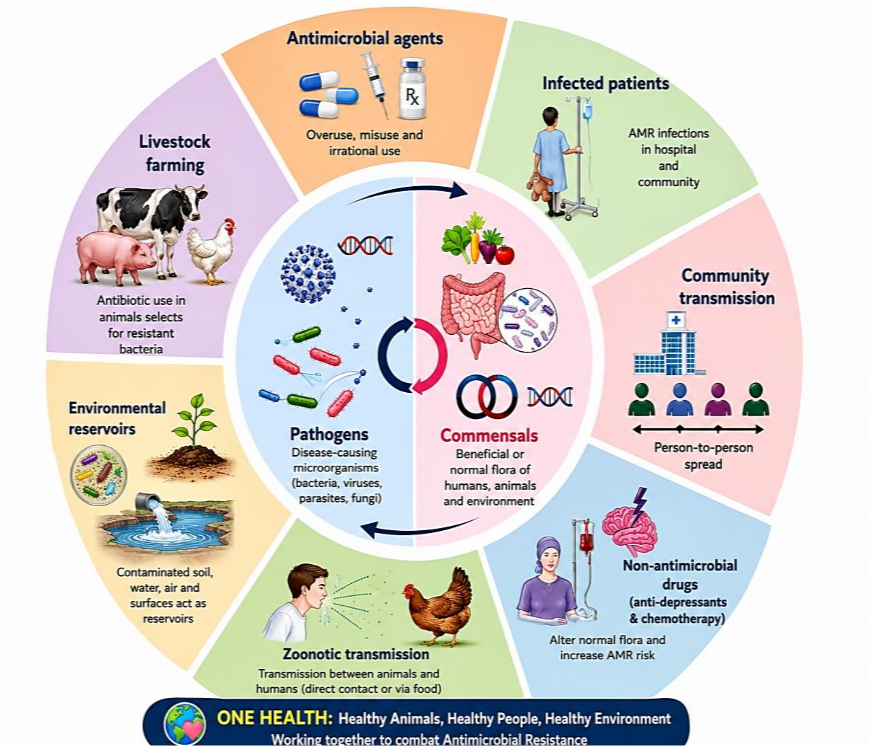
Antibiotic growth promoters (AGPs) are antibiotics added to animal feed at low doses to improve growth performance and feed efficiency rather than to treat diseases. They are believed to alter the balance of beneficial microorganisms in the intestine, allowing animals to utilize nutrients more efficiently and achieve better growth. Some researchers suggest that

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 30/07/2026

AGPs are particularly beneficial during the early stages of production or under poor hygiene conditions, where animals are more vulnerable to infections. However, others believe that improved management practices, proper nutrition, good sanitation, and strong biosecurity can achieve similar production benefits without relying on routine antibiotic use (Hudson *et al*., 2017). The continuous use of antibiotic growth promoters (AGPs) has played a significant role in the emergence of antimicrobial-resistant bacteria in the intestinal microbiota of livestock, including poultry. Recognizing this risk, many countries have banned or restricted their use and now encourage improved nutrition, biosecurity, vaccination and good farm management as safer alternatives to maintain animal health and productivity (Nazeer *et al*., 2021). Despite increasing efforts to limit antibiotic use, they remain essential for the prevention and treatment of bacterial diseases in poultry and other food-producing animals. When used responsibly under veterinary supervision, antibiotics help improve animal health and welfare while reducing the risk of diseases that can spread from animals to humans (Al Sattar *et al*., 2023)

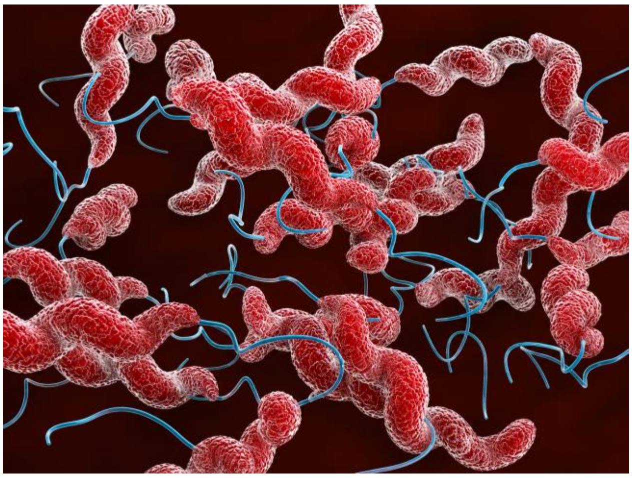
Transmission of antimicrobial resistance

AMR develops and spreads through interconnected pathways involving humans, animals, food and the environment. The excessive and irrational use of antimicrobial agents, livestock production, environmental contamination, zoonotic transmission, healthcare settings and community spread all contribute to the emergence and dissemination of resistant microorganisms, highlighting the need for coordinated One Health interventions.



Major bacterial pathogens in poultry

Important bacterial pathogens associated with poultry include *Salmonella enterica*, *Campylobacter spp*. (especially *C. jejuni*), *Escherichia coli*, *Enterococcus spp*. and methicillin-resistant *Staphylococcus aureus* (MRSA). Among these, *Salmonella enterica* is one of the most important foodborne and zoonotic bacterial pathogen of global importance. It is commonly associated with poultry and poultry products and is a leading cause of foodborne gastroenteritis in humans. Contaminated poultry meat and eggs are responsible for a considerable proportion of salmonellosis cases worldwide, highlighting the importance of effective disease control and responsible antimicrobial use in poultry production (Lorenzo-Rebenaque *et al*., 2022)



Salmonella enterica

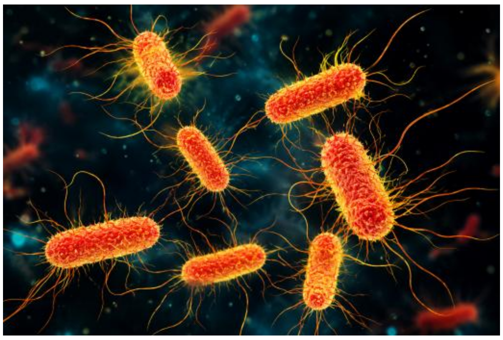
Campylobacter species are common bacteria that inhabit the intestinal tract of poultry and are also present in various environmental sources, including soil and water. Though they generally exist harmlessly in birds, they are among the most important foodborne pathogens affecting humans. Among the different species, *Campylobacter jejuni* and *Campylobacter coli* are the most common caused for acute bacterial gastroenteritis. Since poultry is the major reservoir of these bacteria, contaminated poultry products remain the leading source of human campylobacteriosis (Directorate, 2019).

Escherichia coli (E. coli) is a common bacterium that naturally inhabits the intestinal tract of humans, poultry and other animals. It plays an important role in the One Health framework because it can circulate among animals, humans and the environment through faecal contamination. Due to its widespread occurrence and its ability to acquire and transfer antimicrobial resistance genes through mobile genetic elements, *E. coli* is widely used as an indicator organism for monitoring antimicrobial resistance. It also acts as a reservoir of

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

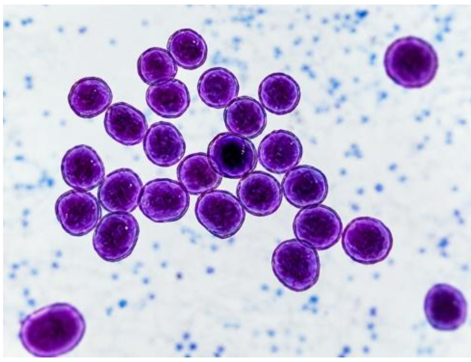
Published 30/07/2026

resistance genes that can be transmitted to other bacteria, contributing to the spread of antimicrobial resistance. (Islam *et al*., 2021)



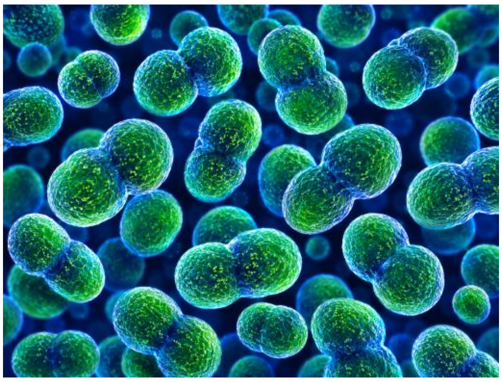
Escherichia coli

Enterococcus species are ubiquitous bacteria that commonly colonize the gastrointestinal tract of humans and animals as part of the normal intestinal microbiota. Although several strains have beneficial probiotic properties, others act as opportunistic pathogens capable of causing disease in poultry and other animals. These bacteria can be transmitted through both vertical and horizontal routes, facilitating their spread within poultry flocks. Among the various species, *Enterococcus cecorum* and *Enterococcus faecalis* are the major enterococcal pathogens associated with avian diseases (Souillard *et al*., 2022). *Enterococcus* species readily acquire antimicrobial resistance genes and play an important role in the emergence and spread of antimicrobial resistance. Among them, vancomycin-resistant *Enterococcus* (VRE) has become a major concern because it is associated with infections in both animals and humans, leading to increased treatment costs and significant economic losses in animal production and healthcare systems. (Khan *et al*., 2015)



Enterococcus spp.

Staphylococcus aureus is one of the most important and frequently isolated *Staphylococcus* species associated with poultry. Although *Staphylococcus* bacteria are naturally present on the skin and mucous membranes of healthy birds and are commonly found in the poultry environment, *S. aureus* can act as an opportunistic pathogen under favourable conditions. The emergence of antimicrobial-resistant *S. aureus* has become a major concern for both animal and public health. In poultry, *S. aureus* infections can lead to reduced growth and productivity, increased mortality, carcass condemnation at processing, and substantial economic losses to the poultry industry (de Mesquita Souza Saraiva *et al*., 2022; Lee *et al*., 2022).



Staphylococcus aureus

A major concern associated with *Staphylococcus aureus* in poultry is the emergence of methicillin-resistant *Staphylococcus aureus* (MRSA). Although MRSA is reported less frequently in poultry than in other livestock, it can still be transmitted to humans through direct contact with infected birds or by handling and consuming contaminated poultry products. In addition, *Staphylococcus* isolates from poultry have shown resistance to several commonly used antibiotics, including penicillins, cephalosporins, aminoglycosides and tetracyclines, making the treatment of infections increasingly challenging (de Mesquita *et al*., 2022).

Strategies for preventing antimicrobial resistance in poultry

As the demand for poultry meat continues to rise, birds are often reared in large numbers to meet consumer needs. High-density farming increases the chances of disease outbreaks and the spread of antimicrobial-resistant bacteria within poultry flocks. This highlights the importance of adopting better disease prevention practices and alternative approaches that reduce the routine use of antibiotics while ensuring healthy and productive birds (Chakraborty *et al*., 2022). To safeguard animal health, public health, and the environment, it is essential to reduce unnecessary antibiotic use and adopt sustainable alternatives such as improved biosecurity, vaccination, balanced nutrition, probiotics, and better flock management. These measures support the transition towards more responsible and sustainable poultry production

Effective control of antimicrobial resistance requires coordinated efforts across the entire poultry production chain. At the farm level, strict hygiene, improved biosecurity and good management practices help reduce disease transmission. During processing and retail, safe food

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 30/07/2026

handling, hygienic processing and proper training of workers are essential to minimize contamination. Consumer awareness regarding the safe handling, storage and proper cooking of poultry products also plays an important role in preventing foodborne illnesses. While these measures substantially reduce the spread of foodborne pathogens, continued surveillance, prudent antimicrobial use and collaborative efforts are necessary to achieve long-term control of antimicrobial resistance (Ricke, 2021). The routine inclusion of antibiotics as growth promoters should be avoided. Improved nutrition, probiotics, prebiotics, organic acids, phytogenic feed additives, enzymes and better management practices can effectively support growth and productivity while reducing reliance on antibiotics.

Strategies to control foodborne pathogens and antimicrobial resistance in poultry can be broadly classified into pre-harvest and post-harvest interventions. Pre-harvest interventions are implemented at the farm level and focus on maintaining bird health, preventing infections and minimizing the colonization of disease-causing microorganisms. These measures include improved biosecurity, vaccination, balanced nutrition, clean drinking water and the use of suitable feed additives that enhance gut health and reduce dependence on antibiotics. Post-harvest interventions are applied after birds are processed and are aimed at reducing microbial contamination of poultry meat and eggs. These include hygienic slaughtering and processing, proper sanitation of equipment and processing facilities, safe packaging and appropriate storage and transportation practices. Maintaining hygiene throughout the processing and marketing chain helps prevent the growth and spread of harmful microorganisms, thereby improving food safety, extending product shelf life and reducing the risk of foodborne diseases in consumers (Sommer *et al*., 2019)

Scientific management practices

The most effective way to reduce infectious diseases and antimicrobial resistance in poultry is to maintain high standards of husbandry and farm management. Healthy birds raised under proper management practices require fewer antibiotic treatments, thereby lowering the risk of antimicrobial resistance. This principle should be followed throughout the entire poultry production chain, from the farm to the consumer's table. Every stage of production plays a vital role in maintaining bird health and food safety. For instance, birds that experience stress during transportation may pass loose droppings which can contaminate other birds, transport crates and the surrounding environment, increasing the risk of disease transmission and cross-contamination. Therefore, proper transportation practices that minimize stress are essential. Similarly, maintaining an appropriate stocking density helps reduce overcrowding, improves

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 30/07/2026

bird welfare, minimizes disease spread, and enhances overall flock performance. Together, these good management practices form the foundation of sustainable poultry production and help reduce the need for routine antibiotic use **(**Rodrigues *et al*., 2022)

Alternative approaches to reduce antibiotic use in poultry

The increasing threat of antimicrobial resistance has prompted the researchers to explore safe and sustainable alternatives to conventional antibiotics. Several promising approaches have been developed to improve bird health, reduce disease incidence and minimize the routine use of antibiotics in poultry production. These include antimicrobial peptides, bacteriophages, probiotics, prebiotics, phytogenic feed additives, organic acids, nanoparticles, and other novel therapeutic strategies. Many of these alternatives enhance gut health, strengthen the immune system, inhibit the growth of harmful microorganisms and improve overall flock performance without contributing to antimicrobial resistance. Although further research is needed to optimize their large-scale application, these innovative approaches offer valuable opportunities to reduce antibiotic dependence and support sustainable poultry production under the One Health framework.

i) Antimicrobial peptides

Antimicrobial peptides (AMPs) are naturally occurring small proteins produced by almost all living organisms. They serve as an important component of the innate immune system by protecting the host against a wide range of harmful microorganisms, including bacteria, viruses, fungi, and parasites (Rodrigues *et al*., 2022). The incorporation of synthetic or recombinant AMPs as feed additives has shown considerable promise in poultry production. These bioactive compounds can enhance the bird's immune response, help control harmful pathogens, reduce the reliance on conventional antibiotics and limit the emergence of antimicrobial resistance. Their use may also lower the risk of transmitting antibiotic-resistant foodborne bacteria to humans through poultry products. Their use may also lower the risk of transmitting antibiotic-resistant foodborne bacteria to humans through poultry products (Nazeer *et al*., 2021). Examples of AMPs include bacteriocins, gallinacin-6, rabbit sacculus rotundus-derived antimicrobial peptides (RSRPs), Divercin AS7, Nisin, Lactoferrin and Lactoferri (bLf).

ii) Bacteriophages

Bacteriophages have emerged as a promising alternative to conventional antibiotics in poultry production. These naturally occurring viruses selectively infect and kill bacteria while

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 30/07/2026

leaving other beneficial microorganisms unharmed (Żbikowska *et al*., 2020). Although phages are commonly found in poultry farm environments, only a small proportion is effective against a particular bacterial pathogen. Consequently, the best place to isolate useful bacteriophages is from environments where the target bacteria are naturally present (Ushanov *et al*., 2020)

In addition to phage therapy alone, combining bacteriophages with conventional antibiotics has emerged as an effective strategy for combating bacterial infections. This interaction, known as *phage–antibiotic synergy (PAS)*, enhances antibacterial activity and allows the use of lower antibiotic doses without compromising therapeutic efficacy. Furthermore, this combination may restore or enhance the effectiveness of antibiotics against antimicrobial-resistant bacteria, offering a promising approach for antimicrobial stewardship in poultry production (Nikolic *et al*., 2022; Alaoui *et al*., 2022).

Several bacteriophages have been successfully evaluated in vivo against important poultry pathogen. These studies have demonstrated their potential to reduce bacterial colonization, improve bird health and decrease the reliance on conventional antibiotics in poultry production. Examples of bacteriophages used against poultry pathogens include Phage type 14, type 40, type 141, Phage R, DAF6 , SPR02, CP8 and CP34, UAB_Phi20, UAB_Phi78 and UAB_Phi87.

iii) Probiotics

The World Health Organization (WHO) defines probiotics as live microorganisms that confer health benefits on the host when administered in sufficient quantities. An ideal probiotic should tolerate the acidic conditions of the gastrointestinal tract, adhere to the intestinal epithelium and contribute to maintaining a balanced gut microbiota (Krysiak *et al*., 2021). Through these mechanisms, probiotics improve intestinal health, enhance immune function, support nutrient utilization and contribute to better growth performance and disease resistance in poultry. Lactic acid bacteria (LAB) constitute the majority of commercially important probiotics. Among them, species of *Lactobacillus* and *Pediococcus* are widely recognized because they naturally colonize the gastrointestinal tract of vertebrates and invertebrates and play a vital role in maintaining intestinal microbial balance and host health (Zheng *et al*., 2020). A variety of beneficial microorganisms, such as *Lactobacillus*, *Bacillus*, *Bifidobacterium*, *Streptococcus*, *Enterococcus*, *Saccharomyces*, *Candida*, and *Aspergillus*, are used as probiotics in broiler production. These probiotics improve growth, maintain a healthy balance of gut microorganisms, reduce harmful bacteria, strengthen immunity, improve intestinal health and enhance the quality of poultry meat. Unlike antibiotics used as growth promoters, probiotics improve bird performance naturally and help reduce the risk of antimicrobial resistance (Yaqoob *et al*., 2022; Halder *et al*., 2024).

Conclusion

AMR poses a significant risk to poultry production, food safety and public health. Although antibiotics remain essential for treating bacterial diseases, their responsible and judicious use is critical to slow the development of resistant microorganisms. Preventing diseases through good husbandry, strong biosecurity, vaccination, balanced nutrition, proper hygiene and veterinary guidance can significantly reduce the need for antibiotics. In addition, sustainable alternatives such as probiotics, antimicrobial peptides, bacteriophages, phytogenic feed additives and nanoparticles offer promising opportunities to improve bird health while minimizing antibiotic dependence. Combating AMR requires a collaborative one health approach involving farmers, veterinarians, researchers, policymakers and consumers. By adopting science-based management practices and promoting antimicrobial rational use, the poultry sector can safeguard animal health, protect public health and preserve the effectiveness of antibiotics for future generations.

References

Al Sattar, A., Chisty, N. N., Irin, N., Uddin, M. H., Hasib, F. Y. and Hoque, M. A. (2023). Knowledge and practice of antimicrobial usage and resistance among poultry farmers: A systematic review, meta-analysis, and meta-regression. *Veterinary research communications*, *47*(3), 1047-1066.

Alaoui Mdarhri, H., Benmessaoud, R., Yacoubi, H., Seffar, L., Guennouni Assimi, H., Hamam, M. and Kettani-Halabi, M. (2022). Alternatives therapeutic approaches to conventional antibiotics: advantages, limitations and potential application in medicine. *Antibiotics*, *11*(12), 1826.

Ayoub, H., Kumar, M. S., Dubal, Z. B., Bhilegaonkar, K. N., Nguyen-Viet, H., Grace, D., and Deka, R. P. (2025). Systematic review and meta-analysis on prevalence and antimicrobial resistance patterns of important foodborne pathogens isolated from retail chicken meat and associated environments in India. *Foods*, *14*(4), 555.

Chakraborty, N., Jha, D., Roy, I., Kumar, P., Gaurav, S. S., Marimuthu, K. and Gautam, H. K. (2022). Nanobiotics against antimicrobial resistance: harnessing the power of nanoscale materials and technologies. *Journal of nanobiotechnology*, *20*(1), 375.

De Mesquita Souza Saraiva, M., Lim, K., do Monte, D. F. M., Givisiez, P. E. N., Alves, L. B. R., de Freitas Neto, O. C. and Gebreyes, W. A. (2022). Antimicrobial resistance in the globalized food chain: A One Health perspective applied to the poultry industry. *Brazilian Journal of Microbiology*, *53*(1), 465-486.

Directorate, V. M. (2019). UK one health report. Joint report on antibiotic use and antibiotic resistance, 2013–2017. *New Haw, Addlestone: Veterinary Medicines Directorate*.

Gaonkar, P. P. and Huber, L. (2025). Addressing antimicrobial resistance in United States poultry: the critical need for environmental surveillance. *Journal of the American Veterinary Medical Association*, *263*(12), 1481-1489.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 30/07/2026

Hudson, J. A., Frewer, L. J., Jones, G., Brereton, P. A., Whittingham, M. J. and Stewart, G. (2017). The agri-food chain and antimicrobial resistance: A review. *Trends in Food Science & Technology*, *69*, 131-147.

Khan, H. A., Ahmad, A., & Mehboob, R. (2015). Nosocomial infections and their control strategies. *Asian pacific journal of tropical biomedicine*, *5*(7), 509-514.

Krysiak, K., Konkol, D. and Korczyński, M. (2021).Overview of the use of probiotics in poultry production. *Animals*, *11*(6), 1620.

Lee, G. Y., Lee, S. I., Do Kim, S., Park, J. H., Kim, G. B. and Yang, S. J. (2022). Clonal distribution and antimicrobial resistance of methicillin-susceptible and-resistant Staphylococcus aureus strains isolated from broiler farms, slaughterhouses, and retail chicken meat. *Poultry science*, *101*(10), 102070.

Lorenzo-Rebenaque, L., Malik, D. J., Catalá-Gregori, P., Torres-Boncompte, J., Marin, C. and Sevilla-Navarro, S. (2022). Microencapsulated bacteriophages incorporated in feed for Salmonella control in broilers. *Veterinary microbiology*, *274*, 109579.

Nazeer, N., Uribe-Diaz, S., Rodriguez-Lecompte, J. C. and Ahmed, M. (2021). Antimicrobial peptides as an alternative to relieve antimicrobial growth promoters in poultry. *British Poultry Science*, *62*(5), 672-685.

Nikolic, I., Vukovic, D., Gavric, D., Cvetanovic, J., Aleksic Sabo, V., Gostimirovic, S., and Knezevic, P. (2022). An optimized checkerboard method for phage-antibiotic synergy detection. *Viruses*, *14*(7), 1542.

Ricke, S. C. (2021). Strategies to improve poultry food safety, a landscape review. *Annual review of animal biosciences*, *9*(1), 379-400.

Rodrigues, G., Souza Santos, L. and Franco, O. L. (2022). Antimicrobial peptides controlling resistant bacteria in animal production. *Frontiers in Microbiology*, *13*, 874153.

Sommer, J., Trautner, C., Witte, A. K., Fister, S., Schoder, D., Rossmanith, P. and Mester, P. J. (2019). Don't shut the stable door after the phage has bolted—The importance of bacteriophage inactivation in food environments. *Viruses*, *11*(5), 468.

Tang, K. W. K., Millar, B. C. and Moore, J. E. (2023). Antimicrobial resistance (AMR). *British journal of biomedical science*, *80*, 11387.

Ushanov, Leonid, Besarion Lasareishvili, Irakli Janashia, and Andreas E. Zautner. (2020) Application of Campylobacter jejuni phages: challenges and perspectives. *Animals*, 10(2), 279.

Yaqoob, M. U., Wang, G. and Wang, M. (2022). An updated review on probiotics as an alternative of antibiotics in poultry—A review. *Animal Bioscience*, *35*(8), 1109.

Halder, N., Sunder, J., De, A. K., Bhattacharya, D. and Joardar, S. N. (2024). Probiotics in poultry: a comprehensive review. *The Journal of Basic and Applied Zoology*, *85*(1), 23.

Żbikowska, K., Michalczuk, M. and Dolka, B. (2020). The use of bacteriophages in the poultry industry. *Animals*, *10*(5), 872.

Zheng, J., Wittouck, S., Salvetti, E., Franz, C. M., Harris, H. M., Mattarelli, P. and Lebeer, S. (2020). A taxonomic note on the genus Lactobacillus: Description of 23 novel genera, emended description of the genus Lactobacillus Beijerinck 1901, and union of Lactobacillaceae and Leuconostocaceae. *International journal of systematic and evolutionary microbiology*, *70*(4), 2782-2858.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 30/07/2026