सत्यमेव जयते

पशुपालन एवं डेयरी विभाग, भारत सरकार

Department of Animal Husbandry and Dairying
Government of India

POULTRY DISEASE ACTION PLAN 2024

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Department of Animal Husbandry and Dairying
Ministry of Fisheries, Animal Husbandry and Dairying
Government of India
Krishi Bhawan, New Delhi 110 001 India

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सत्यमेव जयते

पंचायती राज मंत्री
एवं मत्स्यपालन, पशुपालन एवं डेयरी मंत्री
भारत सरकार
Minister of Panchayati Raj and
Minister of Fisheries, Animal Husbandry and Dairying
Government of India

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MESSAGE

The poultry sector plays a pivotal role in India's agricultural landscape, contributing significantly to the economy and food security. With an annual production of approximately 4.995 million tons of poultry meat and 138.38 billion eggs during 2022- 23, this industry supports millions of livelihoods, providing affordable and nutritious protein to the population. Egg production has increased by 7% over the last 10 years and quadrupled from 37 billion in 2000-01 to almost 140 billion in 2022-23.

As we continue to modernize and expand the poultry sector, safeguarding it from the risks posed by poultry diseases is crucial. These diseases, if unchecked, could impact productivity and compromise food security. The Poultry Disease Action Plan represents the government's forward-thinking approach, addressing the evolving challenges of disease management while ensuring long-term sustainability and resilience.

By integrating biosecurity, routine vaccinations, and early detection into a cohesive framework, the plan emphasizes effective disease prevention and control. It is an essential initiative, not only for protecting the poultry industry but also for maintaining public health, as zoonotic diseases such as avian influenza pose potential risks to both humans and animals.

I encourage all stakeholders, including farmers, industry professionals, and policymakers, to collaborate in the successful implementation of this action plan. Together, we can protect our poultry sector, strengthen rural livelihoods, and ensure that the industry continues to thrive for the benefit of our nation.

(Rajiv Ranjan Singh)

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एवं
पंचायती राज मंत्रालय
भारत सरकार

सत्यमेव जयते

Prof. S. P. Singh Baghel
Minister of State
Fisheries Animal Husbandry & Dairying
and Ministry of Panchayati Raj
Government of india

MESSAGE

India's poultry industry plays a crucial role in its agricultural sector, fulfilling the rising demand for high-quality protein and significantly contributing to the economic stability of rural areas. The industry has experienced remarkable growth, positioning India as the world's second-largest producer of eggs and the fifth-largest producer of poultry meat. These impressive statistics highlight the importance of maintaining the health and productivity of this essential industry.

Poultry diseases in India lead to significant economic losses, disrupt supply chains, and threaten food security by reducing the availability of affordable protein sources. They also impact rural livelihoods and can pose public health risks, emphasizing the need for effective disease management and prevention strategies to ensure industry sustainability.

The Poultry Disease Action Plan is a strategic initiative designed to bolster defences against emerging poultry diseases, which can impact the industry's growth and food security. By enhancing biosecurity, vaccination, and early detection measures, the plan equips stakeholders to effectively manage and mitigate disease risks.

This action plan demonstrates our commitment to a resilient and future-ready poultry sector, one that continues to support rural economies while meeting the protein needs of our population. Successful implementation will require coordinated efforts from farmers, veterinarians, and government agencies. By adopting the best practices outlined in this plan, we can ensure the long-term sustainability of the poultry sector and contribute to national food security.

(Prof. S. P. Singh Baghel)

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सत्यमेव जयते

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MESSAGE

The development of a Poultry Disease Action Plan is a vital initiative aimed at enhancing the resilience and growth of India's poultry sector. Poultry farming is fast becoming a key driver of our rural significant contributor to livelihoods, food security, and economic development in the rural areas. The total egg production in the country has reached 138.38 billion eggs in 2022- 23. Poultry meat production amounted to 4.995 million tonnes, accounting for approximately 51.14% of the total meat production.

India has become the second largest producer of egg in the world, and holds a large potential for scaling up commercial production. The health and well-being of poultry populations are fundamental to the sustained productivity and profitability of this industry. During 2023-24, India exported poultry and poultry products to 64 countries with an export value of 183 million USD and an increase of 41.4% over the previous year. Further to boost the export, the department has adopted compartmentalisation for declaring Avian influenza disease free compartments and at present, India has 32 Avian Influenza free poultry compartments which have also been approved by WOAH as Self-declaration.

In alignment with this goal, the Poultry Disease Action Plan integrates a comprehensive approach to disease management, with an emphasis on early detection and continuous monitoring. This plan promotes high standards of biosecurity and vaccination protocols, ensuring the protection of poultry health, the welfare of animals, and the safety of food products.

India's Poultry Disease Action Plan underscores the government's resolve to advance this critical sector and commitment to adopting best practices and aligning with international standards. Through coordinated efforts between government, industry stakeholders, and local producers, we are laying a strong foundation for a robust, sustainable, and profitable poultry sector. It will also help in strengthening the country's position in global trade.

We are confident that the steps outlined will lead to long-term benefits for the industry, improving livelihoods, enhancing food security, and contributing to our nation's economic prosperity.

Alka

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Animal Husbandry Commissioner

सत्यमेव जयते

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मत्स्यपालन, पशुपालन एवं डेयरी मंत्रालय
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PREFACE

The Poultry Disease Action Plan is a comprehensive framework designed to safeguard the health and productivity of India's poultry sector, a key driver of agricultural growth. With a contribution of ₹1.3 lakh crore annually to the agricultural GDP, the poultry industry plays a significant role in supporting rural livelihoods and providing affordable protein to millions of people across the country. Poultry meat production experienced a growth of 4.52% during 2022-23 compared to the previous year and similarly the annual growth rate of egg production for 2022-23 was recorded at 6.77%.

During the preparation of the dossier for the Highly Pathogenic Avian Influenza (HPAI) disease-free compartment, the need for a comprehensive poultry disease action plan became evident. Under the insightful leadership of the Secretary, Animal Husbandry Department (AHD), a dedicated team of experts successfully developed a draft Poultry Disease Action Plan. This draft was further refined and finalized through a consultative meeting with experts and stakeholders, held on April 29-30, 2024, in New Delhi.

This action plan highlights the government's proactive efforts to strengthen disease management across the sector. By focusing on biosecurity measures, disease surveillance, and vaccination protocols, it aligns with global standards and ensures the protection of both poultry populations and public health. The inclusion of early detection and rapid response mechanisms further enhances our capacity to mitigate disease risks.

Surveillance is crucial in the control of poultry diseases as it facilitates early detection of outbreaks, even before symptoms appear, allowing for swift containment and targeted interventions. This proactive approach ensures comprehensive data collection, which supports informed decision-making and effective control measures. By identifying silent carriers and monitoring risk factors, active surveillance helps to mitigate both economic losses and public health risks. Overall, it enhances biosecurity and contributes significantly to both poultry industry stability and public safety.

The Department of Animal Husbandry remains committed to working with all stakeholders—farmers, industry professionals, veterinarians, and government agencies—to ensure the successful implementation of the action plan. By doing so, we aim to build a resilient and disease-free poultry sector that contributes to India's food security, economic prosperity, and global trade ambitions.

I would like to humbly extend my heartfelt thanks to the Hon'ble Minister of Fisheries, Animal Husbandry, and Dairying, and the Hon'ble Minister of State for Fisheries, Animal Husbandry, and Dairying, for their steadfast support and guidance throughout the process of developing this Poultry Disease Action Plan. I am also deeply grateful to the Secretary, AHD, for her unwavering encouragement and direction. In addition, I sincerely acknowledge the invaluable contributions of all experts and stakeholders, especially the technical experts from the DAHD, whose insights were crucial in shaping the final version of the Poultry Disease Action Plan.

I am confident that through collaborative efforts, we will protect the poultry industry and ensure its continued growth and contribution to the nation's agricultural success.

(Abhijit Mitra)

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Abbreviations

AGID	Agar Gel Immunodiffusion
AHD	Animal Husbandry Department
AI	Avian Influenza
CAM	Chorioallantoic Membrane
CDDL	Central Disease Diagnostic Laboratory
DAHD	Department of Animal Husbandry and Dairying
DAstV	Duck Astrovirus
DHAV	Duck Hepatitis A Virus
DHV	Duck Hepatitis Virus
DVH	Duck Viral Hepatitis
ELISA test	Enzyme-Linked Immunosorbent Assay Test
ERDDL	Eastern Regional Disease Diagnostic Laboratory
HA / H	Hemagglutinin
HA test	Hemagglutination Test
HACCP	Hazard Analysis Critical Control Point
HI	Hemagglutination Inhibition
HN	Haemagglutinin-Neuraminidase
HPAI	Highly Pathogenic Avian Influenza
IBD	Infectious Bursal Disease
IF	Immunofluorescence
ILT	Infectious Laryngotracheitis
IP	Immunoperoxidase
IVPI	Intravenous Pathogenicity Index
LA	Latex Agglutination
LBMs	Live Bird Markets
LPAI	Low Pathogenicity Avian Influenza
MALDI-TOF	Matrix-Assisted Laser Desorption Ionization–Time of Flight
Mg	*Mycoplasma Gallisepticum*
Ms	*Mycoplasma Synoviae*
NA / N	Neuraminidase
NAD	Nicotinamide Adenine Dinucleotide
ND	Newcastle Disease
NERDDL	North-Eastern Regional Disease Diagnostic Laboratory

NGO	Non-Government Organization
NIHSAD	National Institute of High Security Animal Diseases
NRDDL	Northern Regional Disease Diagnostic Laboratory
PPLO	Pleuropneumonia Like Organism
QAC	Quaternary Ammonium Compound
QRT-PCR	Quantitative Real-Time Polymerase Chain Reaction
RBC	Red Blood Cells
RDDL	Regional Disease Diagnostic Laboratory
RFLP	Restriction Fragment Length Polymorphism
RNA	Ribonucleic Acid
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SDS	Safety Data Sheet
SPA	Serum Plate Agglutination
SRDDL	Southern Regional Disease Diagnostic Laboratory
vNDV	virulent Newcastle Disease Virus
VNT	Virus Neutralisation Test
WOAH	World Organization for Animal Health
WRDDL	Western Regional Disease Diagnostic Laboratory

Contents

CHAPTER -1

Introduction

Poultry Sector in India

As per the 20th Livestock Census 2019, India is home to 851.81 million poultry birds, representing 18% of the global poultry population. The poultry population has increased by 16.81% over the last census. The States of Tamil Nadu, Andhra Pradesh, Telangana, West Bengal, Maharashtra, Karnataka, Assam, Haryana, Kerala and Odisha constitute about 78% of the total poultry population of the country (Figure below). The commercial sector comprises 534.74 million birds, reflecting a growth rate of 4.50%, while the backyard poultry segment accounts for 317.07 million birds, showing a substantial growth rate of 45.8%. India ranks as the second-largest producer of eggs globally, with 138.38 billion eggs produced during 2022-23. Additionally, India stands as the world's fifth-largest producer of poultry meat with 4.995 million tonnes during 2022-23.

Growth and Production Systems

Over the past decade, the poultry sector in India has consistently grown at an annual rate of 7-10%. This growth is attributed to the rising demand for animal-sourced food, improved production techniques, and increased investments in poultry farming. The sector is divided into two main production systems: the commercial production system, which is more sophisticated, and the rural backyard system. Both systems are susceptible to infectious diseases, including Avian Influenza.

Historical Data

In 2012-13, India had approximately 729.21 million poultry birds. By 2014-15, this number had increased to 790 million, showing a steady growth trend. The egg production during 2012-13 was about 70 billion, which almost doubled to 138.38 billion by 2022-23. Similarly, poultry

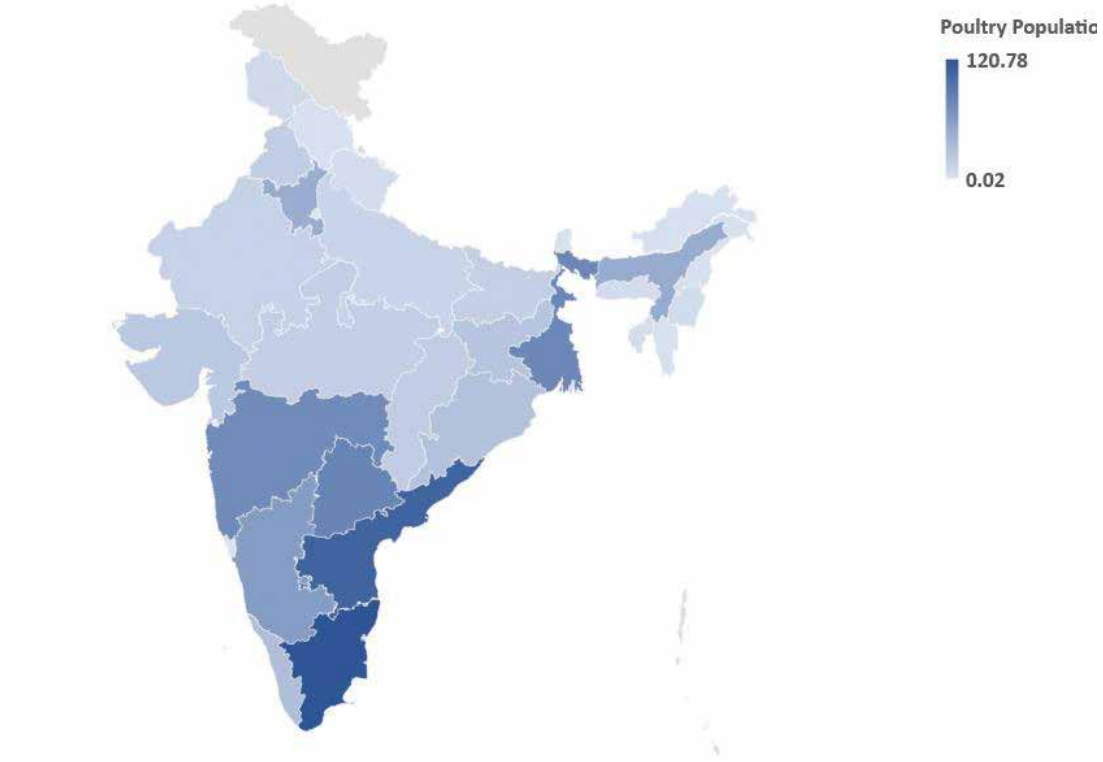


Fig: Distribution of Poultry Population India (2019)

meat production has seen significant growth, from about 3.2 million tonnes in 2012-13 to over 4.995 million tonnes in 2022-23.

Economic Impact and Exports

Over the last decade, the value of poultry and poultry product exports from India has demonstrated a significant upward trend. In 2012-13, the export value was approximately 60 million USD. This figure rose to 134 million USD in 2022-23 and further to 183 million USD in 2023-24, showcasing robust growth driven by strong demand for Indian poultry products. The past year alone saw an increase of around 41.5%. During 2023-24, India exported poultry products to 64 countries, with the top destinations being Oman, the United Arab Emirates, Indonesia, Maldives, and Japan. Major export products included hatching and table eggs, as well as grandparent chicks.

Importance of the Poultry Sector

The poultry sector in India plays a crucial role in food security, providing a reliable source of animal-sourced food. It contributes significantly to nutritional security by supplying high-quality protein to the population. Additionally, it supports livelihoods, especially in rural areas, and boosts trade and exports, thereby contributing to the country's economic growth.

Rationale

The rationale for developing a Poultry Disease Action Plan is multifaceted and addresses both economic and public health considerations:

Economic Impact - Poultry farming significantly contributes to regional economies. Diseases can lead to substantial economic losses due to decreased productivity, increased mortality, and costs associated with disease control measures. Ensuring the health of poultry populations is crucial for sustaining the profitability and stability of the poultry industry, thereby supporting livelihoods and ensuring food security.

Public Health - Poultry diseases, particularly zoonotic like avian influenza, pose direct threats to human health. Effective control of these diseases reduces the risk of zoonotic outbreaks, safeguarding public health and helping to prevent potential pandemics.

Food Safety and Security - Healthy poultry populations are vital for the provision of safe and high-quality food products. Poultry diseases can compromise the safety of meat and eggs, leading to foodborne illnesses. A proactive disease management plan ensures a consistent supply of safe poultry products, thus enhancing overall food security.

Animal Welfare - Effective disease management promotes the health and well-being of poultry, aligning with ethical standards for animal welfare. Reducing disease prevalence and severity enhances the quality of life for poultry, reflecting responsible and humane farming practices.

Global Trade - Robust disease control measures are essential for maintaining and expanding access to international markets, as many countries have strict health requirements for imported poultry products. A comprehensive disease action plan helps meet these standards, facilitating trade and fostering economic growth.

By addressing these key areas and considerations, the "**Poultry Disease Action Plan**" aims to create a sustainable and resilient poultry industry capable of withstanding disease challenges while ensuring economic viability, public health, food security, animal welfare, and global trade compliance.

Scope of Poultry Disease Action Plan

India has been implementing a National Action Plan for Control and Containment of Avian Influenza since 2005. In addition to Avian Influenza, other poultry diseases listed in the World Organisation for Animal Health (WOAH) are prevalent in the Indian poultry production system and affect the trade of poultry and poultry products from India.

The Poultry Disease Action Plan covers several critical areas aimed at preventing, controlling, and mitigating the impact of diseases in poultry populations:

Disease Surveillance and Monitoring

- **Early Detection and Monitoring**: Establish a comprehensive system for early disease detection and continuous monitoring of poultry health.
- **Regular Screening**: Implement regular screening and diagnostic procedures for common and emerging diseases.

Biosecurity Measures

- **Biosecurity Protocols**: Develop and enforce biosecurity protocols to prevent the introduction and spread of pathogens.
- **Training and Compliance**: Train personnel on biosecurity best practices and ensure compliance across all levels of poultry farming operations.

Vaccination and Treatment Protocols

- **Standardized Vaccination Schedules:** Create standardized vaccination schedules for different types of poultry and regions.
- **Antibiotics and Treatment Guidelines:** Establish guidelines for the use of antibiotics and other treatments, emphasizing responsible use to combat anti-microbial resistance.

Outbreak Response and Management

- **Rapid Response Procedures:** Develop clear procedures for rapid response to disease outbreaks, including quarantine measures, culling, and disinfection protocols.
- **Coordination with Authorities:** Coordinate with local and national authorities to ensure timely and effective responses. (Refer to Appendix 2 Disease Outbreak Response for details)

Regulatory and Policy Framework

- **Regulatory Framework**: Establish a robust regulatory framework to support disease control efforts, including import/export controls, reporting requirements, and penalties for non-compliance.
- **International Collaboration**: Collaborate with international organizations to align policies and practices with global standards.

Given the threat of various diseases of poultry (including chickens, turkeys, ducks, geese, quails, pheasants, pigeons, guinea fowls, peafowls, and ratites such as rheas ,ostriches and emus), which affect animal health, the economy, and trade, this action plan is intended to guide and support to prevent control and monitor poultry diseases in various poultry-producing facilities, both commercial and backyard. In addition to the scope listed above, the document also aims to guide education and training for community awareness and support research initiatives aimed at understanding poultry diseases, improving diagnostic tools, and developing new vaccines and treatments is crucial. The Action Plan is based on experiences gained and lessons learned from outbreaks of poultry diseases in various parts of the country and the guidelines of WOAH. It includes various operational requirements and responsibilities of the different stakeholders.

Regulatory Framework

There is central legislation called '*The Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009*' is at (https://dahd.nic.in/sites/default/filess/The%20Prevention%20and%20Control%20of%20Infectious%20and%20Contagious%20Diseases%20in%20Animals%20Act,%202009.pdf) provides legislative back up for the control and eradication of livestock and poultry diseases. Under provisions of the Act, a livestock owner or any other government or private personnel functioning in the area knowing outbreak of an infectious disease in the livestock must inform the nearest veterinary dispensary/hospital/veterinary aid center, which is further communicated to the Veterinary Officer/Surgeon and this information further flows to Director of Veterinary Services/Chief Veterinarian of the State. The State Director also sends a monthly report to DAHD,GoI where the information is collated as monthly Animal Disease Surveillance Bulletin, disseminated throughout the country, and communicated to WOAH in the form of immediate notification and six-monthly reports. There is an in-built Disease Surveillance System in the country with a total of 69,202 institutions for disease surveillance, reporting, control, and containment. These include 13,042 Veterinary Hospitals and Polyclinics, 22,823 Veterinary Dispensaries, and 33,337 Veterinary Aid Centres and Mobile Veterinary Clinics (BAHS 2023).

Binding of the Action Plan

The Action plan is participatory and contributory in nature. The Action plan provides

for bringing both commercial, backyard and government owned poultry production systems to be part of poultry disease reporting, diagnostic, and control mechanisms. The prime objectives of this Action Plan are the occurrence of poultry diseases in their establishment/ state and the control measures in place for controlling such diseases in these areas. The Central Government will, in turn, report these diseases in the International Platform along with the control measures.

Veterinary Services in India

India is administratively divided into 28 States and 8 Union Territories. Besides the Central Government, each State and Union Territory has its government, with responsibilities divided according to the Indian Constitution. The Animal Health Control in the country is jointly looked after by the Central and the State Governments. The policies and provisions related to animal quarantine, prevention of inter-state transmission of diseases, regulatory measures for quality of biological and drugs, import of biologicals, livestock, livestock products and control of diseases of national importance are the responsibilities of the Central Government. Veterinary services are delivered through State Veterinary Hospitals, Dispensaries, Aid Centers, and Mobile Veterinary Clinics, all staffed by Registered Veterinary Practitioners holding graduate degrees in Veterinary Science and Animal Husbandry, recognized by the Veterinary Council of India.

CHAPTER -2

Poultry Diseases

This Action Plan covers the following poultry diseases based on their etiological agents:

- Avian Influenza- High Pathogenicity and Low Pathogenicity
- Avian Infectious Bronchitis
- Avian Infectious Laryngotracheitis
- Avian Chlamydiosis
- Avian Mycoplasmosis (Mycoplasma gallisepticum and Mycoplasma synoviae)
- Duck Virus Hepatitis
- Fowl Cholera
- Fowl Pox
- Infectious Bursal Disease (Gumboro Disease)
- Newcastle Disease Virus (Ranikhet Disease)
- Pullorum Disease

Notwithstanding the diseases listed above, the participating agency(ies) may undertake programs for controlling other poultry diseases.

2.1 AVIAN INFLUENZA

Avian influenza commonly known as bird flu, is a viral infection that affects domestic poultry and a broad spectrum of other avian species. The disease is caused by influenza A viruses, which have been known to infect wild and domestic mammals, including humans sporadically. The primary reservoirs of avian influenza viruses are wild waterfowl and shorebirds, which often carry the virus subclinically, acting as asymptomatic carriers and sources of infection for other birds and mammals.

The Avian Influenza Viruses are classified into two groups, as follows, based on the disease severity they cause in chickens:

- Low Pathogenicity Avian Influenza (LPAI) that causes little or no clinical signs
- Highly Pathogenicity Avian Influenza (HPAI) that causes severe clinical signs and mortality may go up to 100%

Etiology

Avian Influenza (AI) is a highly contagious viral disease that affects domestic poultry and pets, zoos, and wild birds. AI viruses (AIVs) are members of the genus *Alphainfluenzavirus* (Influenza virus A or Influenza A virus) under the family *Orthomyxoviridae*. Sporadically, AIVs infect humans and other mammals.

AIVs are classified into multiple subtypes (such as H5N1, H5N8, H9N2, *etc.*) based on the antigenicity of their surface glycoproteins Hemagglutinin (HA / H) and Neuraminidase (NA / N). However, only H5 & H7 strains are of zoonotic importance and are reported to WOAH.

High Pathogenicity Avian Influenza

Case Definition

Suspected case: A poultry bird or a herd showing high morbidity accompanied by high and rapidly escalating unexplained mortality and showing variable clinical presentations including respiratory signs, and nervous signs.

Probable case: A suspect positive case showing clinical signs of such as ocular and nasal discharges, coughing, snicking and dyspnea, swelling of the sinuses and/or head, apathy, reduced vocalization, marked reduction in feed and water intake, cyanosis of the unfathered skin, wattles and comb, incoordination and nervous signs and diarrhea. In laying birds, additional clinical features include a marked drop in egg production, usually accompanied by an increase in the number of poor-quality eggs.

Confirmed case: A probable case with influenza A antigen detection (virologic or molecular detection methods) and the confirmation of the H5/H7 subtype with Intravenous Pathogenicity Index (IVPI) greater than 1.2, or that cause at least 75% mortality within 10 days in 4- to 8-week-old chickens infected intravenously and/or by virus isolation.

For detailed information on High Pathogenicity Avian Influenza, (clinical signs, diagnosis, sample collection and transport, measures to be taken in outbreak, disease prevention and control measures) please refer to the National Action Plan for Preparedness Control and Containment of Avian Influenza, 2021. The necessary actions shall be guided by revisions thereafter.

https://dahd.nic.in/sites/default/filess/Revised%20AI%20Action%20Plan%202021_1.pdf

Low Pathogenicity Avian Influenza

In domestic poultry, AI viruses are typically of low pathogenicity (LPAI), causing subclinical infections, respiratory disease, or decreased egg production. The H9N2 virus has been globally widespread and isolated from wild and domestic poultry. The virus poses a threat to both the poultry sector and human beings.

Epidemiology

In India, the virus was isolated for the first time in India in 2003 from chicken farms with a history of drop in egg production, respiratory illness, and increased mortality up to 5-10% in the state of Haryana. The virus was characterized to be the LPAI H9N2 subtype and genetically belonged to the G1 lineage under the Eurasian lineage. The virus has been detected in backyard and commercial poultry production systems and live bird markets. H9N2 virus is often found co-circulating in poultry with Newcastle Disease Virus (NDV). For disease control programs, the WOAH recognizes 14 days as the incubation period.

Mode of transmission

H9N2 viruses are shed in the feces and respiratory secretions of birds. Transmission between birds can occur by ingestion of contaminated food and water or inhalation of droplets or aerosols contaminated with

Clinical signs & Postmortem lesions

Host	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Poultry	Respiratory signs: Sneezing Coughing Ocular & Nasal discharge Swollen Infraorbital Sinuses	Incubation period: Varies depending on the strain and conditions. Morbidity: Typically, high Mortality: Generally low, but can increase with co-infections	LPAI viruses can lead to secondary infections and increased disease severity in co-infected birds
Broiler Chickens	Mild to moderate clinical signs Lacrimation, eye and/or facial swelling Sneezing, gasping, nasal discharge Symptoms primarily in the head and upper respiratory tract Mild depression Reduced feed and water intake Loss of body weight	Incubation period: 1-7 days Morbidity: Can be high depending on conditions Mortality: Generally low, but can be higher in cases of secondary infections	The virus can lead to economic losses due to decreased growth and increased management costs
Layers and Breeders	Reduction in egg production or infertility Thinning of eggshells	Incubation period: 1-7 days Morbidity: Significant impact on productivity Mortality: Generally low	Can lead to economic losses due to reduced egg production and quality
All Birds	Immunosuppression	Morbidity: Increases susceptibility to other infections. Mortality: Varies with secondary infections	Co-infection with other microorganisms may lead to varying levels of mortality
All Birds (Respiratory Tract)	Congestion and inflammation of the trachea and lungs	Morbidity: High due to respiratory distressMortality: Generally low, but can increase with co-infections	Lesions in the respiratory tract can exacerbate respiratory symptoms and complications

viruses. Spread between poultry farms results from breaches in biosecurity practices, by the movement of infected poultry or contaminated feces and respiratory secretions on fomites such as clothing or equipment. Airborne transmission between farms may be important over limited distances. Aerosol transmission of H9N2 virus from avian to mammalian species has been reported. Humans may contract the disease by exposure to infected poultry.

Laboratory Diagnosis

World Organization for Animal Health (WOAH) recommends detection of viral RNA, virus isolation, and antigen capture ELISA for diagnosis of AIVs. H9N2 virus can be isolated from cloacal and oropharyngeal swabs. AI virus can be grown in 9 to 11 day old embryonated chicken eggs, and they agglutinate chicken RBC.

Identification of AIVs is based on the following:

- Influenza A virus confirmation by agar gel immunodiffusion
- Viral RNA detection by influenza A-specific reverse transcription PCR (rtPCR) test, and AIV subtype confirmation employing AIV-subtype-specific primers.
- Virus subtype can be confirmed in hemagglutination and neuraminidase inhibition tests by using subtype-specific antisera. Alternatively, the genome of specific H and N subtypes is identified using PCR with subtype-specific primers and probes (*e.g.*, real-time RT-PCR) or sequencing.

Birds that have been infected with AIV and recovered can be confirmed by serological testing for influenza A in AGID or ELISA and further subtyping using subtype-specific antigens in hemagglutinin inhibition and neuraminidase inhibition tests. H9N2 AI must be differentiated from other respiratory diseases or causes of reduced egg production, including the following:

- Viral diseases such as newcastle disease, infectious bronchitis, infectious laryngotracheitis, and infections by other paramyxoviruses.
- Bacterial diseases such as mycoplasma, fowl cholera, and infectious coryza.

Prevention and Control

- Strict biosecurity measures and good hygiene practices in poultry housing are essential to prevent the spread of avian influenza virus
- Keeping poultry away from contact with wild birds
- Reporting of illness and death of birds to the Veterinary services
- Entry of vehicles should be restricted to the farms
- All the vehicles including feed vehicles should be decontaminated before entry into farms
- Sustained surveillance of poultry and wild birds for avian influenza
- GoI has approved the use of LPAI Vaccine (H9N2) in the country for use in all poultry birds, i.e., chicken. However, no vaccination against H5 & H7 has yet been allowed.

Biosecurity measures are crucial to prevent the introduction of AIVs into poultry and hence are termed the “best preventive measures”. Biosecurity is the implementation of practices that create barriers to reduce the risk of the introduction and spread of harmful organisms. The three principal elements of biosecurity are:

- **Segregation:** Creation and maintenance of barriers to limit the infected hosts and contaminated materials from entering an uninfected site. This step, properly implemented, will prevent most of the infections.
- **Cleaning:** Materials (vehicles and equipment, *etc.*) that must enter or leave a site must be thoroughly cleaned to remove most of the virus that is contaminating the materials.
- **Disinfection:** Disinfection will inactivate any virus that might still be present on materials that have already been thoroughly cleaned.
- The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.4)

2.2 AVIAN INFECTIOUS BRONCHITIS

Infectious bronchitis is an acute, highly contagious upper respiratory tract disease in chickens. In addition to respiratory signs,

decreased egg production and egg quality are common, and nephritis can be caused by some strains. Attenuated live and killed vaccines are available, but different antigenic types of the avian coronavirus causing the disease do not cross-protect, complicating control efforts. Diagnostic tests include ELISA and HI testing for serum antibodies and virus detection by RT-PCR and virus isolation in embryonated eggs. Sequence analysis of the Spike gene is used to genetically type the virus.

Case Definition

Suspected case: A sudden large morbidity in chicken flock showing clinical signs like coughing, tracheal rales, depression, ruffled feathers, wet droppings, greater water intake, decrease in egg production as much as 70% with misshapen, thin, wrinkled, and pale eggs.

Probable case: A suspected case which upon post-mortem shows air sacs containing a foamy exudate initially, progressing to cloudy thickening. Cystic oviducts in young and oviducts of reduced weight and length and regression of the ovaries of those infected while in lay.

Confirmed case: A probable case that is confirmed positive by virus isolation (on pathogen-free chicken embryonated eggs or chicken tracheal organ cultures) or RT-PCR.

Etiology

The Infectious Bronchitis (IB) is an acute respiratory disease mainly of young chickens caused by Infectious Bronchitis virus under the Gammacoronavirus subfamily Coronavirinae, family Coronaviridae, in the order Nidovirales.

Epidemiology

In India, Infectious Bronchitis was first reported 1964 based on serology and isolation of the virus. All India coordinated projects on respiratory diseases of poultry revealed the serological existence of this disease in almost all the states of this country.

Mode of transmission

The disease is transmitted by the air-borne route, direct chicken-to-chicken contact, and indirectly through mechanical spread (contaminated poultry equipment or egg-packing materials, manure used as fertilizer, farm visits, *etc.*)

IB virus infection initially causes respiratory disease in the infected birds. In young chicks, IBV causes asphyxia, preceded by severe respiratory distress. Damage occurs in oviducts. The internal quality of eggs changes (watery albumin), eggs become deformed and there is drop in egg production in layers and breeders. Kidney damage can be observed during PM examination.

Postmortem lesions

- The trachea shows congestion and hemorrhage of the tracheal mucosa and presence of hemorrhagic plug at the tracheal lumen
- Nephropathogenic strains may produce interstitial nephritis
- Thin-shelled egg

Clinical signs & Postmortem lesions

Form	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Respiratory	Respiratory disease after infection of respiratory tract tissues; severe respiratory distress leading to asphyxia in young chicks	Incubation: Not specified Morbidity: High Mortality: Variable	Worldwide occurrence; principal form is respiratory disease
Oviductal	Damage to oviducts, resulting in cessation of egg-laying, production of thin-walled, misshapen eggs with loss of shell pigmentation, and watery albumin in eggs	Incubation: Not specified Morbidity: High in young birds Mortality: Variable	Significant impact on egg production in layers and breeders
Nephropathogenic	Acute nephritis, urolithiasis, kidney damage observed during post-mortem examination; chronic nephritis may cause death later after apparent recovery	Incubation: Not specified Morbidity: High Mortality: Variable	Can cause long-term health issues and impact mortality in young birds

- Abnormal granulations on the shell
- Mis-shapen eggs.

Laboratory Diagnosis

- RT-PCR (detection of virus genome)
- Gene sequencing (S Gene) for Genomic surveillance
- Enzyme-linked immunosorbent assay (ELISA) test/Hemagglutination (HA) test (virus identification) for serosurveillance.

IB has no zoonotic relevance but still the poultry owners/hatcheries, their consultants, field veterinary institutions and anyone who notices clinical symptoms/unusual sickness/ mortality must report its occurrence to the nearest veterinary institution and/or any other government agency.

Prevention and Control

Vaccines are available andmust be administered as per the recommended vaccination schedule.

Biosecurity protocols include adequate distancing of flocks. Isolation and disinfection are important in controlling the spread of infection and disease. Strict biosecurity measures must be imposed, and poultry owners be advised to adopt the following measures in all farms, even though they are not currently infected. In commercial farms-

- Only those who take care of the poultry at the farm should be allowed to go close to the birds. Visitors should be strictly restricted from entering the sheds
- Intermingling of other birds/animals with poultry at the farm should be avoided
- Disinfect and wash shoes, clothes and hands before and after contact with poultry. If equipment, tools or poultry supplies are borrowed from other farms, always clean and disinfect them before bringing them and before sending them back
- The bird cages should be cleaned and food and water for birds changed daily
- Do not Introduce New Birds to the Flock: The new birds should be kept away from the flock for at least 30 days
- Every unusual sickness or death of birds should be immediately reported to the nearest Veterinary Centre
- A uniform age-group policy should be adopted. This is best done by adopting 'all-in-all-out' production system

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.2)

2.3 INFECTIOUS LARYNGOTRACHEITIS

Infectious Laryngotracheitis (ILT) is an acute, highly contagious, herpesvirus infection of chickens and pheasants characterized by severe dyspnea, coughing, and rales. It can also be a subacute disease with nasal and ocular discharge, tracheitis, conjunctivitis, and mild rales. The disease is caused by Gallid herpesvirus I, commonly known as Infectious Laryngotracheitis Virus (ILTV). It has been reported from most areas of the USA in which poultry are intensively reared, as well as from many other countries.

Case Definition

Suspected case: A poultry bird showing a group of clinical symptoms like difficulty in breathing with extension of the neck and gasping to inhale; gurgling, rattling, and coughing when trying to expel obstructions in the trachea leading to bloody exudates, tracheitis, moderate conjunctivitis.

Probable case: A suspected case of a poultry bird showing mild to severe hemorrhagic tracheitis on post-mortem.

Confirmed case: A probable case laboratory tested positive by ELISA or PCR.

Etiology

Infectious Laryngotracheitis (ILT) Virus (ILTV) is classified as a member of the family Herpesviridae in the subfamily Alphaherpesvirinae.

Epidemiology

The disease was first reported in 1925 in the USA and subsequently in Australia, the UK, and Europe. Veterinarians initially referred to the disease as avian diphtheria, however, the name ILT was adopted in the year 1931 by the “Special Committee of Poultry Diseases” of the American Veterinary Medical Association.

Clinical signs & Postmortem lesions

Form	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Per-Acute	Sudden onset of rapid spread, high mortality (>50%), lethargy, moderate-to-severe conjunctivitis, swollen eyelids, increased lacrimation, dyspnea, gasping, extension of head and neck, coughing, rattling, gurgling	Incubation: 6-14 daysMorbidity: High Mortality: >50%, Affected birds usually die within 3 days	Death may occur before clinical signs appear in birds with good body condition
Acute	Characteristic dyspnea, inactivity, anorexia, tracheal obstruction with clotted blood, open-mouthed breathing, high-pitched squawk, moist rales, purulent conjunctivitis, sinusitis, nasal discharge	Incubation: 6-14 days Morbidity: 100%Mortality: 10-30%, Duration: up to 15 days	Morbidity and mortality vary, less severe than per-acute form
Chronic	Un-thriftiness, coughing, moist rales, head shaking, squinting eyes, swelling of infra-orbital sinuses, drop in egg production (up to 10%), reduced body weight	Incubation: 6-14 days Morbidity: Up to 5% Mortality: <2%	Resembles other respiratory infections, typically less severe

ILT was the first poultry viral disease for which a vaccine was employed based on the cloacal administration. In India, ILT was first reported in 1964 from the veterinary college poultry farm in Mathura, Uttar Pradesh. ILT has been reported in various Indian states like Haryana, Rajasthan, Uttar Pradesh, Andhra Pradesh and Telangana, West Bengal, Karnataka, and Tamil Nadu.

Mode of transmission

Infected birds shed the virus in their respiratory secretions for 10 days post-infection. ILTV enters the host through the respiratory tract, ocular, and to a lesser extent through oral routes. Direct bird-to-bird transmission is rampant in comparison to contact with latently infected or carrier birds. Mixing of vaccinated and naive chickens is important with respect to direct transmission. Neither vertical transmission nor transmission of virus through the eggshell has been demonstrated. Carrier birds that have survived previous outbreaks also act as a source of infection to the naive birds. Infected birds readily transmit the disease through oral secretion as compared to clinically recovered birds or latent carriers. The virus usually gets introduced into a flock by direct contact with respiratory exudates or indirect/ mechanical transmission of contaminated equipment, litter, feed bags, feathers, vehicles, dust, footwear, clothes, and movement of people. Wind-borne transmission of ILTV has been demonstrated between commercial poultry operations.

PM lesions: The gross lesions are usually restricted to the sinuses and upper respiratory tract and vary with the severity of the disease. The gross lesions in per-acute form consist of mucoid rhinitis and hemorrhagic tracheitis with blood clots. Yellow caseous exudates (cheesy plugs) are also observed in primary bronchi when the lesions extend deeply. In the acute form, yellow caseous diphtheritic membranes adherent to the larynx and mucosa of the upper trachea with or without hemorrhages are commonly noticed. The membrane also forms obstructive plugs in the larynx and syrinx regions leading to suffocation and death. A pseudo-membrane formation with fibrino-necrotic exudates adhering to the upper respiratory tract can also be noticed. The inflammatory response in nares is characterized by heterophilic exudates.

Laboratory Diagnosis

Conventional methods include histopathology, virus isolation in embryonated chicken eggs, and cell culture ImmunoFluorescence (IF), ImmunoPeroxidase (IP) assay, and serology. The ILTV is usually isolated and propagated in 9-11 days-old embryonated chicken eggs through Chorioallantoic Membrane (CAM) inoculation. Several molecular techniques such as PCR, real-time PCR, nested PCR, Restriction Fragment Length Polymorphism (RFLP), *in situ* hybridization have been applied to detect the ILTV because of its high sensitivity, accuracy, rapidity, reproducibility, and simplicity. Among

different molecular techniques, PCR and quantitative real-time PCR (qRT-PCR) are the widely used and preferred molecular assays for confirmation and quantification of viral load in biological samples due to their higher diagnostic sensitivity and accuracy.

Action to be taken in case of outbreak

- In the event of a suspected outbreak or mortalities that match the case definition, the following steps may be taken Disease detection and movement restriction
- Disease containment
- Notification and activation of emergency response plan
- Premises, area, and zone designation (infected premises, suspected premises, monitored premises, risk premises, vaccinated premises, and free premises)
- Biosecurity
- Surveillance
- Stabilization (biohazard waste and litter management)
- Cleaning and disinfection
- Business continuity
- Recovery

Prevention and Control

With the advent of ILTV recombinant vaccines, the vaccination programs for breeders and table egg layers have expanded widely.

At present, there is no indigenous vaccine available in India. Steps should be initiated for the development of suitable vaccines for a uniform vaccinal antigen status. The preparation of vaccines should be focused on indigenous strains circulating in the country rather than the introduction of new ILT virus strains from other countries. Development of ILT vaccines should be focused on alternative vaccine technology instead of live attenuated ones to get rid of the development of virus latency associated with live vaccine strains which ultimately evoke re-infection in the poultry flock.

Biosecurity measures: When a flock is suspected or known to be infected, a veterinarian should be consulted immediately and, in addition to the general biosecurity measures described previously, management procedures should be adjusted to effectively isolate it from other flocks on the establishment and other epidemiologically related establishments. The following measures are recommended:

- Personnel should manage flocks to minimize the risk of dissemination of infectious agents to other flocks' establishments, and humans. Relevant measures include handling an infected flock separately, last in sequence, and the use of dedicated personnel, clothing, and equipment.

When infection has been confirmed, epidemiological investigations should be carried out to determine the origin and route of transmission of the infectious agent. Poultry carcasses, litter, feces, and other potentially contaminated farm waste should be disposed of safely to minimize the risk of dissemination of infectious agents. The disposal method used will depend on the infectious agent involved.

- Depending on the epidemiology of the disease, the results of a risk assessment, and public and animal health policies, the destruction or slaughter of a flock before the end of the normal production period may be used
- When infected flocks are destroyed or slaughtered, they should be processed in a manner to minimize exposure of humans and other flocks to the infectious agent, and in accordance with recommendations of the Veterinary Service and relevant chapters in the Terrestrial Code
- Based on risk assessment, non-infected, high-risk flocks may be destroyed or slaughtered before the end of their normal production period
- Before restocking, the poultry house including equipment should be cleaned, disinfected, and tested to verify that the cleaning has been effective. Special attention should be paid to feed equipment and water systems. Microbiological monitoring of the efficacy of disinfection procedures is recommended when pathogenic agents have been detected in the previous flock
- Depending on the epidemiology of the disease, risk assessment, vaccine availability, and public and animal health policies; vaccination is an option to minimize the dissemination of the infectious agent. When used, vaccines should be administered in accordance with the directions of the Government Veterinary Services and the Manufacturer's Instructions.

Clinical signs & Postmortem lesions

Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Lethargy, hyperthermia, abnormal excretions, nasal and eye discharges, reduced egg production, conjunctivitis, anorexia, weight loss, diarrhea, yellowish droppings, sinusitis, biliverdinuria, sneezing, lachrymation, respiratory distress	Varies greatly by species, age, and strain Morbidity and Mortality: Variable	Older psittacine birds and poultry may show no clinical signs but can shed the agent for extended periods

Recommendations in the Terrestrial Manual should be followed as appropriate.

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.3)

2.4 AVIAN CHLAMYDIOSIS

Avian chlamydiosis can be an inapparent subclinical infection or acute, subacute, or chronic disease of wild and domestic birds characterized by respiratory, digestive, or systemic infection. Infections occur worldwide and have been identified in at least 465 avian species, particularly caged birds (primarily psittacines), colonial nesting birds (e.g., egrets, herons), ratites, raptors, and poultry. Among domestic species, turkeys, ducks, and pigeons are most often affected. The disease is a significant cause of economic loss and human exposure in many parts of the world.

Case Definition:

Suspected case: An avian species (turkey/ duck/pigeon/parrot/caged birds) subjected to transportation/ crowding/ weather change, showing symptoms of anorexia, green to yellow-green droppings, apathy, drop in egg production, watery diarrhea (ducks), ocular discharge, and respiratory distress.

Probable case: A suspected case, which on autopsy shows hepatomegaly, splenomegaly, air sacculitis, hepatic necrosis and pericarditis.

Confirmed case: A probable case of a bird that is laboratory-confirmed by real-time PCR.

Etiology

Avian Chlamydiosis (AC) is a bacterial infection caused by a *Chlamydia* species in birds. It is an important infectious disease of companion birds, domestic poultry, and wild birds. The bacterium is an obligate intracellular and gram-negative. The genus Chlamydia currently includes 11 recognized species among which chlamydia, *C. psittaci*, *C. avium* and *C. gallinacea* have been isolated from birds.

Epidemiology

Evidence from the sero-epidemiological studies in India since the 1970s have been conducted both in Southern and Northern regions suggests that other chlamydial species, such as *C. abortus*, *C. pecorum*, *C. trachomatis*, *C. suis* and *C. muridarum* can also be harbored by birds as well as by the avian species *C. avium* and *C. gallinacea*. However, it seems likely from currently available data that *C. avium* can cause respiratory disease in parrots and pigeons.

Mode of transmission

The main mode of transmission is by the fecal-oral route or by inhalation. Respiratory discharge or feces from infected birds contain elementary bodies that are resistant to drying and can remain infective for several months when protected by organic debris (*e.g.*, litter and feces). Airborne particles and dust spread the organism.

Shedding of the infectious agent among birds with latent chlamydiosis may be activated by several stress factors, including shipping, crowding, chilling, and breeding. Birds can appear healthy but are carriers of *C. psittaci* and can shed the organism intermittently. When shedding occurs, the organism is excreted in the feces and nasal discharges of infected birds.

Clinical signs & Postmortem lesions

Clinical signs are generally non-specific and vary greatly in severity, depending on the species and age of the bird and the virulence of the Chlamydia strain.

Postmortem lesions:

- Generally, the lesions found during postmortem in birds include pneumonia and congestion of lungs, clouding of air sac walls, air sacculitis, hepatitis, and pericarditis.
- Serofibrinous polyserositis (airsacculitis, pericarditis, perihepatitis, peritonitis)
- Bronchopneumonia
- Hepatic necrosis
- Hepatomegaly
- Splenomegaly

Laboratory Diagnosis

Molecular methods

- Conventional PCR
- Real time PCR

Cytological staining

- Giemsa staining

Serological methods

- Elementary Body Agglutination (EBA)
- Agar gel immunodiffusion test
- Latex agglutination (LA) test

Action to be taken in case of outbreak

In the event of a suspected outbreak or mortalities that match the case definition, the following steps may be takenPrecautions should be taken when examining live or dead infected birds to avoid exposure (*e.g.*, dust mask and plastic face shield or goggles, gloves, detergent disinfectant to wet feathers, and fan-exhausted examining hood).

To date, no commercial vaccines against avian chlamydiosis are available.

Appropriate biosecurity practices are necessary to control the introduction and spread of disease in an avian population. The strains of avian chlamydiae can infect humans and should be handled with appropriate biosafety (Personal protective equipment) and containment procedures. Post-mortem examinations of infected birds and handling of cultures should be done in certified Class II Biological Safety Cabinets whenever possible or with proper personal protective equipment.

Appropriatezoonoticagentdecontamination procedures should be followed because human infection can result from transient exposures. Following procedures to be followed:

- Quarantine and examination of all new birds
- Prevention of exposure to wild birds
- Traffic control to minimize cross-contamination
- Isolation and treatment of affected and contact birds
- Thorough cleaning and disinfection of premises and equipment (preferably with small units managed on an “all-in/all-out” basis)
- Provision of uncontaminated feed
- Maintenance of records on all bird movements
- Continuous monitoring for the presence of chlamydial infection

The organism is susceptible to heat and most of the disinfectants (1:1,000 quaternary ammonium chloride, 1:100 bleach solution, 70% alcohol, *etc.*). It may persist for months in the organic matter.

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.1)

2.5 AVIAN MYCOPLASMOSIS

Avian mycoplasmosis is an economically important and frequently reported disease of chickens, turkeys, and wild birds. It causes significant economic losses to the poultry industry by decreasing egg production, reduced growth, and feed conversion efficiency, downgrading of carcass quality, increased mortality, and treatment costs. Concurrent secondary bacterial and/or viral infections have been shown to exacerbate production losses and mortality.

Case Definition

Suspected case: (*Mycoplasma gallisepticum* (MG)- A poultry bird (mostly turkey) with swollen infraorbital sinus leading to closure of eyelids, chronic respiratory distress symptoms including coryza, conjunctivitis, coughing and sneezing, nasal exudate, rales and breathing through the partially open beak. Conjunctivitis, with frothy ocular exudate is also seen in turkeys, along with soiling of the wing feathers.

Mycoplasma Synoviae (MS)- A poultry bird (commonly in multi-age layer flock) exhibiting one or more clinical signs like pale bluish combs, lameness, retarded growth, swellings around joints, greenish droppings, sternal bursitis, swollen hocks and footpads.

Probable case: (*Mycoplasma gallisepticum* (MG) A suspected bird which upon postmortem shows lesions of the respiratory tract initially present as excess mucous exudate followed by catarrhal and caseous exudate, which may form amorphous masses in the air sacs. In turkeys and game birds the swollen infraorbital sinuses contain mucoid to caseous exudate.

(MS) A suspected bird which upon postmortem shows viscous to yellow grey exudates from the joints and along tendon sheath along with hepatosplenomegaly and mottled, swollen kidneys.

Confirmed case: A probable poultry case that is laboratory-confirmed as positive on conventional/Real-time PCR.

Etiology

Mycoplasmosis is caused by the organisms belonging to the genus Mycoplasma. *Mycoplasma gallisepticum* and *Mycoplasma synoviae* are the two most common species associated with avian mycoplasmosis in India, affecting both commercial poultry flocks and backyard birds.

Epidemiology

Avian mycoplasmosis is a concern in India, as it is present in many other countries with significant poultry industries. MS is also pathogenic for both chickens and turkeys. All the age groups of turkey and chicken are susceptible, but the disease is more common in up to 32-weeks-old commercial layer chicken.

The prevalence of avian mycoplasmosis varies across different regions and poultry production systems. According to one study, the prevalence estimates for both MG & MS was comparatively higher in the south zone than other zones. High intensity of commercial poultry may be attributed to this higher prevalence facilitating the spread of Mycoplasma among the poultry population. Under-reporting from certain zones such as East and North-east zones coincide with sparse commercial poultry population and limited access to research institutes and diagnostic facilities.

Mode of transmission

Mycoplasma infection spreads through multiple ways. For example, MG & MS may

Clinical signs & Postmortem lesions

Disease/ Pathogen	Host	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Mycoplasma gallisepticum	Broiler Chickens	Respiratory distress, rales, difficulty breathing, coughing, sneezing, nasal discharge, conjunctivitis with frothiness about eyes	Incubation: 6-21 days Morbidity: High Mortality: Low	Causes increased condemnations of carcasses in processing
	Layers/ Breeders	Usually subclinical, reduction in egg production	Incubation: 6-21 days Morbidity: High Mortality: Low	
	Turkeys	Swollen infra-orbital sinuses (infectious sinusitis)	Incubation: 6-21 days Morbidity: HighMortality: Low	Turkeys are more susceptible
Mycoplasma synoviae	Chickens	Pale-bluish head parts, lameness, swollen hocks, foot pads, sternal bursitis, depression, resting around feeders and waterers	Incubation: VariesMorbidity: Low to moderateMortality: 1%-10%	More severe in turkeys with joint lesions
	Multi-age Layer Flock	Often subclinical, mild upper respiratory infection with slight rales	Incubation: Varies Morbidity: Low to moderate Mortality: 1%-10%	Stress or concurrent infections can trigger clinical signs
	Turkeys	More severe clinical signs compared to chickens, primarily joint lesions	Incubation: Varies Morbidity: Low to moderate Mortality: 1%-10%	Instances of transient egg production drops may be seen

spread vertically through infected eggs, thus so some chicks may already have the infection from the moment they hatch. Mycoplasma infections spread horizontally by close contact, contaminated dust particles, infectious aerosols or droplets. It has been reported that mycoplasma may spread through droplets to farms as far as 2 km. Wild birds (racing pigeons, rooks, carrion crows, jack daws, house sparrows, ducks, Japanese quails and geese) may play an important role as potential reservoir and vectors of MG and MS infection. Flock-to-flock transmission occurs readily by direct or indirect contact from the movement of birds, people, or fomites from infected to susceptible flocks.

Postmortem lesions:

In uncomplicated cases of MG infection; relatively mild catarrhal sinusitis, tracheitis, and air sacculitis could be seen. Severe air sac thickening and turbidity, with exudative accumulations, adhesive pericarditis, and fibrinous peri-hepatitis are often seen with concurrent *Escherichia coli* infections. Turkeys develop severe mucopurulent sinusitis and varying degrees of tracheitis and airsacculitis. Histopathological lesions in trachea include thickening of mucous membranes which are infiltrated with hyperplastic, necrotic, and inflammatory cells, formations of lymphoid hypoplasia and germinal center within the mucosal lamina propria.

In case of infection with MS, respiratory lesions may not be apparent and if present, consist of mild mucoid tracheitis or sinusitis with air sacculitis in poorly ventilated housing. Some birds may show mild respiratory distress, lameness, pale comb, swollen hock and foot pad. Greenish droppings containing large amounts of urates are commonly seen. Synovial structures of swollen hock and wing joints may be filled with creamy to viscous yellow-gray exudate during the early part of the infection. Enlargement of spleen, kidney and liver is seen. Sternal recumbency leads to breast blisters.

Laboratory Diagnosis

Clinically, mycoplasmosis (MG or MS disease) in chickens resembles Newcastle disease virus and avian infectious bronchitis virus. It must be differentiated with *Avibacterium paragallinarum* and *Pasteurella multocida*, *Bordetella avium*, and *Chlamydia*. Infectious synovitis caused by MS should be differentiated from *Staphylococcus aureus*, *Riemerella anatipestifer*, *Ornithobacterium rhinotracheale* and Enterococcus joint infections and, in chicken, from infectious tenosynovitis caused by avian orthoreoviruses.

Laboratory confirmation of the disease is by isolating the organism in mycoplasma broth base (Frey) or SP-4 medium or Pleuropneumonia Like Organism (PPLO) medium. Mycoplasmas have fastidious growth requirements and *M. synoviae* requires extra addition of Nicotinamide Adenine Dinucleotide (NAD) in the media. Penicillin (2,000 IU/ml) and thallium acetate (up to 1:2.000) are added to the growth medium to control other bacterial and fungal contamination. As both the organisms ferment glucose and form acid, their growth in liquid medium can be determined by formation of pellicle and change in color from pink to yellow without any turbidity. In solid media, mycoplasmas produce characteristic fried egg or nipple shaped colonies.

Many laboratories across the world use PCR assays for diagnosis of MG or MS infection. These assays characterized by good sensitivity represent a good alternative to *in vitro* culture of mycoplasmas as these are based on detection of genome of these pathogens. The real-time PCR with fluorescent labelled probes is increasingly being used because of higher sensitivity and shortened duration.

Serological tests such as Serum Plate Agglutination (SPA), Hemagglutination Inhibition (HI) and Enzyme-Linked Immunosorbent Assay (ELISA) are commonly employed for detection of antibodies in the population. The detailed methodology and list of primers for the genome-based assays are available in WOAH Terrestrial Manual 2023, Chapter 3.3.5.

Action to be taken in case of outbreak

In the event of a suspected outbreak or mortalities that match the case definition, the following steps may be taken

- In case of an outbreak, the infected birds should be immediately removed from the flock and isolated from healthy birds to prevent further spread of the disease.

- It is a wise practice to cull the birds in severe cases.
- Sometimes it may be necessary to depopulate the entire flock, from infection being spread to other nearby farms.

Prevention and control:

Prevention of mycoplasma infections in the poultry flock mainly include biosecurity and management practices, treatment, and vaccination.

Vaccination for breeder stocks include administration of live vaccine at sixth week followed by a killed vaccine before lay, *i.e.*, 18 weeks of age. For commercial chickens, Antimycoplasmal medications are advised.

The first and foremost step to prevent entry of pathogen and maintaining the flocks free from infection is to acquire fertile eggs and chicks from Mycoplasma free source.

Adopting Biosecurity measures like

- presence of disinfectants at the farm entry will reduce introduction of pathogens by vehicles carrying chicks, feed, *etc.*,
- use of coverall cloths will reduce pathogen introduction to different sheds,
- proper disposal of dead birds will reduce spread from inanimate things
- control of wild birds and other residential birds including presence of backyard chickens in the farm area will reduce introduction of deadly viruses or any new bacterial agents.

Frequent serological testing as per surveillance plan facilitates early detection of infection, in addition, it also helps in reducing the horizontal and vertical transmission of the disease. In situations where prevention of MG and MS infection is not feasible or economically not viable, appropriate antimicrobial therapy may be considered.

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.5)

2.6 DUCK VIRAL HEPATITIS

Duck Viral Hepatitis (DVH) is an acute, highly fatal and rapidly spreading contagious viral disease of young ducklings characterized primarily by hepatitis. Duck hepatitis is recognized as an economically important disease in all duck-growing areas because of the potential for high morbidity and mortality if not controlled.

Case Definition:

Suspected case: An acute infection in ducklings less than 6 week of age, leading to high mortality, with ducklings showing clinical symptoms like lethargy, loss of balance, spasmodic paddling and sudden death accompanied by opisthotonos.

Probable case: A suspected case which upon post-mortem shows enlarged liver covered with hemorrhagic foci, enlarged and mottled spleen, enlarged kidney with congested renal blood vessels.

Confirmed case: A probable case that is lab confirmed by RT-PCR.

Etiology

Three types of duck hepatitis virus (DHV) have been identified:

- Duck Hepatitis Virus Type 1 (DHV-1)
- Duck Hepatitis Virus Type 2 (DHV-2)
- Duck Hepatitis Virus Type 3 (DHV-3)

Duck Hepatitis Virus Type 1 (DHV-1) renamed as Duck Hepatitis A Virus (DHAV) belongs to the genus *Avihepatovirus* in the *Picornaviridae* family. DHAV consists of three distinct genotypes probably also serotypes

Clinical signs & Postmortem lesions

Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Sudden onset, lethargy, convulsions, opisthotonus, ducklings falling on their sides and kicking spasmodically before death, head drawn back in opisthotonus position at death	Incubation: 1-2 days Morbidity: 100% Mortality: Variable; <1 week old: up to 95%, 1-3 weeks old: ≤50%, 4-5 weeks old: low or negligible	Affects ducklings typically less than six weeks old.

designated as DHAV-1 DHAV-2 and DHAV-3. Both DHV type 2 and DHV type 3 viruses belong to the genus *Avasrtrovirus* in the family *Astroviridae* and are referred to as duck astrovirus type 1 (DAstV-1) and duck astrovirus type 2 (DAstV-2).

The most pathogenic and internationally widespread is DHAV-1. DHAV-2 isolated from Taiwan and DHAV-3 isolated from different regions of China and south Korea also induce hepatitis in ducklings. Duck astrovirus type 1 (DAstV-1) and duck astrovirus type 2 (DAstV-2) have only been reported from ducklings in the USA.

Epidemiology

In naturally occurring outbreaks, DHAV occurs only in young ducks but spreads rapidly to all susceptible ducklings in a flock. Recovered ducks may excrete the virus in their faeces and the virus remains viable in the faeces for many weeks. It is probable that infection spreads when susceptible ducklings ingest the virus-carrying particles from the environment. There is no evidence of egg transmission. There are reports suggesting that wild birds or brown rats may serve as mechanical vectors or host reservoirs for DHAV. There is no known zoonotic threat of duck hepatitis virus.

Mode of transmission

Duck Hepatitis virus is excreted in the feces from infected ducklings and is transmitted horizontally by direct contact between birds or by means of contaminated water, feed, equipment. Within a flock, the disease spreads rapidly to all susceptible ducklings.

Gross pathologic changes appear primarily in the liver, which becomes enlarged with distinct punctate and ecchymotic hemorrhages. Splenomegaly and swollen kidneys with congestion may also occur. DAstV-1 and DAstV-2 cause similar clinical signs as DHAV virus.

Laboratory Diagnosis

Diagnosis of DVH is based on the characteristic disease pattern in the flock, gross lesions, isolation, and identification of virus from dead ducklings and reproduction of disease in susceptible ducklings. It is not possible to distinguish between the different viral agents based on clinical findings and pathologic changes. However, distinctions can be made by virus isolation in ducklings, embryonating eggs, and cell cultures and molecular identification of virus RNA.

Serologic tests have not been useful because of the acute nature of clinical disease. However, various Virus Neutralization (VN) assays have been described that are useful for virus identification, titration of serologic response to vaccination and epidemiologic surveys.

Prevention and control

DHAV can be prevented by strict isolation during the first 4 to 5 weeks of life. In areas where the disease is prevalent, achieving the necessary degree of isolation may be very difficult and vaccination may be required. At present, DHV vaccines are not available in India

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.6)

2.7 FOWL CHOLERA

Fowl Cholera (FC) is a contagious disease affecting domesticated and wild birds. It usually appears as a septicemic disease associated with high morbidity and mortality, but chronic conditions often occur. Fowl cholera is of major economic importance wherever poultry are raised.

Case Definition:

Suspected case: A bird/case/death with a history of sudden death or with clinical signs like swollen wattles, fetid diarrhea cyanosis of face, comb and wattles.

Probable case: A suspected bird/case/death with history of exposure to fowl cholera affected birds and showing postmortem lesions of increased amount of pericardial and peritoneal fluids, Sequestered necrotic lung lesions and caseous arthritis of foot and hock joints.

Confirmed case: A probable bird case/death that is laboratory confirmed by bacterial culture and isolation and typical bipolar organisms in blood smear of heart and impression smear of liver stained by Leishman's stain or a positive PCR result.

Clinical signs & Postmortem lesions

Form	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Acute	Sudden and unexpected deaths without prior clinical signs; rapid increase in mortality; sick birds show anorexia, depression, cyanosis, rales, nasal and oral discharge of mucus, white watery or green mucoid diarrhea; short illness course often followed by death. Prominent lesions include peritonitis associated with ruptured egg yolks in breeders and layers; synovitis and osteomyelitis in localized cases. Liver may show tan color with focal necrosis.	Incubation: Not specified Morbidity: High Mortality: Rapid increase, often followed by death	Acute form is characterized by sudden death and rapid mortality; lesions and symptoms may vary based on infection site.
Chronic	Swelling of wattles, sinuses, leg or foot pads, wing joints, and sternal bursae; conjunctival exudate, torticollis, dyspnea, and tracheal rales. Chronic localized infections can involve middle ear and cranial bones, resulting in torticollis. Reduced egg production and persistent localized infections are common.	Incubation: Not specifiedMorbidity: Variable Mortality: Up to 20% in naturally infected chickens, potentially higher	Chronic form presents with prolonged and localized symptoms; can lead to reduced egg production and persistent infections.

Etiology

Fowl cholera is caused by *Pasteurella multocida*, a member of family *Pasteurellaceae*

Epidemiology

Fowl cholera is endemic in all parts of India. Most reported outbreaks of FC affected chickens, turkeys, ducks, or geese. However, this disease also affects other types of poultry, game birds raised in captivity, companion birds, birds in zoos, and wild birds. Among types of poultry, turkeys are most affected. Death losses from FC in chickens usually occur in laying flocks, because birds of this age are more susceptible than younger chickens. Chickens become more susceptible as they reach maturity. Chronically infected birds are a major source of infection. Cold, damp weather and overcrowding predispose birds to this disease. Chickens are more susceptible to fowl cholera after withdrawal of feed and water or after an abrupt change of diet. Stress appears to be an important factor in breaking down the bird's resistance.

Mode of transmission

Dissemination of *P. multocida* within a flock is primarily by excretions from the mouth, nose, and conjunctiva of diseased birds that contaminate their environment, particularly feed and water. Transmission of Fowl cholera is mostly through contaminated water and feed. Wild birds carrying *P multocida* may act as a source of infection to commercial poultry. In addition, carriers occur in domestic poultry flocks previously affected by fowl cholera. Rodents, dogs, cats and pigs carry *P multocida* that is virulent for poultry.

Laboratory Diagnosis:

Presumptive diagnosis: Observance of typical signs and lesions and/or on the microscopic demonstration of bacteria showing bipolar staining in smears of tissues, such as heart blood, liver, or spleen.

Confirmatory diagnosis: Isolation of *P. multocida* from birds with signs and lesions and identification by biochemical or molecular techniques (PCR). The preferred specimens for isolation of bacteria include heart blood, lungs, liver, bone marrow, meninges and joint fluids. Colonies characteristic of *P. multocida* are transferred to dextrose starch agar slants incubated 18–24 hours. Tubes of phenol red broth base containing 1% glucose, lactose, sucrose, mannitol, and maltose, respectively, are then inoculated with growth from the slant. Fermentation of glucose, sucrose, and mannitol without gas is characteristic of *P. multocida*. Lactose usually is not fermented, but some avian isolates will ferment it. Inoculate 2% tryptose in 0.85% saline solution, incubate 24 hours at 37°C, and test for indole (Kovac's test). Indole is almost always produced by *P. multocida*. There should be no hemolysis of blood and no growth on MacConkey agar.

A range of PCR assays and MALDI-TOF can be used to identify *P. multocida*. In general, serology has not been used as a diagnostic tool. Commercial ELISA kits to detect antibodies are available for monitoring vaccination responses.

Prevention and control:

Management procedures: Prevention of fowl cholera can be achieved by eliminating reservoirs of *P. multocida* preventing their access to poultry flocks.

Good management practices - with emphasis on sanitation - are the best means of preventing fowl cholera. The primary source of infection is usually sick birds, recovered carrier birds, rodents, and cats.

Proper rodent control and elimination of contact of poultry with other animals, such as cats, is an important measure for the prevention of the introduction of *P. multocida* into a poultry flock. Vaccination to prevent fowl cholera is an important aspect of controlling the disease, particularly in broiler breeders and turkeysDifferent species of birds should not be raised on the same premisesFarm animals (particularly pigs, dogs, and cats) should not have access to the poultry area*P. multocida* has been recovered from many species of free-flying birds and are a potential source of bacteria to poultry. Measures should be taken to prevent their association with the flockRaising turkeys in areas where Fowl cholera is a serious problem may warrant their confinement in houses from which free-flying birds, rodents, and other animals can be excludedIf an outbreak of fowl Cholera occurs, the flock should be quarantined and disposed of as soon as economically feasible. All housing and equipment should be cleaned and disinfected before repopulation. Biosecurity must be followed stringently in addition to vaccination practicesInactivated vaccines are available in India to control Fowl cholera. Usually, two doses are given, the first dose at 8-10 weeks of age and the second dose at 18-20 weeks of age. The vaccines should not be substituted for good biosecurity practices.

Action to be taken in case of outbreak

In the event of a fowl cholera outbreak, the following immediate actions may be taken

- **Isolation:** Separate infected birds from healthy ones to prevent further spread of the disease.
- **Veterinary consultation:** Seek advice from a veterinarian for diagnosis and treatment options.
- **Disinfection:** Thoroughly clean and disinfect all equipment, premises, and vehicles to eliminate the spread of the bacteria.
- **Vaccination:** Consider vaccinating susceptible birds to prevent future outbreaks.
- **Surveillance:** Monitor the health of birds closely and report any unusual symptoms to veterinary authorities.
- **Biosecurity measures:** Enhance biosecurity protocols to prevent the introduction of the disease to other poultry farms.
- **Proper disposal:** Dispose of infected birds, carcasses, and contaminated materials properly to prevent further transmission.

2.8 FOWL POX

It is a slow-spreading contagious viral disease characterized by proliferative lesions in the skin that progress to thick scabs (Cutaneous form) and by lesions in the upper GI and respiratory tracts (Diphtheritic form). In India, the disease is endemic and of considerable economic importance. The disease causes economic losses due to a transient drop in egg production and a reduced growth rate in young birds.

Case Definition

Suspected case: A bird/case/death with a history of proliferative lesions in the skin (Cutaneous form), by lesions in the upper GI and respiratory tract (Diphtheritic form).

Probable case: A suspected bird case/ death with a history of exposure to fowl pox virus-affected birds and postmortem lesions showing epithelial hyperplasia on the skin in cutaneous form and opaque, yellowish nodules on the mucus membranes of mouth, tongue, esophagus, and pharynx in diphtheritic form.

Confirmed case: A probable bird case/ death that is laboratory confirmed by virus isolation on the chorioallantoic membrane of embryonated eggs (dropped CAM method)/ PCR technique.

Etiology

The disease is caused by fowl pox virus,

Clinical signs & Postmortem lesions

Host	Form	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Chickens, Turkeys	Cutaneous (Dry Pox)	Nodular lesions on unfeathered skin (head, upper neck of turkeys), may extend to feathered skin; lesions initially raised, blanched, and nodular, then yellowish, progressing to thick, dark scabs. Multiple lesions often coalesce. Localization around the nostrils can cause nasal discharge. Eyelid lesions may cause complete closure of the eyes.	Incubation: Not specified Morbidity: High Mortality: Elevated if lesions develop around the eyes	Can cause drops in egg production or retarded growth in younger birds. Only a few birds develop lesions at a time, but they can significantly affect flock performance. Infection in mammals is considered non-significant.
Chickens, Turkeys	Diphtheritic (Wet Pox)	Elevated white opaque nodules on mucous membranes, yellowish diphtheritic membrane; lesions in mouth, tongue, esophagus, larynx, trachea. Virulent strains may cause lesions in internal organs (systemic form).	Incubation: Not specified Morbidity: High Mortality: Higher (up to 50%), especially in young birds	Slow-spreading virus disease, associated with contamination of open wounds and insect bites. Lesions in the systemic form are more severe and affect internal organs.

belonging to the genus Avipoxvirus in the family Poxviridae. Fowl pox virus has a large (~300 kb), linear double-stranded DNA genome. Molecular analyses of vaccine and field strains of fowl pox viruses have shown noteworthy differences. The large DNA virus present in fowl pox lesions (as in the Poxviridae family) is resistant to normal environment and may survive for extended periods in dried scabs.

Epidemiology

Fowl pox has a worldwide distribution. Its incidence is variable in different areas because of differences in climate, management, and hygiene or the practice of regular vaccination. It can cause drops in egg production, or retarded growth in younger birds. Infection in mammals is considered non-significant.

Mode of transmission

The virus is usually transmitted by contact through abrasions of the skin. Skin lesions (scabs) shedding virus from recovering birds in poultry houses can become a source of aerosol exposure for susceptible birds. Mosquitoes and other biting insects may serve as mechanical vectors. Transmission within a susceptible flock is rapid when mosquitoes are plentiful. The disease tends to persist for extended periods in multiple-age poultry complexes because of the slow spread of the virus and the availability of susceptible birds.

Clinical signs & Postmortem lesions

- Lesions initially start as a nodular area with a blanched appearance (papule).
- It becomes enlarged and yellowish (pustules) terminating into a thick, dark scab.

Postmortem Lesions:

In the diphtheritic form, lesions develop on the mucous membranes of the mouth, esophagus, pharynx, larynx, or trachea (wet pox or fowl diphtheria). Occasionally, lesions occur almost exclusively in one or more of these sites. Caseous patches firmly adherent to the mucosa of the larynx and mouth, or proliferative masses may develop. Mouth lesions interfere with feeding. Tracheal lesions cause difficulty in respiration. Laryngeal and tracheal lesions in chickens must be differentiated from those of infectious laryngotracheitis, due to a herpesvirus that produces intranuclear inclusions. In systemic infection due to virulent fowlpox virus strains, lesions may be present in internal organs.

Laboratory Diagnosis

- PCR assay for detection of the fowlpox virus-specific genes
- A smear technique for fowl pox with H&E reveals eosinophilic cytoplasmic inclusion bodies

- Virus isolation in the Chorioallantoic Membrane (CAM) of chicken embryos, susceptible birds, or avian cell culture
- Molecular methods such as PCR and QPCR.
- Serological tests
- Virus neutralisation
- Agar gel immunodiffusion
- Enzyme-linked immunosorbent assay

Action to be taken in case of outbreak

- Isolation of sick birds from healthy birds
- During disease outbreak, affected birds if less than 30% should be segregated immediately and the remaining birds must be vaccinated at the earliest possible
- Standard sanitation and strict biosecurity measures can control fowl pox
- Disinfection of premises with sodium hydroxide (1:500), cresol (1:400), and phenol (3%) proved beneficial in the control of fowlpox
- Avoid contact with chickens, ducks, or other poultry as much as possible
- Avoid handling (live or dead) chickens, ducks, or any other poultry while visiting friends or family, even if the birds appear healthy
- Avoid visiting poultry farms, duck farms, or any farm where birds have been sick or suspected to have disease
- All persons exposed to an infected environment must wash hands and face properly change clothes and monitor temperature for 4 days. If he/she develops a high temperature, immediately consult a doctor

Prevention and Control

- There is no specific effective treatment for birds infected with the fowlpox virus; therefore, prevention is key. Disease prevention and control is best accomplished by vaccination
- Fowlpox outbreaks in poultry confined to houses can be controlled by spraying to kill mosquitoes
- If fowl pox is endemic in the area, vaccination is recommended
- Do not vaccinate unless the disease becomes a problem on a farm or in the area
- Where fowl pox is prevalent, chickens and turkeys should be vaccinated with a live embryo or cell culture propagated virus vaccine. The most widely used vaccines are live, attenuated fowl pox virus and pigeon-pox virus isolates of high immunogenicity and low pathogenicity.
- In high-risk areas, vaccination with a live, attenuated virus vaccine of cell-culture origin in the first few weeks after hatching and revaccination at 12–16 weeks old is often sufficient. The health of birds, the extent of exposure, and the type of operation determine the timing of vaccinations
- Because the infection spreads slowly, vaccination is often useful to limit spread in affected flocks if administered when < 20% of the birds have lesions. Passive immunity may interfere with the multiplication of vaccine viruses; progeny from recently vaccinated or recently infected flocks should be vaccinated only after passive immunity has declined
- Vaccinated birds should be examined 1-week post-vaccination for swelling and scab formation at the site of vaccination. Absence of vaccine take indicates lack of potency of vaccine, passive or acquired immunity, or improper vaccination. Revaccination (with another vaccine lot number) may be indicated.
- Age at administration 6 weeks (Primary dose) followed by Booster dose 10 weeks
- Route of vaccine administration: Intramuscular/Wing web - 0.2 ml per bird
- Two types of vaccines (pigeonpox and fowlpox vaccines) can be used for vaccination
- Pigeonpox vaccine is less pathogenic and can be used on chickens at any stage by the wing web method and it produces immunity for 6 months therefore revaccination is required
- Fowlpox vaccine produces solid immunity, usually carried out at 6-8 weeks of age by intramuscular route or wing web method
- Successful or effective vaccination can be judged by “Vaccine Takes” in vaccinated poultry, where examination of vaccinated birds after 7-10 days of vaccination, shows swelling or scab at the site of puncture or vaccine application
- Absence of “Vaccine Takes” in vaccinated poultry indicates poor potency of the vaccine, presence of maternal antibodies, and improper vaccination. In such cases,

revaccination with a new batch/lot of vaccine should be done.

Biosecurity measures: Standard sanitation and strict biosecurity measures can control fowl pox. Disinfection of premises with sodium hydroxide (1:500), cresol (1:400), and phenol (3%) is beneficial in the control of fowl pox

Biosecurity measures in backyard poultry:

- Keep the birds indoors. Do not allow wild birds to mingle with your birds
- Keep the yard and surroundings clean and regularly bury/burn the wastes
- Do not catch and keep any wild or migratory birds
- Report sickness/mortality in birds immediately to the veterinarians
- Bury the dead birds properly. Do not throw them in drains or in open areas.

Biosecurity measures for live bird markets:

- Personnel should be educated on the significance of infectious agents and the need to apply biosecurity practices to prevent dissemination of these agents. Education should be targeted to personnel at all levels of operations in these markets, such as drivers, owners, handlers, and processors. Programs should be implemented to raise consumer awareness about the risks associated with activities of live bird markets
- Personnel should wash their hands with soap and water before and after handling birds
- Birds from diseased flocks should not be transported to live bird markets
- All containers and vehicles should be cleaned and disinfected every time they leave the market
- Live birds that leave the market and go to a farm should be kept separately from other birds for a while to minimize the potential dissemination of infectious agents of poultry
- Periodically, the market should be emptied, cleaned and disinfected. This is of particular importance when an infectious agent of poultry deemed significant by the Veterinary Services has been identified in the market or the region
- Where feasible, surveillance should be carried out in these markets to detect infectious agents of poultry.
- Efforts should be made to ensure the possibility of tracing all birds entering and leaving the markets.

2.9 INFECTIOUS BURSAL DISEASE (GUMBORO DISEASE)

Infectious bursal disease is an economically important viral disease of young domestic chickens worldwide. The infectious bursal disease was first identified in Gumboro, Delaware, in 1962. It is seen in young domestic chickens worldwide and is caused by Infectious Bursal Disease Virus (IBDV). The morbidity rate is high and mortality rate is usually low, but some virulent strains cause mortality rates of 60% or higher.

Case Definition

Suspected case: A bird/case/death with a history of watery diarrhea, soiled vent feathers, vent picking, and immunosuppressed or may not have any clinical signs.

Probable case: A suspected bird case/death with a history of exposure to IBD disease-affected birds and showing symptoms of immunosuppression with Postmortem lesions of hemorrhages in the thigh and pectoral muscles typical to IBD and atrophy of bursa is seen.

Confirmed case: A probable bird case/death that is confirmed positive by virus neutralization test.

Clinical signs & Postmortem lesions

Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Feathers around the vent stained, occasionally with feces containing plenty of urates Hemorrhage in thigh muscle and pectoral muscle	Incubation period: approximately 2 to 3 days Morbidity: varies, and can be high in severe cases- Mortality: can reach up to 30–40% or more with very virulent IBDV (vvIBDV)	Post-mortem lesions include numerous ecchymotic hemorrhages, enlargement, and discoloration of kidneys, with urates in tubules Bursa may appear completely hemorrhagic, resembling a "**black cherry**" Peri-bursal straw-colored edema present in many bursae.

Etiology

Infectious bursal disease (IBD), also known as Gumboro disease, is caused by a virus that is a member of the genus Avibirnavirus (family Birnaviridae). Two serotypes of IBDV, designated serotypes 1 and 2, are recognized with serotype 1 responsible for clinical disease in young chickens. Turkey, duck, guinea fowl, pheasant, and ostrich are susceptible hosts, however, clinical disease occurs solely in younger chickens between 3-6 weeks than 10 weeks age. Chickens under 3 weeks of age exhibit subclinical form and older chickens usually show no clinical signs.

Epidemiology

The IBDV - termed as avian nephrosis or "classic IBDV" - was first reported from Gumboro in Delaware, USA in the year 1962. Classical serotype 1 IBDV strains are endemic globally. The vvIBDV strain is endemic in parts of southern Asia, Indonesia, Middle East, Africa and South America. In India, the disease was first reported in the year 1971 from the state of Uttar Pradesh. Since then, IBD has been reported in the states of Assam, Himachal Pradesh, Uttar Pradesh, Haryana, Tamil Nadu, Andhra Pradesh, and Mizoram. Various reports on the prevalence of IBD in India suggested a prevalence of 8.88 to 53.84 percent.

Mode of transmission

The fecal-oral route via ingestion of contaminated feed and water constitutes the natural means by which IBDV infection occurs in chickens and turkeys). In free-living, wild birds, IBDV infection is likely to be indirect through scavenging of dead infected chickens, ingestion of contaminated water, or exposure of respiratory or conjunctival membranes to contaminated poultry dust.

Laboratory Diagnosis

Isolation and identification of the agent provide the most certain diagnosis of IBD but are not usually attempted for routine diagnostic purposes as the virus may prove difficult to isolate. In practice, laboratory diagnosis of IBD depends on the detection of specific antibodies to the virus, or the detection of the virus in tissues, using immunological or molecular methods. The virus can be identified by histopathological examination of the bursa, virus isolation, AGID, Antigen capture ELISA, RT-PCR, and VNT.

Action to be taken in case of outbreak

In the event of a suspected outbreak or mortalities that match the case definition, the following steps may be taken:

- Disease detection and movement restriction
- Disease containment
- Notification and activation of emergency response plan
- Premises, area and zone designation (infected premises, suspected premises, monitored premises, risk premises, vaccinated premises and free premises)
- Biosecurity
- Surveillance
- Stabilization (biohazard waste and litter management)
- Cleaning and disinfection
- Business continuity
- Recovery

Prevention and Control

IBDV is very stable in the environment and difficult to eradicate from premises compared to other poultry diseases. A monopersulfate compound inactivates the IBD virus. This indicates the potential use of sodium hypochlorite which is commonly used for laundry purposes to inactivate the IBD virus and decontamination, although proper contact time is required. IBD virus can be inactivated in 2 hours at a temperature of 56°C. Vaccination against the disease is by using live or inactivated vaccines. The farmer/farm owner may contact the local veterinarian for assistance in vaccination and management.

Biosecurity measures, such as cleaning and disinfection methods are important to suppress the virulent virus. Poultry must be housed in an environment in which disease and infection is controlled to the point where vaccination and medication achieve beneficial effects. The structural and operational biosecurity are essential in mitigating the risk of transmission of the disease. The component of the structural biosecurity involves:

- Fencing of farm perimeter to prevent unwanted visitors
- Test water source for minerals, bacteria, chemical contamination, and pathogen load
- Concrete stage with suitable water and power supply for sanitation of vehicles
- Suitable location for storage of bagged feed
- Facilities for safe and scientific disposal of dead birds
- Safe housing of the poultry, with suitable proofing against wild birds and rodents
- Feed, litter, and equipment should be stored in a section separated from the live bird area to prevent contamination
- At least a three-meter boundary of land around the building must be kept free of all vegetation to prevent rodent and wildlife activity

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.8)

2.10 RANIKHET DISEASE (NEW CASTLE DISEASE)

Newcastle Disease (ND) is an infection of domestic poultry and other bird species with virulent Newcastle Disease Virus (NDV). Newcastle disease is not a food safety or public health concern. Virulent NDV can produce a devastating disease in domestic fowl, with vast social and economic consequences. It is a worldwide problem that presents primarily as an acute respiratory disease; however, depression, nervous signs, or diarrhea may be the predominant clinical form.

Clinical signs & Postmortem lesions

Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Sneezing Gasping for air, nasal discharge Coughing Greenish, watery diarrhea Depression, muscular tremors, Drooping wings, twisting of head and neck, circling, complete paralysis Partial to complete drop in egg production Production of thin-shelled eggs Swelling of the tissues around the eyes and of the neck Sudden death Increased mortality in a flock	Incubation period: 3-6 days (rarely 2-15 days) Morbidity: can range from sub-clinical to high levels Mortality: over 50% in naive populations, rapid death within 2-3 days	Clinical signs can vary significantly depending on viral strain, host species, age of host, co-infection, physiologic and environmental stress, and immune status- Rapid spread of the disease

Prevention is accomplished through vaccination and strict biosecurity. Real-time RT-PCR is the test of choice to detect viral RNA typical of virulent NDV and confirm infection in birds with clinical signs of disease. The occurrence of the disease in poultry is notifiable and may result in trade restrictions.

Case Definition

Suspected case: A bird/case/death with a history of rapid onset of respiratory and nervous signs with or without diarrhea and a sudden drop in egg production accompanied by the production of abnormal or misshapen eggs.

Probable case: A suspected bird case/ death with a history of exposure to Newcastle disease-affected birds showing edema of neck and thorax, hemorrhages in the trachea, proventriculus, gizzard, payers' patches, and caecal tonsils upon post-mortem examination

Confirmed case: A probable bird case/death that is laboratory confirmed by detection of ND-specific antibodies in the sera of suspected samples by Hemagglutination test Inhibition test. (WOAH recommended test for detecting individual case).

Etiology

Newcastle Disease (ND) is caused by virulent strains of avian paramyxovirus type 1 (APMV-1) of the genus *Orthoavulavirus* belonging to the subfamily *Avulavirinae*, family *Paramyxoviridae*. NDV has been classified into Class I and Class II based on its genome sequence. Class I viruses circulate mostly in wild birds and are less virulent as compared to Class II viruses, which

are more prevalent among domestic poultry. The virus has a wide host range among avian species; at least 250 species classified in 27 of the 50 orders of birds are susceptible to NDV. However, its impact is most visible in domestic poultry in which NDV infection leads to major losses in productivity.

Strains of APMV-1 have been grouped into five pathotypes based on the clinical signs observed in infected chickens. These are:

- **Viscerotropic velogenic**: A highly pathogenic form in which hemorrhagic intestinal lesions are frequently seen.
- **Neurotropic velogenic**: A form that presents with high mortality, usually following respiratory and nervous signs.
- **Mesogenic:** A form that presents respiratory signs, and occasional nervous signs, but low mortality.
- **Lentogenic or respiratory**: A form that presents with a mild or subclinical respiratory infection.
- **Subclinical:** A form that usually consists of a subclinical enteric infection.

Epidemiology

New Castle Disease is currently present in most parts of the country. The first outbreak of ND in India occurred in 1927 in Ranikhet, Uttarakhand in North India and there have been several incidences of the disease in the country since then. Cormorants, pigeons, and imported psittacine species can be infected with vNDV and occasionally have also been sources of vNDV infections in poultry. Newcastle disease virus strains of low virulence are prevalent in free-living wild birds, live bird markets, and poultry, especially waterfowl.

Migratory waterfowl and Charadriiformes (shorebirds) can be infected with loNDV and vNDV and can shed NDV without any apparent clinical signs of illness.

Mode of transmission

The transmission of NDV is primarily through aerosol or oral routes. The movement of live birds and migratory feral birds may be responsible for the primary introduction of infection. Secondary spread during most epizootics of ND in recent times has been the result of the movements of personnel or equipment. Human beings play a role in the transfer of infective poultry feces from one site to another via clothing, footwear, crates, feed sacks, egg trays or vehicles.

On necropsy, typical lesions are mucus in the trachea, and usually hemorrhage in the intestine, particularly in the proventriculus and caecal tonsils. It should be borne in mind that all the preceding signs and lesions can be caused by other diseases also.

Laboratory Diagnosis

The preferred method of diagnosis is validated reverse transcription polymerase chain reaction (RT-PCR) and sequencing. Virus isolation in embryonated eggs remains an important laboratory tool. In addition, RT-PCR and sequencing are widely used for the determination of the virulence of APMV-1 viruses. Real-time RT-PCR targeting a highly conserved gene overcomes wide heterogeneity in the fusion (F) or Haemagglutinin-Neuraminidase (HN) gene

Follow SOP - developed by ICAR-NIHSAD - for performing all the steps in disease diagnosis including sample collection, labeling, packaging, transportation, as well as testing in the laboratory(ies).

Action to be taken in case of outbreak

In the event of a suspected outbreak or mortalities that match the case definition, the following steps may be taken Critical Activities and Tools for Containment and Control of Ranikhet Disease:

- Public awareness campaign
- Swift imposition of effective quarantine and movement controls
- Rapid diagnosis and reporting
- Epidemiological investigation and tracing
- Increased surveillance
- Continuity of business measures for non-infected premises and non-contaminated animal products
- Biosecurity measures
- Effective and appropriate disposal procedures
- Cleaning and disinfection measures
- Vaccination (as the response strategy indicates)

For investigations of severe disease and high mortality in poultry flocks, it is usual to attempt virus isolation from recently dead birds or moribund birds. Samples from dead birds should include intestinal contents (faeces) or cloacal swabs and oropharyngeal or tracheal swabs. Samples from lungs, air sacs, intestine, spleen, kidneys, caecal tonsils, brain, liver, and heart should also be collected and processed either separately or as a pool. When pooling samples, the brain should be collected and processed first (to avoid cross-contamination with other tissue types) and kept separate as the presence of virus in the brain may be an indicator of NDV or HPAI. Samples from live birds should include both tracheal or oropharyngeal and cloacal swabs, the latter should be visibly coated with faecal material. To avoid harming them, swabbing of small delicate birds should be done with the use of especially small swabs that are usually commercially available [Caution: Some influenza A viruses and type 1 avulaviruses in birds can have a strong respiratory tropism.

Zoning of outbreak area: In case of an outbreak of ND, the zoning of the area should be done and movement of farm personnel, workers, labourers, etc., should be restricted and SOP protocols determined as per prevalent conditions must be followed for collection of dead and diseases birds, etc. Outbreaks are contained with quarantine, movement control, depopulation of all infected and exposed birds, and thorough cleaning and disinfection of premises.

Prevention and Control

Vaccines are available for chickens, turkeys, and pigeons and are used to induce an antibody response. Live lentogenic virus vaccines, chiefly B1 and LaSota strains, are widely used and typically administered to poultry by mass application in drinking water or by spray. Mucosal immunity induced in birds vaccinated with live virus vaccines applied by these routes decreases the amount of the vNDV while the birds vaccinated with an inactivated virus vaccine will shed more virus if infected with vNDV. Oil-adjuvanted inactivated virus vaccines are also used after live virus vaccine in breeders and layers. They may be used alone in situations where live viruses may be contraindicated (*e.g.*, in pigeons). The frequency of revaccination to protect chickens throughout life largely depends on the risk of exposure and virulence of the field virus challenge. Administering inactivated virus vaccines is more labor-intensive, because each bird has to be handled individually.

Good biosecurity can help protect poultry flocks from ND and control of spread of an outbreak in a farm. Flocks should not be allowed to contact domesticated poultry of unknown health status, any pet birds (particularly psittacine), and wild or feral birds (particularly cormorants, gulls, and pigeons). Workers must avoid contact with birds outside the farm. Biosecurity measures include bird-proofing houses, feed and water supplies, minimizing travel on and off the facility, and disinfecting vehicles and equipment that enter the farm. Pests such as insects and mice should also be controlled. If possible, employees should take showers and change into dedicated clothing for work.

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.9)

2.11 PULLORUM DISEASE AND FOWL TYPHOID

Pullorum Disease (PD) and Fowl Typhoid (FT) are two distinct septicemic diseases specific for avian species (poultry and other production species including game birds, ducks and guinea fowl) that remain of major economic significance in many parts of the world. FT, caused by *Salmonella Gallinarum*, is an acute or chronic septicemic disease that usually affects adult birds, although birds of all ages may be susceptible. PD, caused by *Salmonella Pullorum*, is an acute systemic disease more common in young birds.

Case Definition

Suspected case: A case with a history of sudden death or with clinical signs of dull, depressed, increased thirst, drop in appetite, paleness of combs, wattles and face and droppings being yellow tinged.

Probable case: - A suspected bird case/ death with history of exposure to fowl typhoid affected birds and with postmortem lesions of coppery bronze sheen liver, enlarged spleen,

Clinical signs & Postmortem lesions

Host	Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Young Birds	Nonspecific signs of acute septicemia such as depression, weakness, loss of appetite, drooping wings, huddling, labored breathing, dehydration, ruffled feathers, white and viscous diarrhea, fecal pasting around the vent	Affects chicks less than 3-4 weeks of age Peak mortality: 2-3 weeks, High mortality in young birds	If hatched from infected eggs, some embryos may die in the egg, and dead and dying chicks can be found soon after hatching
Older Chicks	Less acute course, arthritis affecting various joints, especially the hock joints	Affects chicks less than 3-4 weeks of age Peak mortality: 2-3 weeks, High mortality in young birds	

catarrhal enteritis, pericarditis and retained yolks.

Confirmed case: A probable bird case/ death that is laboratory confirmed by bacterial isolation and identification.

Pullorum Disease

Etiology

Salmonella is a rod-shaped, Gram-negative, facultative anaerobic bacterium belonging to the *Enterobacteriaceae* family.

It encompasses two main species, *Salmonella bongori* and *Salmonella enterica* (*S. enterica*), Among the various serovars of *S. enterica*, *Salmonella Gallinarum biovars Gallinarum* (*SG*) *and Pullorum* (*SP*) are notable for their unique characteristics. Unlike most *Salmonella* members, *SG* and *SP* are non-flagellated and non-motile and serologically identical. Pullorum disease is caused by *Salmonella Pullorum* which is a Gram-negative bacterial rod in Salmonella serogroup D in the family Enterobacteriaceae.

Epidemiology

Pullorum disease and fowl typhoid are endemic and prevalent all parts of India. Pullorum disease is an infectious, egg-transmitted disease of poultry, usually affects young chicks, characterized by white diarrhoea and high mortality in young birds and by asymptomatic adult carriers. *Salmonella* Pullorum usually causes illnesses in chicken, turkey, and game birds.

Mode of transmission

Pullorum disease can be transmitted orally (*e.g.*, in food and water or by cannibalism) and *via* the respiratory tract. Causative organisms may also enter the body at other sites, such as in wounds. Vertical transmission is important in the epidemiology of pullorum disease. Some infected poultry become long-term asymptomatic carriers of *Salmonella Pullorum* and transmit it to their progeny in eggs. Although only a small number of eggs may be infected, horizontal transmission can amplify the outbreak after the chick's hatch. *Salmonella Pullorum* may survive for several months in the environment. Wild birds, mammals and insects can act as mechanical or biological vectors.

Common lesions in recently hatched birds with pullorum disease include unabsorbed yolk sacs, which sometimes have evidence of infection (*e.g.*, creamy or caseous material), peritonitis, congested lungs and a dark, swollen liver. Some chicks only have signs of septicemia, with dilated subcutaneous blood vessels and a congested liver. Chicks that survive longer frequently have typhlitis with firm, cheesy material in the caecum (necrotic cecal casts) and small white or grey necrotic foci or nodules in the liver, spleen, lungs, heart and other viscera. Some nodules may resemble the tumors of Marek's disease. Liver lesions are reported to be less common in young pheasants than young chickens, but lung lesions (white or pale nodules) can be prominent in this species. Swollen joints (arthritis) with cream-colored, yellow or orange, and gelatinous or viscous exudate can be seen occasionally in chicks. The anterior chamber of the eye contained exudates in birds with ocular lesions. Mis-shapen, discolored and/or shrunken ovaries are the most consistent gross lesion in adult carriers of Salmonella Pullorum. The affected follicles are often attached by

pedunculated fibrous stalks, and the abnormal ova may contain encapsulated caseous and oily material. In some birds, ovarian dysfunction leads to peritoneal ovulation or impaction of the oviduct and can result in fibrinous peritonitis. Additional lesions, such as pericarditis, arthritis, or necrotic foci in the testes can also be seen in some carriers.

Laboratory Diagnosis

In young chicks - typical history, clinical signs and lesions may suggest pullorum disease. For confirmatory diagnosis, *S. pullorum* must be isolated and identified from affected birds. PCR tests can be used to identify *S. pullorum* directly in tissues. Serology can be employed as a flock test or to help identify chronically infected birds in control programs. Serological tests used in poultry include the rapid whole blood plate agglutination test, the rapid serum agglutination test, and ELISA. Diseases that must be differentiated from pullorum disease in young chicks include chilling, omphalitis, typhoid, paratyphoid and colibacillosis.

Prevention and control:

Treatment of affected birds is unreliable and unsatisfactory. Treatment can perpetuate the carrier state. It may be possible to eliminate the disease in valuable flocks by repeated testing and application of rigorous biosecurity practices. Mortality in young birds can be suppressed by good husbandry and the use of sulpha drugs or broad-spectrum antibiotics. Control is based on routine testing of breeding stock to ensure that the flock is free from infection.

Fowl Typhoid

Etiology

Fowl typhoid is an infectious disease primarily of growing and adult poultry. Fowl typhoid is caused by *Salmonella Gallinarum*, a Gram-negative bacterial rod in Salmonella serogroup D in the family Enterobacteriaceae. It usually causes illnesses in chicken, turkey, and game birds.

Mode of transmission

Fowl typhoid can be transmitted orally (*e.g.*, in food and water or by cannibalism) and via the respiratory tract. Causative organisms may also enter the body at other sites, such as in wounds. Although *Salmonella Gallinarum* has been detected in eggs, vertical transmission to progeny has been difficult to reproduce experimentally. Wild birds, mammals and insects can act as mechanical or biological vectors. Red mites (*Dermanyssus gallinae*) appear to be involved in spreading fowl typhoid and may maintain these bacteria for several months. The incubation period is 4 to 6 days.

Birds with acute fowl typhoid typically have generalized signs of septicemia and a dark, enlarged, friable liver than often has a coppery bronze tinge. This bronze discoloration may only develop after the liver is exposed to air. Catarrhal enteritis with viscous, bile-stained, slimy intestinal contents is common. The bone marrow is typically dark brown. In more chronic cases, the carcasses may be intensely anemic and wasted or emaciated, and fibrinous pericarditis is common. Focal necrosis may be detected in the heart, liver, intestines and pancreas of chronically affected birds.

Laboratory Diagnosis

Fowl typhoid can be diagnosed by isolating *S. gallinarum* from affected birds. PCR tests can be used to identify *S.gallinarum* directly in tissues (Spleen, liver, ovary). Serology can be employed as a flock test or to help identify chronically infected birds in control programs. Serological tests used in poultry include the rapid whole blood plate agglutination test, the rapid serum agglutination test and ELISA. As *S.gallinarum* has the similar antigenic structure as *S. pullorum*, the

Clinical signs & Postmortem lesions

Clinical Signs	Incubation Period, Morbidity, and Mortality	Other Notes
Depression, decreased appetite, weight loss, dehydration, ruffled feathers, watery to mucoid yellowish diarrhea, respiratory distress, decreased egg production, hatchability, and fertility, progressive loss of condition, anemia with pale, shrunken combs and wattles	Incubation: Not specified Morbidity: High in chicks Mortality: High in chicks	Dead and dying chicks may be found soon after hatching, like Pullorum disease

rapid plate agglutination test, using *S pullorum* antigen, can be used to detect carriers of *S. gallinarum*

Prevention and control:

Reinfection of susceptible birds with the development of clinical disease may also occur, with the disease recycling in the flock. To exclude *S. gallinarum* from a poultry flock, live birds and eggs should be purchased from stock known to be free of these organisms or tested. Disease-free flocks should not be allowed to contact infected birds or contaminated environments. Good biosecurity is also important in excluding organisms that may be present on fomites and visitors. To the extent feasible under the production system, rodents and wild birds should be excluded from the facility, and potential insect vectors or reservoirs, including poultry mites, should be controlled.

Fowl typhoid vaccines (SG9R) can be used in chickens in endemic areas. Two vaccines at the age group of 6 weeks and 18 weeks are generally administered. Vaccination can protect birds from clinical signs and mortality, but it does not prevent them from becoming infected and protection may be short-lived.

Because *S. pullorum* and *S. gallinarum* show chronic persistent infection and varying degrees of vertical transmission, the chain of infection can be broken by identifying carriers with specific circulating IgG. This can be done either by slide agglutination test using stained Pullorum antigen containing an anticoagulant or by ELISA.

Action to be taken in case of outbreak

In the event of a Pullorum Disease & Fowl Typhoid outbreak, immediate actions should include:

- **Isolation:** Separate infected birds from healthy ones to prevent further spread of the disease.
- **Veterinary consultation:** Seek advice from a veterinarian for diagnosis and treatment options.
- **Disinfection:** Thoroughly clean and disinfect all equipment, premises, and vehicles to eliminate the spread of the bacteria.
- **Vaccination:** Consider vaccinating susceptible birds to prevent future outbreaks.
- **Surveillance:** Monitor the health of birds closely and report any unusual symptoms to veterinary authorities.
- **Biosecurity measures:** Enhance biosecurity protocols to prevent the introduction of the disease to other poultry farms.
- **Proper disposal:** Dispose of infected birds, carcasses, and contaminated materials properly to prevent further transmission.

The basic requirements for importing poultry and poultry products are outlined by the World Organisation for Animal Health (WOAH) in the Terrestrial Animal Health Code, 2023 (Chapter 10.7)

CHAPTER -3

Surveillance and Laboratory Network

Surveillance

Effective surveillance of avian diseases, encompassing those affecting migratory birds and a variety of poultry species is crucial. This surveillance should prioritize high-risk areas, including poultry farms, live bird markets, wetlands, and border regions, and must be conducted regularly. A comprehensive approach involving clinical, and microbiological, serological surveillance at designated laboratories, supported by scientifically rigorous protocols for sample collection, packaging, and transport, is essential to ensure the accuracy and reliability of the data collected

The surveillance program should include an early warning system throughout the poultry production, marketing, and processing value chain for reporting suspicious cases with objectives like:

- Early detection of clinical disease and infection
- Assess the disease's temporal and spatial patterns to improve control efforts' effectiveness
- Demonstrate freedom from the disease
- Identify the avian population at risk.

The population at risk of infection with various poultry diseases includes:

- Commercial birds- High-density population of chicken and ducks
- Backyard Birds – chickens, ducks, pigeons and other species
- Wild/migratory birds
- Live bird markets including wet markets particularly at the border areas (affected country/state/area).

The Surveillance Plan is an ongoing activity and may be updated from time to time based on new requirements, experience gained, scientific knowledge, and epidemiological studies. In the meantime, ICAR-NIVEDI is in the process of developing a detailed sampling plan for surveillance of the poultry diseases based on the inputs and expert consultation from the Department.

Environmental Surveillance

Environmental surveillance in poultry diseases involves systematically monitoring the farm environment to detect and assess potential health risks. This includes identifying high-risk areas, collecting samples from air, water, soil, feed, and equipment, conducting laboratory tests, analyzing data to identify disease trends and risk factors, and implementing control measures. Effective surveillance targets key pathogens, considers sampling frequency and laboratory capacity, and fosters collaboration between poultry producers, veterinarians, and public health authorities to prevent disease outbreaks, protect animal health, and ensure safe poultry products.

Surveillance strategies

Surveillance aimed at the identification of disease and infection and should cover all the susceptible poultry species within the country, zone, or compartment. Regular surveillance, including active and passive surveillance, should be an ongoing activity. Surveillance should be composed of random and targeted approaches using clinical, virological, and serological methods. Targeted surveillance, *e.g.*, based on the increased likelihood of infection in particular localities or species, may be an appropriate strategy for valuable clues on the disease. Special emphasis should be given on surveillance in Live Bird Markets (LBMs), wetlands, border areas, areas with high bird density, and areas inhabited by wild and migratory birds to rule out any possibility of viruses/pathogens. Surveillance must include both poultry and migratory birds.

Tools in the detection of infection in the population under surveillance may start with

the detection of clinical symptoms or changes in production indices or may rely more heavily on the use of diagnostic tests. Passive surveillance systems can achieve a relatively high surveillance system sensitivity cost-effectively, given a large proportion of the target population (domestic poultry) is being observed frequently by producers for clinical symptoms that can be marked in certain host species. In contrast, active surveillance strategies tend to be substantially less sensitive in the early detection of disease incursions, as target population coverage and temporal coverage are relatively limited. Nevertheless, in some circumstances, passive surveillance may be inadequate as a stand-alone tool for early detection. In these cases, supplementation with active surveillance approaches may be necessary to raise sensitivity in the early detection of infection—for example, in wild birds where clinical signs or mortality may be minimal and/or difficult to observe. Targeting such active surveillance strategies based on risk, to augment passive surveillance for early detection of infection, is most efficient and effective when based on detailed and objective risk data

States should follow the surveillance plan by taking an epicenter/designated area as an epidemiological unit. As regards migratory/wild birds, the State Animal Husbandry Department shall carryout the surveillance in cooperation with State Department of Health, Forest, Local bodies, *etc.*

The surveillance plan shall consider the following:

- Population and density of poultry in each block, both in backyard and commercial establishments, flyways of migratory-birds and wetlands
- Live-bird markets including wet-markets
- Existence of Wildlife Sanctuaries, National Parks, Water bodies, Wetlands visited by migratory/wild birds
- Interstate borders with the affected States

The surveillance strategy may be divided into the following parts

- Surveillance should be carried out with multi-stage stratified cluster random sampling
- The State Animal Husbandry Departments should ensure the collection and transportation of the samples in accordance with the sampling plan (in consultation with laboratories).

Surveillance in the Absence of Outbreak

There is a need to define and identify the population at risk of infection with poultry diseases in the first stage as per the bird population in the area.

Active Surveillance

Active surveillance is a specifically targeted investigation for evidence of poultry diseases in at-risk populations based on detecting exposure to (antibody detection by serology) or the presence of (virus or antigen detection through swabs). The veterinary authorities should visit commercial poultry farms, backyard poultry, and Live Bird Markets (LBMs) for clinical examinations and collection of samples.

Wild birds and Domestic poultry in Buffer Zones

Dead bird surveillance should be carried out in all the identified wildlife sanctuaries, water bodies, and buffer zones around such areas, especially in case of abnormal mortality of wild birds/ in poultry farms nearby. Fresh fecal samples of wild birds may be collected from their nesting places and water bodies. Wildlife officials, conservation organizations, participatory groups, and the public residing in the vicinity of water bodies are required to report dead birds to State AHD for necessary action. After proper wrapping, whole carcasses should be submitted for testing at NIHSAD/ RDDLs. Migratory waterfowl may be sampled by collecting fresh wet feces from areas used overnight by the birds in conjunction with wildlife officials.

An adequate number of serum samples from domestic poultry should be collected from buffer zones (national park, lake, and watershed areas) and buffer zones of each water body during the wild bird migration season (September to March). Border vigilance by the states bordering the neighboring countries shall be stepped up. All the samples for testing should be sent with the epidemiological inquiry form at the village level.

Passive Surveillance

All stakeholders like health and forest authorities, local bodies, poultry producers, entrepreneurs, associations, private veterinary practitioners, community organizations, wildlife officials, NGO participatory groups, veterinary institutions, and village/community animal health workers are required to report to the nearest veterinary authority for any unusual sickness or mortality in poultry and other species of birds.

Collect swab samples from sick birds and collect dead birds from specific bird populations at risk

- Swab samples shall be taken from the oro-pharynx, cloaca, or fresh wet feces.
- Tracheal samples are best for species with pathogens accumulating in the respiratory tract (chickens)
- Cloacal swabs are best for species with pathogens accumulating in the intestinal tract (ducks)
- Fresh, wet feces swabs are useful for birds that are not handled (wild birds) or where it is uncommon to see sick or dead birds (live market and wild). Fresh droppings from live bird market and wild water bird zone.

Dead birds: After proper wrapping, whole carcasses should be submitted for testing as per the instructions for packaging for maintenance of cold chain and mode of transport

Surveillance during the outbreak

The surveillance team may include the District Veterinary Officer/Veterinarian, Veterinary Technician, and Helper. The number of surveillance teams shall depend upon the number and size of the outbreak and risk. Such teams shall be appointed by the Director, AH of the State, and shall work in association with the control room. Such teams shall formulate surveillance programs and roadmaps in their respective areas as per the surveillance plan.

Visit all the commercial poultry and backyard poultry premises- clinical surveillance followed by sampling of sick/dead birds dailyVisit live bird markets, poultry distributors, slaughter facilities, and other key stakeholders very frequently if not dailyConduct community dialogue and sample collection as indicated based on clinical surveillance daily.

Laboratory Network

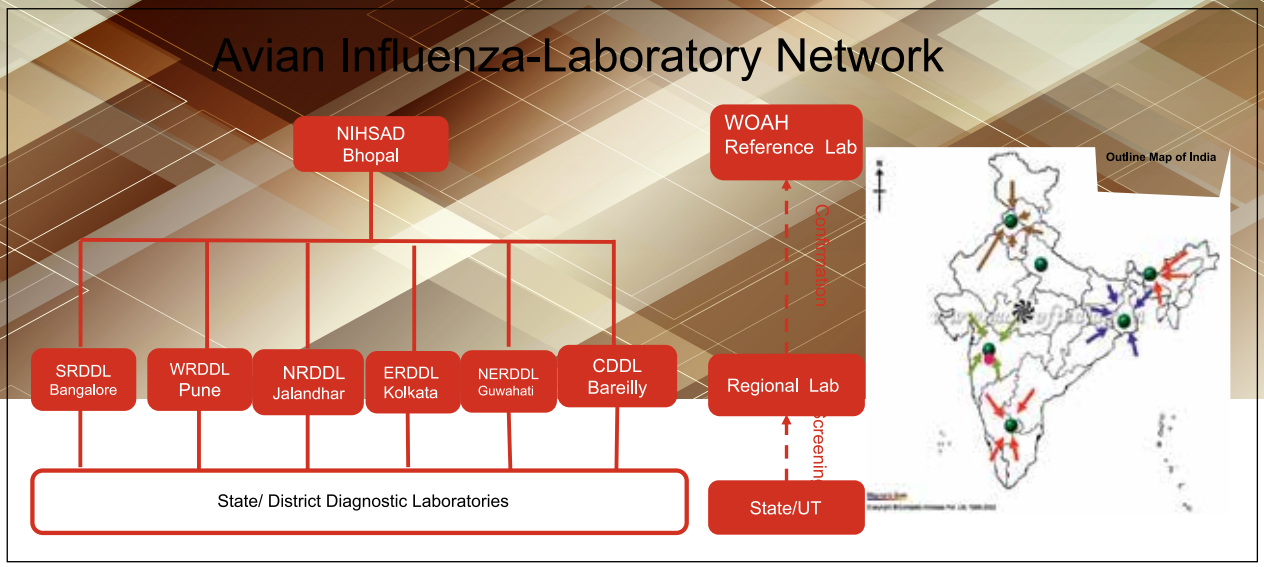
Indian commercial poultry has its poultry disease diagnostic laboratories. These disease diagnostic laboratories have never been evaluated. Therefore, under this action plan, these poultry disease diagnostic laboratories will be accredited for disease diagnosis provided they follow the diagnostic methodologies/ procedures as per the standards of WOAH Reference Laboratories. These accredited laboratories will be duty-bound to abide by the guidelines of the Government of India and they shall follow the extant provisions under The Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009.

Reference laboratories for each of the poultry diseases will be designated and notified by the Department of Animal Husbandry & Dairying.

Registration of Poultry Farm: The registration of poultry farms is necessary for monitoring animal diseases. The Layer Farm should follow the guidelines as prescribed in the Prevention of Cruelty to Animal (Egg Laying Hens) Rules, 2023. In the case of the other production systems, they shall be registered by the State Government for which DAHD will develop the necessary guidelines and mechanism(s) of notification.

Laboratory Information Network Management System (LINMS): The DAHD will develop a LINMS wherein the private, government laboratories desirous of poultry disease diagnosis may request for accreditation/ approval from the DAHD. Necessary SOP for accreditation process will be notified by DAHD under the action plan.

India has got the WOAH Reference Laboratory for Avian Influenza at ICAR-National Institute of High Security Animal Disease (ICAR-NIHSAD), Bhopal. This laboratory has been designated by the Department of Animal Husbandry and Dairying (DAHD) to confirm any case of Avian Influenza in the country. To support the screening of samples and for preliminary diagnosis; DAHD is supported by a Network of central and regional laboratories, *viz.*, 05 Regional Disease Diagnostic Laboratories, *viz.*, Northern Regional Disease Diagnostic Laboratories (NRDDL) at Jalandhar in Punjab; North-Eastern Regional



Disease Diagnostic Laboratories NERDDL) at Guwahati in Assam; Eastern Regional Disease Diagnostic Laboratories (ERDDL) at Kolkata in West Bengal; Southern Regional Disease Diagnostic Laboratories (SRDDL) at Bengaluru in Karnataka; and Western Regional Disease Diagnostic Laboratories (WRDDL) at Pune in Maharashtra and one Central Disease Diagnostic Laboratories (CDDL) located at ICAR-IVRI, Izatnagar, Barielly in Uttar Pradesh. Further, there are State Animal Disease Diagnostic Laboratories that can conduct the initial diagnosis of the poultry diseases for which they are being strengthened.

Approach to surveillance for early detection of infection

Domestic gallinaceous poultry production and pet birds

In domestic gallinaceous poultry production, typically all poultry are observed frequently by the farmers/ producers, and clinical symptoms of disease and/ or changes in production metrics are sensitive indicators of the presence of most poultry diseases. Similarly, pet and zoo birds tend to be observed frequently over time. In these cases, passive surveillance and syndromic surveillance can be highly sensitive tools for the early detection of disease incursions in these groups.

Domestic waterfowl production

In domestic waterfowl (and possibly some other domestic avian species), population coverage and temporal coverage of passive surveillance may be very good. However, subclinical infection across an infected flock is more likely than in gallinaceous poultry. In this circumstance, supplementation of passive surveillance with active surveillance approaches may be appropriate to increase surveillance system sensitivity in the early detection of infection. For avian influenza, a risk-based or sentinel approach may be taken in domestic waterfowl populations, to maximize the cost-effectiveness of using active surveillance to increase surveillance system sensitivity for early detection of infection (as compared to using representative-sampling survey approaches). Production systems with relatively poor biosecurity practices, or on high-risk wild bird migratory pathways, are also options for risk targeting.

Live bird markets

In live bird markets, passive surveillance should be encouraged. As for domestic waterfowl production, risk-based active surveillance can be used to improve the sensitivity of surveillance for early detection of infection in live bird markets. The risk basis for sampling would be targeting birds with clinical symptoms consistent with disease infection, and species where subclinical infection is relatively likely to occur.

Wild birds

In wild birds, population coverage is inherently poor, so passive surveillance is a relatively insensitive tool for early detection surveillance. Active surveillance strategies are

similarly limited in early detection surveillance sensitivity, given limited population coverage and limited temporal surveillance coverage. In these cases, a targeted combination of approaches to surveillance is most likely to maximize the sensitivity of detection of AI incursions in these populations. Risk-based active surveillance strategies can target species of birds and migratory pathways considered high risk for the spread of avian influenza, and particularly in regions in close contact with poultry production (especially where production is free-range) for the benefit of early warning to poultry production. Areas of congregation of wild birds considered a substantial risk for AI could also be targeted (e.g. wetlands associated with migratory bird populations).

CHAPTER -4

Biosecurity Guidelines for Backyard and Commercial Poultry Farms

The poultry industry is one of the largest sectors of animal husbandry in India and most of the farmers rely on poultry rearing for living. In addition, the poultry sector is also catering to the nutritional needs of people, thus adding more weight to it. Hence, it`s quite important to ensure a smooth management of the poultry sector in the country with minimal issues.

Coming are the days laden with novel infections and pathogens, and we are at the precipice where we are bound to be stringent in every sense with respect to animal rearing and food safety as zoonotic infections have been on the rise lately. Any disease or pathogen affects the health of the flock and the overall performance of the farm and thus, adhering to proper biosecurity guidelines would ensure minimal spread of the disease in the farm environment. Preventing the introduction and dissemination of any pathogen into the poultry establishment would form the cornerstone of formulating the biosecurity guidelines and these would be further potentiated with the implementation of Good Agricultural Practices and Hazard Analysis Critical Control Point (HACCP) systems. In addition, biosecurity measures would also encompass the safety of meat and eggs for human consumption which is of immense significance considering its public health impact.

An integrated biosecurity program is an application of logical and sound principles specific to an enterprise, monitoring of disease status, and evaluation of ongoing poultry farm operations on a continuous basis with an objective to contain the diseases at a bare minimum level.

Objectives

The biosecurity measures are designed considering in mind the following two objectives:

- Ensuring the good health status of the flocks and workers.
- Preventing the entry and spread of pathogens across farm establishments.

Components

Biosecurity guidelines need to be designed, under different components to ensure a proper and comprehensive emphasis on all the crucial aspects of farm management. Across the divisions, several important aspects are to be taken care of, *viz.*, species of bird being reared, location and layout of the establishment, source of water and feed supply, disease prevalence in the area, proximity to other farms, *etc.* Summing up these factors, biosecurity could be

- Structural biosecurity
- Operational biosecurity
- Managemental biosecurity
- Personnel biosecurity

Structural biosecurity

This concept encompasses all aspects related to facilities and equipment. Poultry farms should be designed to facilitate biosecurity measures to limit access of unauthorized persons to poultry production areas and to prevent access by other animals, both domestic and wild.

Location

- The farm should be away from any other poultry farms or water bodies that are populated by wild birds
- New farm should preferably be established:
- The farm should be 1-2kms away from any commercial facility
- A three-meter boundary of land around the building must be kept free of all vegetation

to prevent rodent and wildlife activity. Landscape - trees and shrubs should be selected to minimize wild bird attraction, particularly in free-range operations

- Distance between two sheds of the same type of birds should be 30 feet, whereas between different types, 100 feet distance should be maintained
- There should be a single window system for the sale of all poultry & poultry products with a sale counter at the entrance gate
- Client and their vehicle should not be allowed in any case to visit farm or hatchery.

Perimeter

- The farm needs to have a clear-cut defined perimeter with fencing to avoid the entry of any unwanted animal or personnel, largely curtailing the contact of external factors to the birds
- The perimeter should be fenced with a single access gate that will always be kept closed and with signage like "no trespassing", "Biosecure Area No Entry Unless Authorized" or similar wording, should be displayed
- The surrounding landscape of the farm should have fewer trees, no overhanging branches, no shrubs or dense foliage so that the farm does not harbor any wild birds, wild animals, rodents, or other vermin.

Orientation

The farm orientation is crucial to ensure proper sunlight and ventilation to the flock and the farm itself so that the disinfection and airflow are properIf the farm is in the cold regions, the farm orientation should be such that, the long axis is along the North-South directionIf the farm is in hot and humid regions, the farm orientation should be such that the long axis is along the East-West direction

If the farm is in the zones with very high temperatures in summer months, the farm orientation should be such that the long axis is along South – East direction.

Drainage

The farm structure must ensure that there is proper drainage of the farm effluent and other wastes so that there is no stagnation of water since such water bodies can serve as a source of water to migratory waterfowl and shore birds.

Working principle

In poultry farms, the establishments should be such that they must be designed to have a single species/single production flock in a shed at any point of timeAn "ALL–IN–ALL–OUT" principle should be employed such that the flock of a similar age group should be taken in all at once and would be cleared all at once. This ensures minimal infections in the flock.

Shed pattern

Starting from the entrance point of the farm – the first ones must be the brooder sheds, followed by the grower shed and then the adults shedSheds should have a 1 to 2 m wide strip of concrete, gravel or neatly cut grass around the perimeter, and this area should always be kept free of waste material, weeds, garbage, or unused equipment. This will reduce potential hiding places for vermin or nesting areas for wild birds and help reduce the presence of rodents around the housesEach broiler requires one square foot of floor space while a layer requires two square feet of floor space under a deep-litter system of rearing. So, the size of the house depends on the number of birds to be rearedThe height of the sides from the foundation to the roof line should be 6 to 7 feet (eaves height) and at the center 10 to 12 feet. In the case of cage houses, the height is decided by the type of cage arrangement (3-tier or 4-tier)The foundation of the house should be of concrete with 1 to 1.5 feet below the surface and 1 to 1.5 feet above the ground levelThe door must be open outside in case of deep-litter poultry houses. The size of the door is preferably 6 x 2.5 feet. At the entry, a footbath should be constructed which will always be filled with a disinfectant.

Operational biosecurity

This concept would include all those operations that are routinely performed on a farm on a regular basis, such as personnel entry, vehicle entry and disinfection, pest control, waste disposal, *etc.* These routine operations must be clearly described in the corresponding farm operating procedures manual.

Prevention strategies

Several prevention strategies are mandatory in a farm establishment to ensure minimal spread of infections to the flocks and to maintain a healthy environment.

Bait stations

- Bait stations are an effective means of vermin control in poultry farms
- Over the course of time, at places of severe rodent or other vermin population, the bait stations could be increased in number.

Foot dips

- Foot dips are to be located at the entrance of the farm so that the foot and shoes of the personnel entering the farm would be thoroughly disinfected
- 50% lime powder and 50% bleaching powder is an effective combination for foot dipsFoot baths need to have a Sole scraping facilityFoot dips can accumulate organic matter, and disinfectants may lose effectiveness due to sunlight, rainwater dilution, or contamination with mud or organic material. Therefore, regular replenishment of the disinfectant is necessary.

Vehicle disinfection

- Before loading any consignment regarding the poultry, the vehicle needs to be thoroughly disinfected using any non-corrosive disinfectant
- The vehicles are to be allowed into the farm only when needed.

Farm waste management

- Litter and manure must not be stockpiled in the production area. Litter and manure must be stored in an appropriately designed storage area, off the production area, with sufficient buffering zone from the bird sheds and enclosures
- Poultry manure should be left undisturbed for at least 90 days and then can be used as fertilizer. High-risk farming practices such as use of contaminated water and recycling of poultry waste without treatment should be stopped
- Effluent generated from poultry processing of manure can also be disposed off after treatment with acids such as hypochloric acid 2% or citric acid 0.2% or with alkali treatment such as Sod. Hydroxide 2% or sodium carbonate anhydrous 4%
- Dead birds should be removed quickly and properly, to ensure no contact with other birds. The best way to dispose of the dead birds is by rendering, burial or incineration
- The Bio-Medical Waste (Management & Handling) Rules, 2016 under Environment (Protection) Act, 1986 should be referred for the appropriate disposal of some biomedical wastes.

Feed Safety

- To avoid on-farm contamination of feed by rodents or wild birds, silos should always be kept closed and any feed spillage should be cleaned up immediately
- Hazardous microorganisms in feed can be inactivated by heating or irradiation, while acidification of feed and use of controlled storage conditions may also be of value
- Feed should be pelleted to achieve pasteurization. This requires a temperature of 82°C for at least 30 seconds to eliminate enteric bacteria. Maintaining Good Manufacturing Practices and careful monitoring of the pelleting process will reduce the probability of infection
- Either feed plant personnel should be trained in the selection, application or control of pesticides and rodenticides, or a licensed applicator should be used. This may reduce the probability of accidental contamination of feed or contravention of regulations
- Analysis of feed for mycotoxins or other toxic components should be a part of regular biosecurity measures.

Pest control

Pests are significant disease-carrying vectors. An effective pest control program is essential to minimize disease transmission by pests which act as active and passive vectors. Minimizing pest populations reduces the risk of disease transmission.

- Maintain premises to minimize pest infestations by properly storing feed, eliminating water leaks, and practicing good housekeeping (*e.g.*, removing debris, recycling old tires and equipment, securing temporary garbage storage)
- Implement and document a targeted control program to eliminate or reduce rodent and insect populations.

Rodent control

Rodent-proof buildings, repairing visible damage as it occurs.

- Ensure Rodent-proof feed storageClean up feed spills immediately
- Clean up feed spills immediately
- Employ regular baiting (follow label instructions) or trapping. Adapt your pest control program to activity and seasons

Dispose of rodent carcasses immediately. Handle carcasses while wearing gloves and dispose them of in a manner so that prevents access by pets or wildlife, such as by incineration.

Insect control

- Eliminate or control fly-breeding areas such as wet manure, decaying birds, and low-lying areas where stagnant water can accumulate, especially in warm weather
- Remove mortalities from the barn/pasture at least once a day and dispose them of in a manner acceptable under the Environmental Management Act, Health Act, and Agriculture Waste Control Regulation, etc.
- Apply insecticides as necessary (misting, residual sprays, at clean out)
- If spraying for flies, regularly clean up all dead flies.

Wild bird control

- Screen all poultry shedopenings
- Avoid using wild bird feeders
- Use trees sparingly for dust control on the barn's exhaust side and remove unnecessary trees and shrubs near the barns
- A routine pest control program designed and supervised by a pest control specialist is highly recommended over a self-directed approach. Professionals bring an understanding of pest biology, resulting in more effective control
- To prevent disease transmission from wild birds to free-range flocks, use netting over the enclosure as a barrier. This measure is highly recommended and maintains the free-range status while keeping wild birds out

Record Maintenance

- On an individual flock basis, the records are to be maintained up to date. This ensures a thorough traceability of any complication that arises in the flock
- Records pertaining to the following aspects must be maintained
- Flock health
- Diseases in the flock
- Production records
- Medications
- Vaccinations
- Mortality
- Cleaning and disinfection
- Bird movement in and out of the farm
- Visitor logbook

Managemental biosecurity

The management of the farm involves a holistic approach in managing all the operations, personnel, and production of the farm regularly. This involves events like preparing a farm for bird delivery, managing the birds for a period, cleaning and disinfecting the farm, post-clearance management of the farm.

Preparing the farm for flocks

- The purchase of the flock should be made from a good breeder flock ensuring that they are free from any vertically transmitted infectious diseases
- Before stocking a farm, the entire farm must be thoroughly cleaned, disinfected and the disinfection should be further tested to verify the cleaning. If the farm had a previous flock that was known to be infected with any pathogen, in addition to regular disinfection verification, microbiological monitoring of the disinfection procedures is recommended
- The new birds are not immediately introduced into the farm if there is an already present flock of birds. Instead, they are kept separated from the old flock for at least 21 days and observed for any disease
- If the poultry farm has any infectious disease outbreak, then the new flock is not introduced immediately. The house must be kept empty for at least 3 weeks after clearance of the old flock
- It should be ensured that the shed houses birds of the same age group, even if the farm consists of birds of different age groups.

Cleaning and Sanitation

House cleaning is the most arduous phase of biosecurity and can be divided in two types

Complete / Terminal cleaning:

- Done after complete removal of the birds
- Removal must include the entire flock, manure, feathers, droppings
- Post removal, the sheds should be initially fumigated
- After fumigation, the sheds have to be disinfected
- Post disinfection, the sheds must be kept empty for at least 10 days.

Partial/Concurrent cleaning:

- Done while birds remain in the house
- The sweeping should be from top to bottom
- The waterers, feeders, jugs, containers and other farm equipment must be regularly disinfected with 5% Sodium hypochlorite
- In addition to iodophores, other disinfectants that could be used are SDS, formalin, and Iodine compounds.

Note: We should avoid carcinogenic substances in poultry farm operation.

Disinfection

- The clothes of the farm workers should be washed with laundry detergent. 2% dilute sodium hypochlorite is effective in this regard
- The floors, walls, ceilings, and equipment can be disinfected with Quaternary Ammonium Compounds (QAC)
- The floors can be disinfected with 2% Cresolic acid or 2% synthetic phenols. Use a minimum of 0.4 l / m2 floor space. Disinfect from the end to the front of the poultry house, and from the ceiling to the floor. Do not work with a water pressure of more than 10 to 12 bar
- Manure or farm effluent cannot be directly disposed of without treatment. It should be treated with 2% hypochloric acid or 0.2% Citric acid.

Cleaning and disinfection regimen

Cleaning and disinfection of the farm is a perennial procedure that must be performed in a defined manner. Firstly, the farm must be completely cleared off all the organic matter and this clearance is a pre-requisite to farm disinfection.

- Equipment - that could be dismantled - should be completely removed, disinfected, and put in for drying
- If hens are kept in an alternative housing systems, like free range systems, treat the floor with lime at least once a year
- The drinking water circuit has to be completely flushed, refilled with detergent and descaling solutions. The circuit should be cleaned by manual cleaning methods as well as by vacuuming
- The cleaning should be done in a logical sequence – Ceilings first, followed by walls and then the floor. Similarly, the cleaning should be from inside to outside
- The entire farm should be sprayed with a disinfectant to eliminate any formation of biofilms
- Finally, fumigation of the farm must be done and left closed and empty for a minimum of 10 days.

Disposal of dead birds and other bio/ biomedical wastes

- Dead birds should be removed quickly and properly, to ensure no contact with other birds which will be helpful in removing the source of infected foci to poultry as well as to handlers
- The best way to dispose of the dead birds is by rendering, burial, or incineration
- Other wastes generated are Litter waste - shed cleanout with poultry manure and bedding materials, hatchery waste, biomass wastes like fallen tree leaves, twigs, *etc.*, biomedical wastes like syringe, needle, swabs, empty vials, and other used chemical containers
- Incineration, rendering, boiling, fermentation, composting, enzyme or sodium hydroxide treatment, autoclaving are some of the methods of destruction which may be followed as per the guidelines for proper disposal of the farm waste
- The Bio-Medical Waste (Management & Handling) Rules, 1998 under Environment (Protection) Act, 1986 should be referred for appropriate disposal of some biomedical wastes.

Medication/vaccination of birds

The birds should be provided requisite medicines and essential vaccines regularly, which can boost immunity such as vitamins, trace minerals and proteins. Deficiency of these will not only lead to decreased production but there will be more chances of getting infection in flock with low level of immunity. Anti-stress medication during hot weather and other stressed conditions may be given.

Flock profiling

- Analysis of feed for mycotoxins or other toxic components should be a part of regular biosecurity measures
- Environmental monitoring of Salmonella in poultry house should also be carried out regularly
- Isolation, identification and antibiogram of pathogenic organisms should be a part of biosecurity measures
- Stress reducing measures should be part of regular biosecurity measures
- Controlling environmental temperature is most important for removing summer stressPerson working with poultry operation should be educated about the disease, its transmission and prevention measures.

Documentation and Record keeping (*indicative list*)

- Outlay/map of the entire farm with clear demarcation of clean and dirty areas with unidirectional approach (one-way route) roads/ access points-roads and gates/ clean-dirty water demarcation, etc. and all colour codes should be displayed in office with Critical Control Points clearly marked and should be kept up to date.
- Personnel roster- shed-wise/ entry/exit time; duty /job chart-cleaning of shed, feeding pans/ watering channels, cage cleaning, litter turning, *etc.*
- Visitor's entry log
- Vehicle entry log
- Disinfectant spray schedule for houses; wheel/foot-dip change roster
- Trace-in and Trace-out for both consignments (chicks/Hatching Eggs, *etc.*) arrivals and transfers, respectivelyLog for feed/ equipment arrival and allocation shed-wise, in hatchery/disinfection of equipmentHealth check-up and cleanliness check-up schedules for personnel
- Vaccination and health register/record
- Schedule for vector/ rodent control program & monitoring
- Record of dead bird disposal, hatchery waste disposal, manure disposal
- Water sanitization schedule/water testing frequency
- Microbial load testing frequency in different areas - schedule of testing for ensuring freedom status from Salmonella, Coli, and Clostridium species.
- Salmonella testing schedule
- Shed cleaning/disinfection/fumigation schedule
- Record of separate sheds having single age group stocks, etc.
- Feed Testing schedule

Personnel biosecurity

The biosecurity measures related to the personnel are crucial as these personnel are involved in every activity related to the management and production of the poultry farm.

Farm personnel

- These workers are to be dedicated to each flock separately
- Workers working in one type of shed or the infected ones should not be allowed to work in the normal uninfected sheds
- These personnel should avoid contact with other pet birds or pigs before entering the farm.

Company/service personnel

- Protective clothing and footwear are mandatory when entering the farm premises
- The visits must be in a defined manner: They must visit the sheds with the younger flock first, followed by the older ones.

Repair/maintenance personnel

- If these repair personnel have already visited a farm the same day or has an association with pets or pet birds the same day, the visit should be avoided
- Compared to the earlier company personnel, these repair personnel are involved in handling of the farm equipment, entering

the sheds and are more closely associated with the flock, thus are a higher risk to the farm
- Their tools are to be thoroughly disinfected after each farm visit and are to be again cleaned thoroughly prior to putting them to use in a new farm.

Contractors/suppliers/visitors

- Any other visitors or neighbors or suppliers or others must have a proper need to enter the farm premises
- Their visit must be approved by the farm manager.
- Signing the visitor book is mandatory for these personnel.

Levels of biosecurity

Biosecurity guidelines can be divided into two levels for convenience in farm management.

Level 1: Routine biosecurity procedures

Level 2: High-risk biosecurity procedures

Level 1:

- These are to be followed on a daily basis.
- These procedures ensure that pathogens would not be carried into poultry production areas to a major extent
- These also reduce the risk of transmission of any infection
- These procedures can be considered as minimum requirements in a poultry farm.

The procedures under level 1 are:

- Documentation
- Perimeter establishment and fencing
- Proper drainage of the farm waste and effluent
- Establishment of proper baiting program across the farm
- Ensuring potable water quality – Standards if not met, are to be subjected to treatment procedures like Chlorination or UV Cleaning and managing the surrounding landscape with barely minimal foliage
- Measures to curtail vermin access to the farm
- Disease control and monitoring plan.

In case of any emergencies, like an unusual increase in mortality or drop in production, a disease alert should be raised by the farm manager.

In case of such an emergency, Level – 2 biosecurity guidelines come into play.

Level 2:

The owner needs to establish clear guidelines on such preparedness.

- The concerned authorities must be alerted
- All the facilities should be locked, with minimal movement
- No flock movement in and out of the farm
- No visitors are allowed except emergency personnel like service personnel
- No routine visits allowed
- Until the disease status is clarified, no birds or litter can be moved in or out of the farm.
- Disease control and monitoring plan

Appendix I: Biosecurity Monitoring/ Auditing Checklist

A.	Documentation and training
A1.	Is a copy of the current Biosecurity Manual held on the production area and readily available?
A2.	Has staff been given instruction/suitabletrainingin there levant biosecurity procedures?
A3.	Is a record kept of all relevant training received by employees?
A4.	Is a bird mortality register being maintained?
A5.	Is an appropriate bird movement register being maintained?

B.	Facility standards
B1.	Does the production area have a perimeter fence and can access routes be closed off to prevent vehicle entry?
B2.	Is there a sketch or map clearly defining the production area and the property, including all access roads and gates?
B3.	Is there adequate signage to inform visitors of the Biosecure Area and what action they should take?
B4.	Is there an off-site parking area for visitiors?
B5.	Are footbaths available and used at all entrances allowing personnel access to sheds?
B6.	Are the footbaths inspected daily and replenished as required?
B7.	Alternative to B5 and B6: is a separate pair of boots available and used for each poultry enclosure?
B8.	Is the area around the sheds neat and tidy? E.g. grass, vegetation
B9.	Are the sheds rodent proof? Is there a bait plan in position?
B10.	Is hand sanitizer or washing facilities available and used at all entrances allowing personnel access to sheds?
B11.	Are other livestock excluded from the production area or effectively restricted so that their faeces do not come in contact with poultry either directly or indirectly, e.g. water draining into poultry areas/ shed?
B12.	Are the sheds wild bird proof?
B13.	Are no other pet caged or aviary birds, pigs or any other animals held on the property?

C	Personnel standards
C1.	Is there a visitors' log book and are all production area vistors required to complete their details in the book?
C2.	Are the conditions of entry to the production area visitors required to complete their details in the book?

D	Water treatment
D1	Is there a Water sanitizing system in place for the production area?
D2	Is the effectiveness of the sanitizing confirmed by independent microbiological testing on an annual basis if required?

E.	Dead bird and bio-wastes disposal (including vaccine vials, needles, syringes etc.)
E1.	Is there an appropriate procedure in place for the disposal of dead birds and other bio-wastes?
E2.	Is the procedure both environmentally sound and biosecure?

F.	Health related records
F1.	Is vaccination record in place?
F2.	Are the details of medication and other management procedures, post-mortem report, sale of culled birds recorded?

Appendix II: Disease Outbreak Response

This section describes the processes and protocols to be utilized by the State Animal Husbandry Departments (AHDs) during a poultry disease outbreak. These processes and protocols are designed to enable execution of the responsibilities of the AHD and to integrate Central, State, local and industry efforts into an effective and coordinated approach to a disease outbreak in poultry.

Responding to a disease outbreak in poultry will involve the actions described below.

- **Disease Detection** - Investigate suspected animal disease and initiate preliminary poultry movement restrictions
- **Disease Control** - Quarantine infected and exposed premises and control movement of poultry and poultry products
- **Surveillance** - Develop surveillance plan based on epidemiological investigation
- **Epidemiology** - Determine the extent of the outbreak and/or confirm non-infected premises
- **Stabilization** - Control, prevent spread of and, as possible, eradicate disease
- **Business Continuity** - Protect economic viability and continuity of operations
- **Recovery** - Return affected premises to normal business operations

The Timeline for Disease Control Response Activities is given at Table 1

Table 1: *Timeline for Disease Control Response Activities*

Disease Outbreak Response Actions	12 hours Within a confirmed positive case	24 Hours Within a confirmed positive case	48 Hours Within a confirmed positive case	24 Hours Within determination of need	72 Hours Within determination of need
Disease Control -- Quarantine Infected and Exposed Premises and Control Movement of Animals					
Mobilize livestock disease-related incident command personal.					
Establish initial control areas.					
Enhance biosecurity procedures on infected, contact and susceptible premises.					
Establish quarantine zones for infected and contacted premises, +/- broader movement restrictions.					
Surveillance -- Develop Surveillance Plan Based on Epidemiological Investigation					
Develop a surveillance plan and implement existing diagnostic support.					
Epidemiology -- Determine the Extent of the Outbreak and/or Confirmed Non-Infected Status					
Implement epidemiological surveillance and diagnostic support plan in at-risk species and notify other states of trace-outs.					
Stabilization -- Control, Prevent Spread of, and, as Possible, Eradicate Disease					
Begin treatment, inoculation, and /or depopulation of animals at identified site.					
Begin decontamination and disposal procedures at identified site.					
Business Continuity -- Protect Economic Viability and Continuity of Operations					
Implement procedures for the creation of bio-secure transportation corridors to market or other key facilities for disease – free goods and animals.					
Develop procedures for managing contaminated products.					
Establish storage and/or disposal areas for animals or products stopped in transit.					

Appendix III List of Contributors and Stakeholders

The name of the contributors and stakeholders is given in alphabetical order and doesn't imply any hierarchy.

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