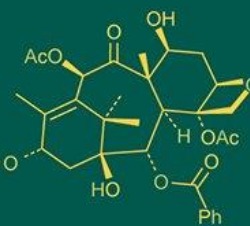
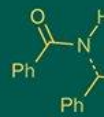


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Wildlife diseases human-animal-environment interface: An update

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Abstract

Newly identified and returning infectious threats in wildlife pose significant threats to biodiversity, ecosystem health, livestock production, and public health. Factors such as habitat loss, climate change, and increased wildlife-livestock-human interactions have accelerated disease emergence and transmission. This review highlights major wildlife diseases, including canine distemper, African swine fever, anthrax, and tuberculosis, focusing on their epidemiology, transmission, diagnosis, and conservation impacts. The necessity of an integrated human-animal-environmental health framework in disease surveillance, prevention, and control is emphasized. Strengthening integrated surveillance systems, molecular monitoring, and interdisciplinary collaborations is essential for effective wildlife disease management and global health security.

Keywords: Emerging, biodiversity, ecosystem health, livestock production, health, diseases, emergence

1. Introduction

Wildlife plays a crucial role in maintaining ecosystem stability and biodiversity. However, increasing anthropogenic activities, habitat fragmentation, climate change, globalization, and intensified interactions among wildlife, livestock, and humans have facilitated the outbreak of novel and returning contagious diseases in wildlife populations. These diseases not only threaten wildlife conservation but also pose significant risks to domestic animals and public health.

Emerging infectious diseases are those that have recently appeared in a population or are rapidly increasing in incidence or geographic range, whereas re-emerging diseases are previously recognized diseases that are reappearing after a period of decline. Wildlife species serve as important reservoirs and amplifying hosts for numerous pathogens, contributing to disease transmission across species barriers. Consequently, wildlife diseases have become a major concern under the One Health framework, which recognizes the interconnectedness of animal, human, and environmental health.

Among the most significant emerging and re-emerging diseases affecting wildlife are Canine Distemper, Avian Influenza, African Swine Fever, Anthrax, and Tuberculosis. These diseases have been associated with substantial wildlife mortality, population declines of endangered species, economic losses in livestock sectors, and potential zoonotic transmission. Understanding their epidemiology, transmission dynamics, ecological impacts, and control strategies is essential for effective wildlife health management and biodiversity conservation.

We look closely at the primary novel and resurging infections affecting wild animals today. In doing so, we examine their transmission patterns, disease mechanisms, and diagnostic methods, while highlighting what they mean for wildlife conservation and unified health strategies.

2. Drivers of Disease Emergence in Wildlife

2.1 Habitat loss and fragmentation

Habitat loss and fragmentation are recognized as major drivers of biodiversity decline and newly identified pathogens within wildlife populations. Anthropogenic activities including forest clearance agricultural expansion, urbanisation, and infrastructure development have

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caused the reduction and subdivision of natural habitats into smaller and isolated patches. These fragmented landscapes restrict wildlife movement, reduce genetic exchange, alter species distribution, and increase physiological stress, thereby making animals have weakened defenses against pathogens. Furthermore, habitat fragmentation increases interactions among wildlife, livestock, and humans, facilitating the transmission of pathogens across species barriers. Studies have reported that more than 70% of the world's remaining forests occur in close proximity to human-modified environments, highlighting the growing risk of disease spillover at the wildlife-livestock-human interface. Therefore, habitat loss and fragmentation play a crucial role in the rise and resurgence of contagious illnesses, which severely threaten both wildlife preservation and international public health.

2.2 Climate Change

Climate change is increasingly acknowledged as a major catalyst for new and returning wildlife diseases. When temperatures climb, rainfall shifts, and extreme weather hits more often, it directly alters how well pathogens survive, reproduction, and geographic distribution of pathogens and their vectors. Environmental shifts can accelerate the geographical expansion of vector-borne pathogens into new territories, introducing novel infectious agents to immunologically naïve wildlife populations [1, 2]. Furthermore, climate-induced alterations in wildlife migration, breeding behavior, and habitat use can modify host-pathogen interactions and enhance disease transmission. The ecological disturbances associated with climate change may also increase physiological stress in wildlife populations, reducing immune competence and increasing susceptibility to infection. Consequently, climate change has become a significant factor influencing disease dynamics at the wildlife-livestock-human interface.

2.3 Increased Livestock-Wildlife Interactions

Growing interactions between wild animals and livestock serve as critical drivers for both newly appearing and resurging transmissible diseases. In many pastoral and rangeland ecosystems, wildlife and domestic animals share grazing areas, water sources, and migration routes, creating opportunities for direct and indirect pathogen transmission. These interactions enable pathogens to cross species barriers while triggering resource competition and ecological disruptions. Furthermore, climate change, habitat degradation, and altered land use intensify contact at the wildlife-livestock interface. Understanding and managing interactions between wildlife and domestic animals is essential for promoting animal health, biodiversity conservation, and sustainable coexistence because it reduces increasing disease risks for both groups.

3. Canine Distemper

3.1 Etiology

Canine distemper is a highly transmissible viral infection caused by the Canine Distemper Virus (CDV), a member of the *Paramyxoviridae* family under the genus *Morbillivirus*. This enveloped, single-stranded, negative-sense RNA virus shares close genetic relationships with the measles and rinderpest viruses. Upon infection, CDV primarily targets and damages the respiratory, gastrointestinal, and central nervous systems of susceptible hosts.

3.2 Host Range

CDV exhibits an extensive host range, capable of infecting a diverse array of wild and domestic carnivores. Vulnerable populations include domestic dogs, wolves, foxes, jackals, raccoons, skunks, ferrets, and minks, alongside large wild felids like tigers and lions. Among these, domestic dogs function as the primary reservoir, frequently serving as the reservoir where wild animals contract the disease.

3.3 Epidemiology

Distributed globally, canine distemper remains one of the most critical infectious diseases affecting canine populations. It is most prevalent in puppies between 3 and 6 months old and within unvaccinated communities. Outbreaks are frequently documented in areas with low vaccination coverage, where the virus can easily spill over from domestic canines to cause devastating impacts on local wildlife.

3.4 Transmission

The primary route of transmission is through direct interaction with infected hosts or exposure to aerosolized respiratory droplets. Animals shed the virus through saliva, urine, feces, and ocular or nasal secretions. While indirect transmission via contaminated surfaces (fomites) is possible, it is less common because the virus cannot survive long in the environment.

3.5 Clinical Signs

The clinical presentation of canine distemper varies depending on the viral load and the stage of the infection. Frequent symptoms include:

- Elevated body temperature (fever)
- Lethargy and physical depression
- Loss of appetite (anorexia)
- Clear to thick pus-like discharge from the eyes and nose
- Persistent coughing and breathing difficulties (dyspnea)
- Gastrointestinal distress, including vomiting and diarrhea
- Roughening and drying of the nasal and paw tissues
- Neurological issues, including involuntary muscle spasms, uncoordinated movement (ataxia), seizures, and partial or full paralysis

3.6 Diagnosis

Veterinarians diagnose the disease by evaluating clinical presentation, reviewing vaccination records, and utilizing laboratory tests. Primary diagnostic methodologies include:

- Complete blood counts and biochemistry profiles
- Cytological analysis to identify viral inclusion bodies
- Antigen detection assays
- RNA-based and quantitative polymerase chain reaction tests
- Isolation of the virus and genetic sequencing
- Serological screening via ELISA and virus neutralization tests

3.7 Impact on Wildlife Conservation

Because it crosses species barriers to infect numerous carnivore families, CDV represents a severe threat to global wildlife conservation. Historical outbreaks have led to massive die-offs in endangered wild canid and large felid populations. Consequently, viral transmission at the

domestic-wildlife interface remains a top concern for preserving biodiversity and maintaining healthy ecosystems.

3.8 Prevention and Control

Immunizing domestic dogs serves as the cornerstone of prevention. Comprehensive control strategies involve:

- Implementing routine, widespread vaccination schedules
- Quarantining infected individuals immediately
- Restricting the relocation of livestock and pets in active zones
- Enforcing strict sanitation and disinfection protocols
- Monitoring and tracking health trends in wildlife populations
- Minimizing contact opportunities between domestic pets and vulnerable wild species

4. African Swine Fever

4.1 Etiology

The African Swine Fever Virus (ASFV) causes ASF, an aggressive and highly transmissible disease in wild and domestic swine. This particular pathogen is structurally distinct, representing the sole member of the *Asfivirus* genus inside the *Asfarviridae* family. ASFV is a large enveloped double-stranded DNA virus characterized by remarkable resistance in the environment and prolonged survival in pork products, carcasses, and contaminated fomites. The disease is associated with severe hemorrhagic fever and high mortality in susceptible swine populations.

4.2 Susceptible Wildlife Species

African Swine Fever affects both domestic and wild members of the family Suidae. Wild boar (*Sus scrofa*) represents the most important wildlife host in Europe and Asia, while warthogs (*Phacochoerus africanus*), bushpigs (*Potamochoerus larvatus*), and giant forest hogs (*Hylochoerus meinertzhageni*) serve as natural reservoirs in Africa. Warthogs and bushpigs generally remain asymptomatic but help the virus survive and persist in wild environments.

4.3 Epidemiology

ASF was first reported in Africa and has subsequently spread to several countries across Europe and Asia, causing substantial massive disruptions to the global pork market. The disease persists through complex transmission cycles involving domestic pigs, wild suids, and soft ticks of the genus *Ornithodoros*. Outbreaks are often associated with inadequate biosecurity, movement of infected animals, and trade in contaminated pork products. Highly virulent strains may result in mortality rates approaching 100%.

4.4 Transmission

Transmission of ASFV occurs through direct contact with infected pigs or wild boars and indirectly through contaminated feed, water, equipment, vehicles, clothing, and pork products. Biological transmission by infected soft ticks also plays an important role in endemic regions. Infected animals shed the virus in blood, saliva, feces, urine, and other secretions, facilitating rapid spread within susceptible populations.

4.5 Clinical Signs

The clinical presentation of ASF is dictated by the strength of the virus strain and the host's ability to fight it off host. Common clinical signs include high fever, anorexia, depression, weakness, respiratory distress, skin hyperemia or cyanosis, hemorrhages, diarrhea, abortion, and sudden death. Acute infections are frequently associated with severe haemorrhagic lesions and very high mortality rates.

4.6 Diagnosis

Diagnosis of ASF is based on clinical history, postmortem findings, and laboratory confirmation. Real-time When it comes to finding ASFV, PCR is the benchmark because it is highly sensitive and specifically targets this virus. Other diagnostic methods include conventional PCR, virus isolation, hemadsorption tests, ELISA, and immunofluorescence assays. Timely and precise identification of pathogens is fundamental to executing successful containment strategies and mitigating outbreaks.

4.7 Economic and Ecological Impact

African Swine Fever is one of the most outbreaks that cause massive economic wreckage for the global pig industry. Outbreaks lead to massive losses due to mortality, compulsory culling, trade restrictions, and reduced pork production. In addition to economic consequences, ASF has significant ecological impacts by reducing wild boar populations and altering wildlife disease dynamics, particularly in regions where wildlife reservoirs contribute to virus maintenance.

4.8 Prevention and Control

There is no specific treatment for ASF. Prevention and control rely primarily on strict biosecurity measures, including surveillance, early detection, movement restrictions, quarantine, culling of infected animals, proper disposal of carcasses, and disinfection of contaminated premises. Control of wild boar populations and prevention of contact between domestic pigs and wildlife are also important components of disease management. Vaccination strategies are under development and may contribute to future control programs.

5. Anthrax

5.1 Etiology

A highly lethal zoonotic infection, anthrax occurs when *Bacillus anthracis*, a large Gram-positive, spore-forming, rod-shaped bacterium. The organism produces environmentally resistant spores that can survive in soil for decades, serving as a long-term source of infection for susceptible animals. The severity of the pathogen. of *B. anthracis* is primarily attributed to its capsule and exotoxins, which facilitate immune evasion and systemic disease development.

5.2 Wildlife Species Affected

Anthrax affects a wide a wide range of both captive and free-ranging animals, particularly herbivores. Wildlife species commonly affected include deer, antelope, bison, buffalo, zebra, wildebeest, elephants, hippopotamuses, and various wild ruminants. Carnivores and scavengers such as lions, hyenas, and jackals may become infected through consumption of contaminated carcasses, although they generally exhibit greater resistance to the disease.

5.3 Epidemiology

Anthrax occurs worldwide but is most common in regions where environmental conditions favor long-term survival of spores. In parts of Africa, Asia, Australia, and North America the disease is endemic. Outbreaks are frequently associated with drought, flooding, soil disturbances, and grazing in contaminated areas. Wildlife anthrax is particularly important in protected ecosystems where environmental contamination can perpetuate recurring outbreaks.

5.4 Transmission

Transmission occurs primarily through ingestion of spores present in contaminated soil, feed, or water. The virus can also spread through inhalation of spores or contamination of skin wounds. Carnivores and scavengers are commonly infected after feeding on carcasses of animals that died from anthrax. The spores released from infected carcasses contaminate the environment and contribute to disease persistence.

5.5 Clinical Signs

The clinical course of anthrax is usually peracute or acute. Affected animals may exhibit sudden death without premonitory signs. Clinical manifestations include high fever, depression, respiratory distress, muscle tremors, staggering gait, and hemorrhages from natural body openings. Carcasses often show incomplete rigor mortis and dark, unclotted blood oozing from the mouth, nose, and anus. In wildlife, in many cases, unannounced deaths are the initial warning sign of an incoming outbreak.

5.6 Diagnosis

History, characteristic postmortem findings, and laboratory confirmation. Common diagnostic methods include microscopic examination of blood smears stained with polychrome methylene blue, bacterial culture, polymerase chain reaction (PCR), immunohistochemistry, and serological assays. Carcasses suspected of anthrax should not be opened because exposure to air promotes sporulation and environmental contamination.

5.7 Outbreaks in Wildlife

Wildlife populations across Africa, North America, and Asia experience periodic anthrax outbreaks. Large-scale mortalities have been reported among herbivores in ecosystems such as Namibia's Etosha National Park and Tanzania's Serengeti ecosystem. Elephant, buffalo, zebra, and antelope populations are particularly vulnerable. These outbreaks can significantly alter population dynamics and ecosystem structure while posing risks to livestock and human health.

5.8 Prevention and Control

Prevention of anthrax relies on vaccination of susceptible livestock in endemic areas, proper disposal of carcasses, and restriction of animal movement during outbreaks. Carcasses should be burned or deeply buried to prevent environmental contamination. Surveillance, early detection, and public awareness are essential for controlling disease spread. In wildlife populations, management strategies focus on monitoring outbreaks and minimizing contact between infected carcasses and susceptible animals.

6. Tuberculosis

6.1 Etiology

Tuberculosis (TB) is a long-lasting contagious illness triggered by a group of the *Mycobacterium tuberculosis* complex (MTBC), particularly *Mycobacterium bovis*, *Mycobacterium tuberculosis*, and *Mycobacterium caprae*. In wildlife and domestic animals, *M. bovis* is the principal causative agent. These organisms are acid-fast, aerobic, slow-growing bacilli capable of persisting within macrophages, leading to chronic granulomatous inflammation in affected tissues.

6.2 Host Range

Tuberculosis affects a broad range of domestic animals, wildlife species, and humans. Susceptible wildlife hosts include deer, wild boar, badgers, bison, buffalo, elk, rhinoceroses, elephants, lions, leopards, and non-human primates. The disease is maintained in several wildlife reservoirs, which can contribute to transmission between wildlife, livestock, and humans. This wide host range makes tuberculosis a significant One Health concern.

6.3 Epidemiology

Bovine tuberculosis remains endemic in many regions of Africa, Asia, Europe, and the Americas. The persistence of infection in wildlife reservoirs complicates eradication efforts in livestock populations. Wildlife-livestock-human interfaces play an important role in disease maintenance and transmission. Increased wildlife movement, habitat overlap, and human activities have enhanced opportunities for cross-species transmission, making tuberculosis a growing concern for animal and public health authorities worldwide.

6.4 Transmission

The main route of transmission is the inhalation of infectious aerosols containing mycobacteria shed by infected hosts. Infection may also transmit through ingestion of contaminated feed, water, milk, or environmental materials. Close contact between infected and susceptible hosts facilitates disease spread. Wildlife reservoirs can serve as continuous sources of infection for livestock, while zoonotic transmission to humans may occur through direct contact or consumption of contaminated animal products.

6.5 Clinical Signs

Tuberculosis is generally characterized by a chronic progressive course. Clinical signs depend on the organs affected and may include weight loss, chronic cough, respiratory distress, enlarged lymph nodes, weakness, reduced productivity, and emaciation. In wildlife, clinical signs are often subtle and may remain undetected until advanced stages of disease. Granulomatous lesions are commonly observed in lungs, lymph nodes, liver, and other organs during postmortem examination.

6.6 Diagnosis

Diagnosis of tuberculosis relies on a combination of ante-mortem and post-mortem methods. Common diagnostic techniques include the tuberculin skin test, interferon-gamma release assay (IGRA), Ziehl-Neelsen staining, bacterial culture, histopathology, and polymerase chain reaction (PCR). Molecular diagnostic methods have improved the rapid detection and differentiation of members

of the *Mycobacterium tuberculosis* complex, facilitating surveillance and control programs.

6.7 Conservation and Public Health Impact

Tuberculosis poses significant challenges to wildlife conservation and public health. Infected wildlife reservoirs can threaten endangered species and hinder conservation programs. The disease also causes substantial economic losses through livestock production losses, surveillance costs, and trade restrictions. As a zoonotic disease, bovine tuberculosis remains a major a serious threat to community health, especially in regions where close interaction exists among wildlife, livestock, and humans. Consequently, tuberculosis is recognized as a priority disease under the One Health framework.

6.8 Prevention and Control

Control of tuberculosis requires integrated One Health approaches involving wildlife, livestock, and human health sectors. Key measures include routine surveillance, testing and removal of infected animals, movement control, biosecurity enhancement, wildlife reservoir management, and pasteurization of milk. Molecular epidemiological investigations help identify transmission pathways and support targeted intervention strategies. Continued monitoring and coordinated disease control programs are necessary for reducing the burden of tuberculosis at the wildlife-livestock-human interface.

7. Comparative Overview of Major Wildlife Diseases

Disease	Etiological Agent	Main Hosts	Zoonotic Potential	Conservation Impact
Rabies	Rabies virus (<i>Lyssavirus</i> , Family: <i>Rhabdoviridae</i>)	Dogs, foxes, wolves, bats, jackals, raccoons, wild carnivores	Very High-fatal zoonosis transmitted through bites	Causes mortality in wild carnivores and threatens endangered species
Canine Distemper	Canine distemper virus (<i>Morbillivirus</i> , Family: <i>Paramyxoviridae</i>)	Dogs, foxes, wolves, lions, tigers, ferrets, raccoons	Low-no confirmed human infection	Major cause of population declines in several wild carnivore species
African Swine Fever	African swine fever virus (<i>Asfivirus</i> , Family: <i>Asfarviridae</i>)	Domestic pigs, wild boars, warthogs, bushpigs	None	Causes severe mortality in wild and domestic suids, affecting ecosystem dynamics
Anthrax	<i>Bacillus anthracis</i>	Herbivores such as deer, antelope, buffalo, elephants, livestock	High-infection through contact, inhalation, or ingestion of spores	Periodic mass mortalities in wildlife populations and ecological disturbances
Tuberculosis	<i>Mycobacterium bovis</i> and other members of the <i>M. tuberculosis</i> complex	Deer, wild boar, badgers, buffalo, bison, elephants, primates	High-important zoonotic disease	Threatens wildlife conservation and serves as a reservoir for livestock infection

8. One Health Perspective

8.1 Wildlife-Human-Livestock Interface

The wildlife-human-livestock interface represents a critical zone for the emergence and transmission of infectious diseases. Increasing human population growth, habitat fragmentation, agricultural expansion, and environmental changes have intensified interactions among wildlife, domestic animals, and humans. These interactions facilitate the spillover and spread of pathogens, including rabies, tuberculosis, anthrax, canine distemper, and African swine fever. Understanding disease dynamics at this interface is essential for preventing outbreaks and protecting animal, human, and ecosystem health.

8.2 Disease Surveillance

Disease surveillance is a cornerstone of the One Health approach. Effective surveillance systems enable early detection, monitoring, and reporting of diseases occurring in wildlife, livestock, and human populations. Modern surveillance programs increasingly utilize molecular diagnostics, geographic information systems (GIS), wildlife health monitoring, and integrated reporting networks. Timely identification of disease outbreaks allows rapid implementation of control measures, reducing the risk of widespread transmission and economic losses.

8.3 Public Health Significance

Many wildlife-associated diseases are zoonotic and pose substantial risks to human health. Diseases such as rabies, anthrax, and tuberculosis is capable of passing from animal hosts to humans. through direct contact, contaminated environments, animal products, or vectors. Wildlife

reservoirs often contribute to the persistence and spread of pathogens, complicating disease control efforts. Consequently, monitoring wildlife diseases is essential not only for conservation but also for safeguarding public health and ensuring global health security.

8.4 Integrated Disease Management

Integrated disease management under the One Health framework promotes collaboration among veterinarians, physicians, wildlife biologists, ecologists, public health professionals, and policymakers. Key strategies include surveillance, vaccination, biosecurity enhancement, habitat management, public awareness programs, and coordinated outbreak response. By addressing animal, human, and environmental health simultaneously, the One Health framework offers a practical, long-term blueprint for managing novel and resurging infections, simply because it tackles the root causes across human, animal, and environmental sectors.

9. Challenges in Wildlife Disease Management

9.1 Diagnosis in Free-Ranging Wildlife

Diagnosis of diseases in free-ranging wildlife is challenging due to difficulties in capturing, restraining, and sampling animals. Clinical signs often remain unnoticed because affected animals may die before observation or exhibit nonspecific symptoms. Furthermore, obtaining adequate biological samples for laboratory testing can be logistically difficult and costly. These factors frequently result in delayed disease detection and underestimation of disease prevalence in wildlife populations.

9.2 Limited Surveillance

Wildlife disease surveillance is often less developed than livestock or human health surveillance systems. Remote habitats, limited accessibility, and inadequate reporting mechanisms hinder systematic monitoring of wildlife diseases. As a result, many disease outbreaks remain undetected until significant mortality occurs or transmission to livestock and humans is observed. Strengthening surveillance networks and integrating wildlife health monitoring into national disease control programs are essential for early outbreak detection and response.

9.3 Resource Constraints

Effective wildlife disease management requires substantial financial resources, specialized personnel, diagnostic laboratories, and field infrastructure. Many countries face limitations in funding and technical capacity, restricting their ability to conduct routine surveillance, epidemiological investigations, and disease control programs. Resource shortages are particularly evident in developing regions, where competing public health and agricultural priorities may reduce investment in wildlife health initiatives.

9.4 Vaccination Difficulties

Vaccination of wildlife populations presents significant logistical and biological challenges. Capturing and vaccinating large numbers of free-ranging animals is often impractical, labor-intensive, and expensive. While oral immunization tactics have proven effective for specific illnesses like rabies, significant challenges persist regarding deployment logistics, variations in species immunity, and achieving sufficient herd coverage. Additionally, vaccination programs must be carefully designed to minimize ecological disturbances and ensure long-term effectiveness.

10. Future Directions and Research Needs

10.1 Molecular Surveillance

Advanced molecular tools such as whole-genome sequencing, metagenomics, environmental DNA (eDNA), and CRISPR-based diagnostics should be integrated into wildlife disease surveillance programs. These technologies enable rapid detection of emerging pathogens, monitoring of pathogen evolution, identification of transmission routes, and detection of antimicrobial resistance. Expanding genomic surveillance can improve preparedness for zoonotic disease emergence and facilitate evidence-based disease control strategies.

10.2 Early Warning Systems

Future research should focus on developing integrated early warning systems that combine wildlife surveillance data, climate information, remote sensing, GIS mapping, artificial intelligence, and epidemiological modeling. Such systems can identify disease hotspots, predict outbreak risks, and support timely interventions before pathogens spread among wildlife, livestock, and humans. Reinforcing these frameworks is essential, given that the majority of novel infectious pathogens originate in animals before spilling over into humans.

10.3 Wildlife Disease Monitoring

Long-term and standardized wildlife health monitoring programs are needed to improve understanding of pathogen

ecology, disease distribution, and population-level impacts. Enhanced surveillance should include sentinel species monitoring, routine pathogen screening, mortality investigations, and cross-border data sharing. Continuous monitoring can provide valuable information for conservation planning and early detection of zoonotic threats.

10.4 One Health Collaborations

Future disease management requires stronger collaboration among wildlife biologists, veterinarians, public health professionals, environmental scientists, and policymakers under the One Health framework. Integrated surveillance systems, shared databases, coordinated outbreak responses, and interdisciplinary research can improve prevention and control of zoonotic diseases at the human-animal-environment interface. Expanding wildlife inclusion in One Health programs remains a key research priority.

11. Conclusion

Wildlife diseases are increasingly recognized as major threats to biodiversity conservation, ecosystem stability, livestock production, and public health. Around the world, wild animals are suffering and dying in large numbers from both new and returning diseases, such as rabies, tuberculosis, anthrax, avian flu, and canine distemper. Human-driven factors including habitat loss, climate change, urbanization, and increased wildlife-livestock-human interactions have accelerated disease emergence and transmission. Recent advances in molecular diagnostics, disease surveillance, and One Health approaches have improved our understanding of wildlife disease ecology and management. However, challenges such as limited surveillance, difficulties in diagnosing diseases in free-ranging animals, and resource constraints continue to hinder effective control efforts. Strengthening integrated surveillance systems, wildlife health monitoring, molecular epidemiology, and interdisciplinary One Health collaborations will be essential for preventing future outbreaks and safeguarding wildlife, animal, and human health.

References

1. Gippet JMW, Carlson CJ, Klaftenberger T, Eskew EA, Gore M, Bertelsmeier C, *et al.* Wildlife trade drives animal to human pathogen transmission over 40 years. *Science*. 2026;392:178-182. doi:10.1126/science.adw5518.
2. Zhou C, *et al.* Integrated surveillance and early warning system of emerging infectious diseases: Current status, gaps and perspectives. *Sci One Health*. 2025;4:100102.
3. Greening SS, Pascarosa LR, Munster AL, Gagne RB, Ellis JC. Climate change as a wildlife health threat: A scoping review. *BMC Vet Res*. 2025;21:60.
4. Stephen C, Berezowski J. Expectations of wildlife health surveillance systems and implications for system design. *Res Dir One Health*. 2025;3:e2:1-13.
5. Turnbull PCB, Doganay M, Lindeque PM, Aygen B, McLaughlin J. Anthrax in wildlife and domestic animals. *Rev Sci Tech*. 2008;27(2):359-383.
6. Virapin M, Barroso I, Zanet S, *et al.* Risks at the wildlife-pastoral livestock systems interface: Toward a framework for sustainable coexistence. *Front Sustain Food Syst*. 2025.

7. Barroso P, López-Olvera JR, Kiluba wa Kiluba T, Gortázar C. Overcoming the limitations of wildlife disease monitoring. *Res Dir One Health*. 2024;2:e3:1-14. doi:10.1017/one.2023.16.
8. Byrne AW, Morgan ER. Emerging and endemic infections in wildlife: Epidemiology, ecology and management in a changing world. *Pathogens*. 2024;13(6):513.
9. Kuhn C, *et al.* How studies on zoonotic risks in wildlife implement the One Health approach: A systematic review. *One Health*. 2024;19:100929.
10. World Organisation for Animal Health. *Bovine tuberculosis* (Infection with *Mycobacterium bovis*)-Terrestrial Manual. Paris: WOA; 2024.
11. World Organisation for Animal Health. One Health concept and wildlife health framework. Paris: WOA; 2024.
12. Centers for Disease Control and Prevention. One Health basics and zoonotic disease prevention. Atlanta (GA): CDC; 2024.
13. Oura CAL. African swine fever. In: MSD Veterinary Manual. 2024.
14. FAO, WOA, WHO. One Health Joint Plan of Action: Addressing zoonotic tuberculosis at the human-animal-environment interface. Rome: FAO; 2023.
15. Destoumieux-Garzón D, *et al.* The One Health approach: Integrating human, animal and environmental health. *Front Public Health*. 2023.
16. FAO, UNEP, WHO, WOA. One Health Joint Plan of Action (2022-2026). Rome: FAO; 2022.
17. Blome S, Franzke K, Beer M. African swine fever—A review of current knowledge. *Virus Res*. 2020;287:198099.
18. Dixon LK, Stahl K, Jori F, Vial L, Pfeiffer DU. African swine fever epidemiology and control. *Annu Rev Anim Biosci*. 2020;8:221-246.
19. Cunningham AA, Daszak P, Wood JLN. One Health, emerging infectious diseases and wildlife: Two decades of progress? *Philos Trans R Soc B Biol Sci*. 2017;372:20160167.
20. Arias M, Jurado C, Gallardo C, Fernández-Pinero J, Sánchez-Vizcaíno JM. African swine fever: A global view of the current challenge. *Porcine Health Manag*. 2017;3:21.
21. Blackburn JK, Goodin DG. Differentiation of anthrax outbreaks in wildlife and livestock. *Vet Microbiol*. 2014;172:1-10.
22. Altizer S, Ostfeld RS, Johnson PTJ, Kutz S, Harvell CD. Climate change and infectious diseases: From evidence to a predictive framework. *Science*. 2013;341(6145):514-519.
23. Bengis RG, Leighton FA, Fischer JR, Artois M, Mörner T, Tate CM. The role of wildlife in emerging and re-emerging zoonoses. *Rev Sci Tech*. 2004;23(2):497-511.
24. Dragon DC, Rennie RP. The ecology of anthrax spores. *Can Vet J*. 1995;36:295-301.