Unravelling the Secrets of Nature's Health - A Journey into Wild Animal Disease Surveillance and Disease Forecasting

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Abstract

Monitoring and predicting diseases is essential to track and anticipate disease outbreaks in wild animal populations, impacting both animal and human health. Effective animal disease monitoring and control programmes, along with swift response systems, rely on robust surveillance systems. They can provide decision-makers with timely and reliable information about the state of animal diseases within a country. Conserving nature and preserving ecosystem services, including disease regulation, is crucial. The article summarizes the surveillance approaches from the animal health perspective.

Keywords: Health, Wild animal disease, Surveillance

Introduction

Monitoring and predicting diseases in wild animals are crucial elements of public health and wildlife management plans. These procedures seek to track and anticipate disease outbreaks in wild animal populations, which could have a big impact on both animal and human health. Effective animal disease monitoring and control programmes, along with swift response systems to emerging threats, rely on robust surveillance systems. They furnish decision-makers with timely and reliable information about the state of animal disease(s) within a country. Surveillance is the continuous scrutiny of the factors that determine the occurrence and distribution of disease and other conditions of ill health in a population.

Conserving nature and preserving ecosystem services, including disease regulation, is crucial for human well-being. Biodiversity acts as a buffer against the emergence and transmission of infectious diseases. Healthy ecosystems with diverse species populations can help regulate disease dynamics by limiting the transmission of pathogens between species or controlling the population of disease vectors. South Asia has been identified as a hot spot for the emergence of zoonotic infectious diseases, but limited capacity has kept wildlife departments in most countries from being active participants in preparedness and response efforts.[3]

The idea of "One Health" has changed over the past ten years as a result of the more frequent and serious risks to the health of people, animals, plants, and the environment.The interaction between domestic animals, wildlife, and humans has evolved as a result of the continuous globalization of society, human population development, and related landscape changes (Molyneux et al. 2011). A holistic and systems-based approach is required for one health, which acknowledges the interconnectedness between the wellbeing of people, animals, plants, and the environment. This integrative concept brings together various sectors to address the problems with productivity, conservation, and health.

With its extensive animal herds, rich fauna, and dense human population, India poses a higher risk for the inter-compartmental spread of illnesses.

Additionally, One Health approaches emphasize collaboration and cooperation among various sectors, including human health, veterinary science, environmental conservation, agriculture, aquaculture and wildlife management. By working together, sharing data, conducting joint research, and implementing coordinated strategies, we can enhance disease surveillance, early detection, and rapid response capabilities. Adopting holistic One Health approaches is crucial towards addressing the increasing threat of infectious diseases to wildlife conservation, public health,and overall ecosystem well-being. By conserving nature, preserving biodiversity, and understanding the drivers of disease emergence, we can better mitigate and manage the risks of emerging infectious diseases for the benefit of all species.

Wild Animal Disease Surveillance

Wild animal disease surveillance involves systematic monitoring and data collection to detect the presence and spread of diseases in wildlife populations. It is crucial for early detection and containment of infectious diseases that could potentially spill over to domestic animals or humans (zoonotic diseases). In the context of animal health, wildlife disease surveillance may provide information regarding domestic and wild animal morbidity and mortality, identify changes in patterns of disease occurrence over time, and assist in early detection of disease outbreaks, including those linked to emerging diseases. Since there are many species of wildlife, there are varied risks of bi-directional disease transmission in different regions or areas, which are dictated by the wildlife species and types of livestock interfaces present. Thus, setting up national wildlife disease surveillance programme is crucial for understanding local risks to animal health and potential zoonotic disease transmission.

Key elements of wild animal disease surveillance include

a. Data Collection: Wildlife biologists and veterinarians collect samples, such as blood, tissues, or faeces, from wild animals. These samples are then analysed in laboratories to identify pathogens and monitor disease prevalence.

b. Monitoring and Reporting: Surveillance programmes track disease patterns and incidents in specific animal populations and regions. This information is reported to relevant authorities for further analysis and response planning.

c. Disease Mapping: By recording disease occurrence geographically, surveillance efforts can create disease distribution maps, which help identify high-risk areas and potential sources of outbreaks.

d. Zoonotic Disease Monitoring: Surveillance focuses on zoonotic diseases to understand and mitigate their transmission risks. Many diseases can be transmitted from wild animals to humans. Health officials can identify potential zoonotic threats by monitoring wild animal populations and take preventive measures to minimize human exposure.

e. Population Health Assessment: Disease surveillance also plays a role in assessing the overall health and well-being of wildlife populations. Tracking disease prevalence can provide valuable data on the conservation status of species.

Distinctions from Domestic Animal Surveillance

Whereas farmers, animal handlers and veterinarians will commonly recognize illness in domestic animals, in most situations wild animals do not have this close observational vigilance and monitoring, which can limit detection and reporting of diseases in wildlife as well as access to data collected from other sources. In addition, some diagnostic tests may not be validated for wild species in terms of specificity and sensitivity. Furthermore, there are different stakeholders and participants; for example, wildlife biologists and ecologists should be engaged in the development, analysis, interpretation, and communication of results for a wildlife disease surveillance programme. Additionally, wildlife managers or rehabilitators, conservation managers and other stakeholders may be key collaborators in acquiring specimens.

Wild Animal Disease Forecasting

Wild animal disease forecasting employs various models and data analysis techniques to predict the likelihood of disease outbreaks in wild animal populations. The aim is to anticipate disease outbreaks and take proactive measures to prevent or control their spread. It helps wildlife managers prepare for potential outbreaks and take preventive measures.

Key components of wild animal disease forecasting include

a. Data Analysis: Surveillance data, environmental factors, and other relevant information are analyzed to identify patterns and trends related to disease occurrences. Environmental factors, such as temperature, humidity, and precipitation, can influence disease transmission and the behavior of wild animals. Forecasting models integrate this data to predict disease patterns. Understanding the movement patterns and behaviors of wildlife can help predict the potential pathways for disease transmission between different animal populations.

b. Mathematical Models: Disease models are used to simulate disease spread based on factors like population density, animal movement, environmental conditions, and transmission dynamics. Historical disease data can be analyzed to identify patterns and trends, helping to predict potential future outbreaks.

c. Risk Assessment: Forecasting enables the assessment of the risk of disease emergence and spread in specific regions or animal populations.

d. Early Warning Systems: Forecasting can trigger early warning systems to alert authorities and stakeholders about potential outbreaks, allowing them to implement appropriate measures promptly.

Benefits of Wild Animal Disease Surveillance and Forecasting

Early Detection: Surveillance allows for early detection of diseases, facilitating timely response measures and reducing the risk of widespread outbreaks. Forecasting helps implement preventive measures, reducing disease transmission and protecting both wildlife and human populations. By predicting disease outbreaks, resources can be allocated more efficiently to target high-risk areas and populations, optimizing disease control efforts.

Conservation: Disease surveillance helps protect endangered species by preventing disease-induced population declines.

Public Health: Monitoring zoonotic diseases in wildlife contributes to the prevention of human infections and pandemics.

Ecological Balance: Preventing disease outbreaks in wildlife maintains ecological balance and supports ecosystem health.

Avian Influenza as a specific case for integrated surveillance

Avian Influenza infection in poultry and other avian species is caused by the Influenza A viruses. Avian Influenza viruses have been classified into subtypes based on haemagglutinins (HA) and neuraminidase (NA) proteins. At least 16 types of HA and nine types of NA have been identified in Avian Influenza virus in birds. Diverse influenza A viruses are also found in aquatic waterfowl (Anseriformes and Charadriiformes), poultry, swine, horses, aquatic mammals, bats, and domestic pets such as cats and dogs. However, wild water birds (e.g., gulls) are the natural reservoirs. Because of antigenic shift and antigenic drift, the new Avian Influenza subtypes may emerge that could result in serious consequences. The first outbreak of Avian Influenza was reported in China in 1996, and it entered India in 2006. India has seen multiple outbreaks of Avian Influenza between 2006 and 2019 across 15 different states. A recent outbreak was reported in Kerala in December 2022. As per data from WHO, since 2003, more than 860 human infections of HPAI - H5N1 have been reported.

The Action Plan for Prevention, Control and Containment of Avian Influenza, 2021, has provided a surveillance plan for avian influenza with the aim of early warning, detection, and to take containment measures. The surveillance for avian influenza includes the screening of both domestic poultry and migratory birds. The samples collected during the surveillance process are screened at RDDLs, whereas ICAR – NIHSAD, Bhopal, acts as national referral laboratory for Avian Influenza.

Following the principles mentioned above, the following set of information is presented for designing the surveillance programme for Avian influenza:

1.Surveillance sites: Zoos, national parks, poultry farms, Slaughter houses, poultry markets, wet markets and other risk-based sites

2.Samples: Soil in deep litter system, droppings in battery caging system, carcass, air, water

3.Time and Frequency of Sampling: October to March; April to September

4.Epidemiological units: Poultry, migratory bird aggregation sites (e.g., lakes etc.), birds in zoos, birds in the wild.

5.Assays that can be used: Serological assays, Real-time PCR, sequencing

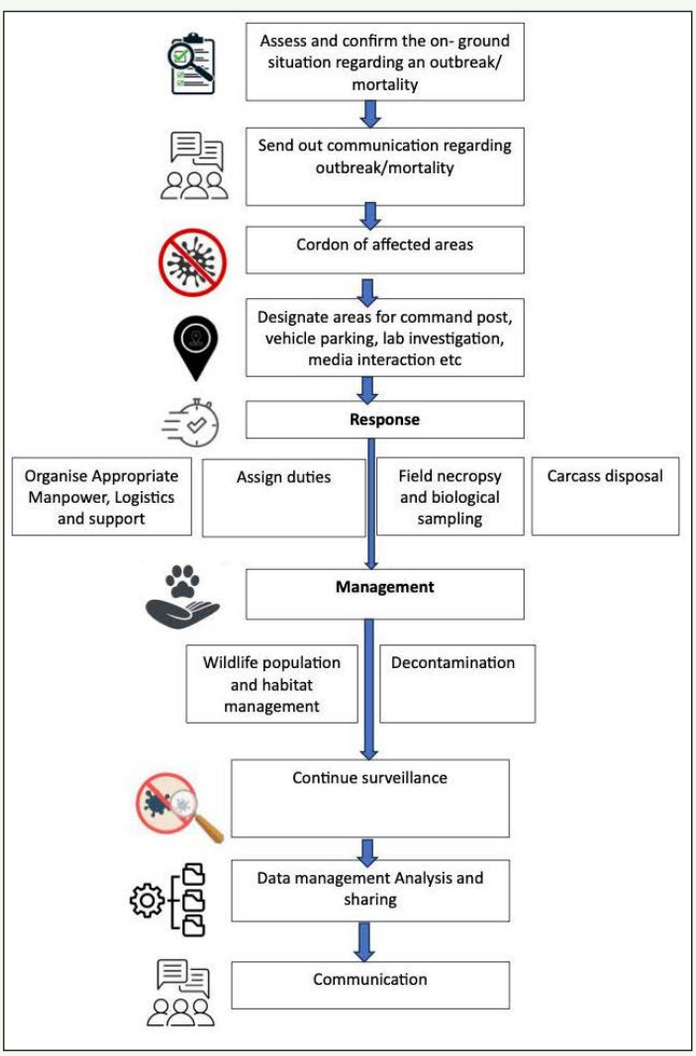

Figure 1: Integrated Surveillance for Avian Influenza

Conclusion

Overall, wildlife disease surveillance and forecasting are vital components of a comprehensive strategy to safeguard both wildlife and human health, conserve biodiversity, and sustain ecosystems. With increasing globalization and movement of people and goods and illicit wild animal trade, diseases can quickly spread across borders. Wildlife diseases can have significant

economic impacts on agriculture, aquaculture, and related industries. Surveillance and forecasting support biosecurity efforts by identifying potential sources of infection and guiding the implementation of preventive measures, such as quarantine protocols. Further, it helps minimize losses by enabling proactive measures to control outbreaks and make evidence-based decisions on disease control measures and resource allocation.

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Conflicts of Interest

No conflict of interest.

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