

DISEASE SURVEILLANCE THROUGH VETERINARY DIAGNOSTICS: PROTECTING ANIMAL AND HUMAN HEALTH

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ABSTRACT

Animal health and human health are closely interconnected, with more than 60% of emerging infectious diseases in humans originating from animals. Effective disease surveillance, supported by robust veterinary diagnostic systems, plays a critical role in detecting, monitoring, and controlling diseases before they spread widely. Modern veterinary diagnostics—from conventional laboratory testing to molecular techniques, genomic sequencing, and point-of-care technologies—enable rapid identification of pathogens, facilitate evidence-based disease control, and strengthen food safety and public health. This article explores how veterinary diagnostics underpin disease surveillance, highlights their importance within the One Health framework, discusses emerging diagnostic technologies, and examines the challenges and future opportunities for improving surveillance systems that protect animals, humans, and the environment.

KEYWORDS: Veterinary diagnostics, disease surveillance, One Health, animal health, biosurveillance, emerging infectious diseases.

INTRODUCTION

The health of animals, humans, and the environment has never been more interconnected than it is today. Expanding livestock production, increasing movement of people and animals, wildlife interactions, climate change, and globalization have created new opportunities for infectious diseases to emerge and spread. Outbreaks of avian influenza, African swine fever, rabies, and other diseases demonstrate that pathogens do not recognize geographical or species boundaries. Veterinary diagnostics form the backbone of disease surveillance by providing timely and accurate information about disease occurrence. Whether identifying an emerging pathogen in poultry, monitoring antimicrobial resistance in dairy cattle, or detecting a zoonotic infection in wildlife, diagnostic laboratories serve as the first line of defense against disease outbreaks. Early diagnosis not only protects animal populations but also reduces economic losses, safeguards food supplies, and minimizes the risk of transmission to humans.

UNDERSTANDING DISEASE SURVEILLANCE

Disease surveillance is the systematic collection, analysis, interpretation, and dissemination of health information to guide disease prevention and control measures. In veterinary medicine, surveillance provides essential information about disease trends, outbreak detection, and the effectiveness of control programs.

Veterinary surveillance generally includes:

Passive surveillance, based on routine reporting of suspected disease cases by veterinarians and farmers.

Active surveillance, involving planned sampling and testing of apparently healthy animals.

Targeted or risk-based surveillance, focusing on high-risk regions, species, or production systems.

Sentinel surveillance, using selected animal populations as indicators for disease emergence.

Each surveillance approach relies heavily on accurate laboratory diagnosis to confirm suspected cases and provide reliable epidemiological data.

VETERINARY DIAGNOSTICS: THE FOUNDATION OF SURVEILLANCE

Clinical signs often provide only preliminary clues because many infectious diseases produce similar symptoms. Laboratory diagnostics provide definitive identification of pathogens, allowing veterinarians to make informed decisions regarding treatment, quarantine, vaccination, and movement restrictions.

Modern veterinary diagnostic laboratories employ a wide range of technologies, including:

- Clinical pathology
- Microbiological culture
- Histopathology
- Serological testing
- Polymerase Chain Reaction (PCR)
- Real-time PCR
- Enzyme-linked immunosorbent assays (ELISA)
- Whole-genome sequencing
- Next-generation sequencing
- Rapid antigen detection tests
- Point-of-care diagnostic devices

These technologies have dramatically improved the speed, sensitivity, and specificity of disease detection, enabling earlier intervention and more effective outbreak control.

EARLY DETECTION SAVES LIVES

Disease surveillance is most effective when diseases are identified before widespread transmission occurs. Rapid diagnostic testing allows authorities to:

- Detect outbreaks at their earliest stages.
- Implement quarantine and movement restrictions.
- Initiate targeted vaccination campaigns.
- Reduce unnecessary antimicrobial use.
- Protect neighboring farms and wildlife populations.
- Minimize economic losses.

For livestock producers, early diagnosis prevents production losses associated with mortality, reduced fertility, decreased milk production, and poor growth performance. For companion animals, timely diagnosis improves treatment outcomes and animal welfare.

PROTECTING HUMAN HEALTH THROUGH VETERINARY SURVEILLANCE

Many important human diseases originate in animals. These zoonotic diseases include rabies, brucellosis, leptospirosis, salmonellosis, avian influenza, and several emerging viral infections.

Veterinary diagnostics contribute to human health by:

- Detecting zoonotic pathogens before human exposure increases.
- Monitoring disease reservoirs in domestic and wild animals.
- Supporting food safety surveillance.
- Tracking antimicrobial resistance.
- Providing early warning for emerging infectious diseases.
- By identifying pathogens in animal populations, veterinary laboratories often detect health threats before they become public health emergencies.

VETERINARY DIAGNOSTICS AND FOOD SAFETY

Healthy animals contribute directly to safe food production. Surveillance programs routinely monitor livestock for infectious diseases that may compromise food safety.

Diagnostic laboratories support:

- Meat inspection programs.
- Milk quality testing.
- Surveillance for food-borne pathogens.
- Residue monitoring.
- Detection of antimicrobial-resistant bacteria.

These activities help maintain consumer confidence while supporting national and international trade in animal products.

SUCCESS STORIES IN VETERINARY DISEASE SURVEILLANCE

Several major animal disease control programs demonstrate the importance of veterinary diagnostics.

Rabies Control: Routine laboratory confirmation of suspected rabies cases guides vaccination campaigns and helps protect both domestic animals and humans. Continuous surveillance has significantly reduced human rabies deaths in many regions.

Highly Pathogenic Avian Influenza: Rapid molecular diagnostics enable early detection of infected poultry flocks, allowing authorities to implement containment measures before widespread transmission occurs.

African Swine Fever: Although no widely available commercial vaccine exists for many production settings, early laboratory diagnosis remains the most effective strategy for limiting spread through movement control, enhanced biosecurity, and surveillance.

Foot-and-Mouth Disease: Routine surveillance and rapid laboratory confirmation help countries detect outbreaks quickly and maintain disease-free status, which is essential for livestock trade.

Emerging Technologies Transforming Surveillance: Veterinary diagnostics continue to evolve rapidly.

Point-of-Care Diagnostics: Portable diagnostic devices now allow veterinarians to perform certain tests directly on farms, reducing turnaround times and enabling immediate management decisions.

Molecular Diagnostics: PCR-based methods provide highly sensitive detection of pathogens even before animals develop clinical signs.

Genomic Surveillance: Whole-genome sequencing enables scientists to identify pathogen variants, trace transmission pathways, and monitor disease evolution.

Artificial Intelligence: Artificial intelligence is increasingly being used to analyze surveillance data, identify disease patterns, predict outbreaks, and improve decision-making.

Digital Surveillance: Mobile applications, cloud-based reporting systems, and electronic laboratory networks allow real-time sharing of diagnostic information among veterinarians, laboratories, and government agencies.

CHALLENGES FACING VETERINARY SURVEILLANCE

Despite significant advances, several challenges remain.

- Many countries continue to face:
- Limited diagnostic laboratory infrastructure.
- Inadequate funding.
- Shortage of trained veterinary diagnosticians.
- Delayed sample transportation.
- Limited access to advanced molecular technologies.
- Poor integration of surveillance databases.
- Inconsistent disease reporting.

Resource limitations can delay diagnosis and reduce the effectiveness of disease control efforts.

THE ONE HEALTH APPROACH

Disease surveillance is most effective when veterinary, medical, and environmental sectors work together. The One Health approach recognizes that protecting human health requires healthy animals and healthy ecosystems. Veterinary laboratories contribute valuable information that complements human health surveillance and environmental monitoring. Collaboration among veterinarians, physicians, epidemiologists, microbiologists, wildlife experts, and policymakers enables coordinated responses to emerging health threats. Integrated surveillance systems improve preparedness for future outbreaks while supporting biodiversity conservation, food security, and sustainable livestock production.

CONCLUSION

Veterinary diagnostics are far more than laboratory procedures—they are powerful tools for protecting societies from infectious diseases. Accurate and timely diagnosis enables effective surveillance, supports rapid outbreak response, protects livestock production, enhances food safety, and reduces the risk of zoonotic disease transmission. As emerging diseases, antimicrobial resistance, and environmental changes continue to challenge global health, stronger veterinary diagnostic systems will become increasingly important. Investing in modern laboratories, innovative technologies, skilled professionals, and integrated surveillance networks is essential

for safeguarding the health of animals and humans alike. Ultimately, disease surveillance through veterinary diagnostics represents one of the most effective investments in prevention. By detecting diseases early and enabling coordinated responses, veterinary diagnostics protect not only animal populations but also economies, food systems, and public health—demonstrating that healthy animals are fundamental to a healthier world.

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