Animal Disease Forecasting and Forewarning

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Epidemiology is the scientific study of why and how frequently diseases occur in different human or animal populations.

Surveillance is addressed to detect a pathogen that is not yet present or diagnosed in the population at risk. Disease surveillance is the continuous and systematic ongoing collection, collation, analysis and dissemination of disease-related data.

Monitoring indicates the intermittent performance and analysis of routine observations, aimed at detecting changes in the environment or health status of a population

Epidemiological and disease surveillance and monitoring information are used to plan and evaluate strategies to prevent and control and manage diseases within populations.

Epidemiology and disease surveillance is used to assist in identifying causes and sources of disease, to identify parts of the population at highest risk of disease and to develop and evaluate disease management programmes.

All of these elements will ultimately lead to improved animal health and welfare

Surveillance activities can be either active or passive, or scanning or targeted or its various combinations.

- Active - we go out and look for information
- Passive - vet services wait for information to come
- Scanning - constantly searching in the general population
- Targeted - looking in selected sections of the population

These disease surveillance methods are helpful for early diagnosis of diseases, based on either clinical signs or laboratory confirmation, already present in a particular geographical area. However, they are unable to predict the subsequent emerging animal disease outbreak.

Early detection of disease outbreaks is important to minimize morbidity and mortality through timely implementation of disease prevention and control measures.

Forecasting is prediction of situations that could lead to the occurrence of a given disease and its subsequent spread based on monitoring of specific risk parameters.

Forecasting involves all activities in ascertaining and notifying the farmers in a community that the conditions are sufficiently favourable for certain diseases, that the application of control measures will result in economic gains or that the disease expected is unlikely to be enough to justify the expenditure of time, energy and money to be utilized for its control.

Forecasting is process of making future predictions using past and present disease trends.

Objectives of Forecasting

1. To prevent incursion and spread of epidemic diseases
2. To monitor the effectiveness of disease control strategies
3. Emergency preparedness and disease management methods

Generally forecasting systems are developed against

- Those diseases which causes high economic losses and trade barriers
- Those diseases whose occurrence, spread and virulence depend on weather conditions
- Those diseases whose control measures are known and can be applied effectively and economically by the farmers
- Those diseases whose epidemiology is fully understood
- The drivers of disease occurrence globally are as follows:
- Changes in agro-ecological dynamics
- Human behaviour – Trade opportunities, cultural practices, civil unrest etc.
- Movement of humans, animals and food products
- Intensification of contact between wildlife and livestock or humans
- Unprecedented erratic fluctuations in climate
- Lack of uniform access to goods and services
- Climatic factors that affect disease forecasting include
- Rainfall
- Temperature
- Humidity
- El-Nino

Rainfall and temperatures are known to affect pathogen survival in the environment and disease vector behaviour. High temperatures and heavy seasonal rainfall followed by water-logging are generally associated with an increase in arthropods which may increase the likelihood of transmission and occurrence of vector-borne diseases such as LSD, RVF and Trypanosomiasis in areas where these diseases are endemic.

But expansion can occur to new areas (non-endemic) because of climatic change.

The persistence and stability of most viruses increase as the result of low temperatures and high relative humidity in tropical settings. Additionally, wild bird migration patterns and their ability to spread diseases like H5N1 may be affected by climatic changes through alterations in their migratory pathways.

Dryness and low precipitation trigger livestock movement to water points where wildlife species also tend to come. In these areas, the increased contact between different livestock herds and between domestic / wildlife species further increases the risk of disease spill over and spread *(Global Animal Disease Intelligence Report from FAO, 2015).*

Early warning is to rapidly detect communicable disease phenomena with the potential for serious socioeconomic consequences or international public health concerns in order for adequate and timely response to be taken.

Global early warning and response system is a combined system by WHO, FAO and OIE with an overall objective to improve the early warning and response capacity to animal disease threats for the benefit of the international community.

Geographical information system (GIS), Global Positioning System (GPS) and remote sensing are powerful tools that enable the EWS at the International, national and local levels.

Disease forecasting models *(Corley et al., 2014, PLoS ONE 9(3): e91989.doi:10.1371)*

Risk Assessment models correlate risk factors for a specific location based upon weather and other covariates to calculate disease risk. This type of model is commonly referred to as ecological niche modelling or disease risk mapping

Event Prediction models will assign a probability for when and where the disease event is likely to occur based upon specific data sources and variables. In Event prediction, the output is the location and a time period a disease outbreak will occur, while the risk assessment model provides the risk of an outbreak occurring under specified conditions.

Spatial models forecast the geographic spread of a disease after it occurs based upon the relationship between the outbreak and primarily geospatial factors.

Dynamical models examine how a specific disease spreads through a population. These models may depend on movement restrictions that have the effect of interventions on the severity of the disease.

Event Detection models attempt to identify outbreaks either through sentinel groups or through the collection of real-time diagnostic, clinical, or syndromic data and to detect spikes in signs, symptoms or syndromes that are indicative of an event (e.g., event-based biosurveillance).

Disease Forecasting in India

In India, the function of surveillance and control of exotic as well as indigenous animal disease is undertaken by the Department of Animal Husbandry under the Ministry of Agriculture (GOI) through its network of

- Animal Quarantine and Certification Services
- Disease Diagnostic Referral Laboratories
- National Centre for Disease Control (NCDC)
- National Institute of High Security Animal Diseases (NIHSAD), Bhopal
- National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI)
- National Animal Disease Referral Expert System (NADRES)
- National Animal Disease Reporting System (NADRS)
- Integrated Disease Surveillance Project (IDSP)

Changes in the way we live and animals live have triggered widening of horizons and species spectrum of pathogens at an unprecedented rate. Under these circumstances, there is an urgent need for a potent disease forecasting system and world-wide surveillance.

A constant vigil is needed to control epidemic diseases without vaccination suing these small steps that would culminate in to a substantial gain for man, animals alike.

- Detect it quickly – Surveillance / Reporting
- Contain it efficiently: Biosecurity
- Kill it quickly: Slaughter, Segregation etc
- Trace source and spread – Epidemiological investigation

All this ultimately depends on the speed of identifying the first case and forecasting of diseases!