Bio Vet Innovator Magazine

Volume 1 (Issue 2) AUGUST 2024

OPEN ACCESS

Popular Article

Disease Reporting & Forecasting System: Current Status & Future Prospects

Ravi Dabas[1], Mayur M Jadav[1], Siraj Ansari[1], Mahesh Kumar[2], Basharat Rizwan Naik[1], Asha Yadav[1]

1MVSc Scholar, Division of Medicine,
2MVSc Scholar, Division of Surgery,
ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly -243122 (UP)

***Corresponding Author:** ravidabas2000@gmail.com

DOI – https://doi.org/10.5281/zenodo.13377409

Received: August 20, 2024
Published: August 27, 2024

Abstract:

Animal disease reporting is collection, analyzing & sharing data of diseased animal and help in disease monitoring & controlling. In India, the animal disease surveillance is done through National Animal Disease Reporting System. Zoonotic disease is controlled by inter sectoral coordination of IDSP & NADRS. Disease forecasting is predicting the disease outbreak. Techniques involve in forecasting are statistical modelling, geographical information system, machine learning, remote sensing and artificial intelligence. NADRES is national level web based dynamic forecasting system which is predict 13 economically important disease 2 month in advance. Different software used for forecasting is of high values. Disease forecasting is a future for development of early warning system, impact on animal welfare and policy making in country's economy strengthening.

Key Words: Disease reporting, Monitoring, NADRES

Introduction:

Livestock demographics play a vital role in effective disease reporting and forecasting, especially in a country like India, which leads the world in livestock population with 535.78 million animals, including 302.79 million bovines. This significant population underpins India's status as the largest milk producer globally. However, the livestock sector's growth is challenged by animal diseases and the prevalence of zoonotic diseases, which pose global health threats due to the intricate interactions between humans, animals, and the environment. With nearly 60 percent of infectious agents affecting humans being zoonotic, and 75 percent of emerging pathogens also being zoonotic, robust disease surveillance and reporting systems are essential for protecting both animal and human health.

Disease forecasting is crucial for predicting future disease occurrences and spreads by analyzing historical and current trends. The primary objectives are to equip animal husbandry departments at state and central levels to prevent disease incursions, swiftly control outbreaks, enhance surveillance, strengthen veterinary laboratory networks, and improve national preparedness for animal and zoonotic epidemics. This forecasting process relies on three core principles: Data Collection from sources like the NADRS portal and district veterinary dispensaries; Analytics, which uses machine learning algorithms to convert data into

geographical models; and Communication, which focuses on implementing disease surveillance based on the analytical insights across various regions.

Techniques Used for Disease Forecasting:

1. **Statistical Modelling**:

   Statistical modelling is a key tool in disease forecasting, using historical data and environmental factors to predict future outbreaks. Time Series Analysis, including models like ARIMA, Prophet, Neural Prophet, and Stacking, helps identify trends and seasonality in disease occurrence. For example, in 2022, Harrisburg University researchers used these models to forecast monkeypox outbreaks, finding the Neural Prophet model to be 95% accurate.

2. **Geographic Information System (GIS):**

   GIS technology is crucial for capturing, storing, and displaying spatial data related to disease forecasting. It enables the collection and analysis of data on animal populations, environmental factors, and disease incidence, providing insights into disease spread and risk areas. GIS can create risk maps and early warning systems by analyzing environmental factors such as temperature, humidity, and rainfall, helping veterinary authorities and farmers prevent outbreaks. GIS also supports predicting the spread of diseases like H5N1 and planning control programs for vector-borne diseases.

3. **Machine Learning:**

   Machine learning algorithms analyze historical data on animal health and environmental conditions to predict future disease outbreaks. These algorithms identify patterns and have been evaluated in studies for predicting infectious diseases using climatic and geospatial features, proving to be powerful tools in disease forecasting.

Machine Learning Workflow:

The machine learning workflow begins with the collection of various datasets, including disease data, meteorological data, animal density data, land cover data, and land elevation data. These inputs are then processed through machine learning algorithms such as Support Vector Machines, Linear Regression, Neural Networks, Gradient Boosting, and Random Forest. The output generated provides predictions about future disease occurrences.

Advancements in Disease Diagnosis & Forecasting Using Machine Learning:

- **Detection of Subclinical Mastitis in Cows:** Machine learning has been utilized to detect subclinical mastitis in cows. A decision tree algorithm uses several input datasets (such as electrical conductivity, volume, lactose, milking time, fat, protein, and peak flow) to predict somatic cell count.
- **Forecasting Lumpy Skin Disease (LSD):** Machine learning models, specifically Artificial Neural Networks (ANN), are employed to forecast LSD occurrences based on data such as meteorological conditions, population density, land cover, and land elevation.

Citation: Ravi Dabas, Mayur M Jadav, Siraj Ansari, Mahesh Kumar, Basharat Rizwan Naik, Asha Yadav. (2024). Disease Reporting & Forecasting System: Current Status & Future Prospects. In Bio vet innovator magazine (Vol. 1, Issue 2, pp. 17–20). Bio vet innovator magazine. https://doi.org/10.5281/zenodo.13377409

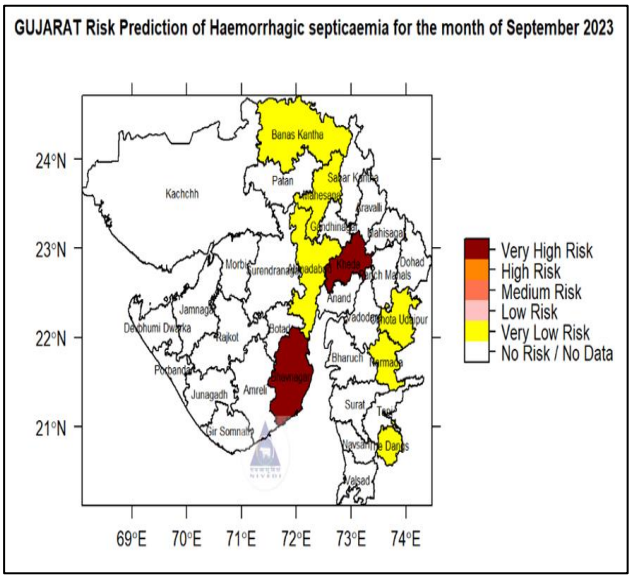
- **Predicting Colic Outcomes in Horses:** Random Forest algorithms have been applied to predict the survivability and the need for surgery in horses presenting with colic.
- **Diagnosis of Chronic Hypoadrenocorticism in Dogs:** A decision tree algorithm is used to diagnose chronic hypoadrenocorticism in dogs by analyzing complete blood counts (CBC), resting cortisol levels, cortisol levels before and after ACTH stimulation tests, and the Na ratio.
- **Early Detection of Emerging Animal Diseases:** The PADI-web platform is a bio surveillance system that monitors online news sources to detect emerging animal infectious diseases. This platform gathers daily news articles in 16 different languages from the web and employs machine learning algorithms to classify the relevance of the news and categorize the information based on the type of event and content.

National Animal Disease Referral Expert System (NADRES):

The National Animal Disease Referral Expert System (NADRES) is a dynamic expert system enhanced with geographic information and remote sensing technologies. It is based on extensive animal disease data collected and collated, along with risk factor data from 652 out of 735 districts across India over an extended period. Established in April 2000 as part of the All India Coordinated Research Project (AICRP) under PD-ADMAS, NADRES had expanded by 2015 to include 31 AICRP centers spread across the country.

The Indian Council of Agricultural Research (ICAR)-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI) has identified 13 priority economically significant livestock diseases, including zoonotic diseases such as anthrax, FMD, babesiosis, BQ, BT, HS, theileriosis, trypanosomiasis, PPR, enterotoxaemia, sheep pox, goat pox, fasciolosis, and swine fever.

NADRES captures past disease incidence patterns, with data sourced from across the country through the AICRP on Animal Disease Monitoring and Surveillance (ADMAS) centers and the Department of Animal Husbandry and Veterinary Services of all states on a monthly basis. NADRES provides monthly livestock disease forewarning at the district level, published in the form of a bulletin, to alert national and state animal husbandry departments to take appropriate control measures. Disease predictions are categorized based on probability values ranging from 0 to 1, with risk levels depicted as very high, high, moderate, low, very low, or no risk. Spatial analysis of disease data is incorporated into NADRES to produce risk maps, hotspot maps, and disease maps.



NADRES provides state-wise livestock disease forecasts. For example, it issued a forecast for a Haemorrhagic septicemia outbreak in Gujarat for the month of September 2023.

Citation: Ravi Dabas, Mayur M Jadav, Siraj Ansari, Mahesh Kumar, Basharat Rizwan Naik, Asha Yadav. (2024). Disease Reporting & Forecasting System: Current Status & Future Prospects. In Bio vet innovator magazine (Vol. 1, Issue 2, pp. 17–20). Bio vet innovator magazine. https://doi.org/10.5281/zenodo.13377409

Different Mobile Apps Developed for Disease Reporting & Forecasting:

- **Livestock Disease Forewarning App:** Developed by NIVEDI, this app provides disease forewarnings up to two months in advance.
- **IVRI Zoonoses App:** This app offers basic information about key zoonotic infections and national disease control programs.
- **IVRI Disease Control App:** Designed to educate users on important diseases affecting livestock, poultry, and dogs, this app covers symptoms, diagnosis, treatment, prevention, and control measures.

Conclusion:

Disease reporting is crucial for the early control and prevention of significant losses. NADRS and IDSP are two key disease reporting systems in India. The health sector must be prepared for any emerging or re-emerging disease outbreaks by utilizing early warning systems. Forecasting stands out as a critical control measure, as it predicts the potential occurrence of a disease before it actually appears in a population. Artificial intelligence and machine learning algorithms have proven to be transformative technologies in disease reporting and forecasting. Effective disease forecasting significantly enhances animal welfare by reducing the suffering caused by diseases.

References:

Ebrahimie, E., Ebrahimi, F., Ebrahimi, M., Tomlinson, S. and Petrovski, K.R. 2018. Hierarchical pattern recognition in milking parameters predicts mastitis prevalence. Comput. Electron. Agric., 147: 6–11.

Lawson, A. B., & Banerjee, S. (2019). Handbook of Spatial Epidemiology.

Raschka, S., & Mirjalili, V. (2019). Python Machine Learning (3rd ed.). Packt Publishing. ISBN: 978-1789955750.

Reagan, K.L., Reagan, B.A. and Gilor, C. 2020. Machine learning algorithm as a diagnostic tool for hypoadrenocorticism in dogs. Domset., 72: 106396.

Suresh KP, Hemadri D, Patil SS, Krishnamoorthy P, Jacob SS, Shome BR. Livestock Disease Forewarning Monthly Bulletin, June 2023. Bengaluru: ICAR-NIVEDI, 2023; p. 1-117.

Citation: Ravi Dabas, Mayur M Jadav, Siraj Ansari, Mahesh Kumar, Basharat Rizwan Naik, Asha Yadav. (2024). Disease Reporting & Forecasting System: Current Status & Future Prospects. In Bio vet innovator magazine (Vol. 1, Issue 2, pp. 17–20). Bio vet innovator magazine. https://doi.org/10.5281/zenodo.13377409