Evidence-Based Early Clinical Detection of Emerging Diseases in Food Animals and Zoonoses: Two Cases

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KEYWORDS

- Epidemiology • Evidence-based veterinary medicine (EBVM)
- Classification and regression tree analysis
- Early clinical detection • Bovine spongiform encephalopathy
- Bluetongue virus serotype 8 (BTV-8)

Evidence-based veterinary medicine (EBVM) is the application of evidence-based medicine (EBM) to the veterinary field.[1] By definition, it is the conscientious, explicit, and judicious use of the best scientific evidence to inform clinical decisions with a view to improve the clinical outcome at the individual level.[2,3] However, in the veterinary profession, a great deal of time is spent in making diagnostic, therapeutic, and preventive decisions in a complex and uncertain environment where optimal evidence is often lacking.[4]

Medical care is the art of making decisions without adequate information.[5] Medical decision making has been studied extensively and follows a mainstream trend, labeled "rational optimizing."[6] It is usually based on cognitive rational models, such as decision analysis, decision tables, decision trees, and Bayes' theorem.[7–11] When *decision* refers to *diagnosis,* the consideration of the possible causes of a disease, its prevalence, and an initial evaluation of clinical signs will lead to a differential diagnosis about which clinical judgment, informed by evidence clinical data, is exercised.[3]

The authors have nothing to disclose.

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Vet Clin Food Anim 28 (2012) 121–131
doi:10.1016/j.cvfa.2012.01.001 **vetfood.theclinics.com**
0749-0720/12/$ – see front matter

Diagnosis may involve the choice and interpretation of an appropriate confirmatory diagnostic test.

To detect and identify emerging or rare diseases, a good clinical approach is essential as few biological and epidemiologic data and/or laboratory tests are available. The approach aims at establishing the limits between normality and abnormality as veterinarians cannot relate the clinical signs to those of a known disease or to their experience. These limits should be built on the ability to detect biological variations in physiologic and environmental conditions. The various actors involved in epidemiosurveillance networks (eg, breeders, veterinarians, and slaughterhouse staff) should be prepared for this clinical approach to fulfill their responsibility in health monitoring.[12] Part of this training should develop knowledge of disease biology and epidemiology, and skills in a rigorous, standardized, and evidence-based clinical approach including that of differential diagnosis.[13–16]

Because, with emerging diseases, the implementation of classic EBVM is difficult as a result of few published cases are available and/or accessible via web searches, other options are necessary.

The current report aims to describe a method to improve the early clinical detection of emerging diseases in food animals and zoonoses. This approach is based on the analysis of field clinical observations collected on the first cases suspected of disease using a method called "classification and regression tree" (CART) (Zanella G, Martinelle L, Guyot H, et al. Clinical pattern characterisation of cattle naturally infected by BTV-8. Unpublished data, 2011.).[17,18] Those clinical facts become the only evidence available. Two practical examples are developed to illustrate the feasibility of the method in cattle. Future prospect is also proposed like the implementation of a structured, well-informed and interactive veterinary web clinical data mining platform.

CASE DESCRIPTION

Two examples are developed to illustrate the use of CART analysis for stimulating the early warning of emerging animal diseases. This is a key parameter of health control strategy.[19] CART analysis is a nonlinear and nonparametric model fitted by binary recursive partitioning of data (including clinical signs). Using CART 6.0 software (Salford Systems, San Diego, California), the analysis successively splits the dataset into increasingly homogeneous subsets until it is stratified and meets specified criteria (clinical signs) (**Fig. 1**). Further details about CART are presented in previously original articles or reviews (Zanella G, Martinelle L, Guyot H, et al. Clinical pattern characterisation of cattle naturally infected by BTV-8. Unpublished data, 2011.).[17,18,20]

Case 1: Early Detection of Bovine Spongiform Encephalopathy

Background

Bovine spongiform encephalopathy (BSE) emerged in 1986.[21] It is a neurodegenerative disease characterized by a very long incubation period compared to the life of the host species.[22] BSE started a dramatic chain of events in the United Kingdom and subsequently in other countries.[23] The peak of interest was the discovery of its potential zoonotic character after the first description of a new variant of Creutzfeldt-Jakob disease (νCJD) in 1996.[24–26] The presence of clinical signs seems to be linked to the localization and degree of vacuolization of neurons. The main warning signs are psychic disorders (apprehension, temperament change, abnormal ear position, and abnormal behavior), sensory disorders (exaggerated responses to stimuli, excessive licking), as well as postural and locomotion abnormalities (ataxia and tremors). Their