World Academy of Science, Engineering and Technology
International Journal of Medical and Health Sciences
Vol:10, No:07, 2016

Valorization of Surveillance Data and Assessment of the Sensitivity of a Surveillance System for an Infectious Disease Using a Capture-Recapture Model

Authors : Jean-Philippe Amat, Timothée Vergne, Aymeric Hans, Bénédicte Ferry, Pascal Hendrikx, Jackie Tapprest, Barbara Dufour, Agnès Leblond

Abstract : The surveillance of infectious diseases is necessary to describe their occurrence and help the planning, implementation and evaluation of risk mitigation activities. However, the exact number of detected cases may remain unknown whether surveillance is based on serological tests because identifying seroconversion may be difficult. Moreover, incomplete detection of cases or outbreaks is a recurrent issue in the field of disease surveillance. This study addresses these two issues. Using a viral animal disease as an example (equine viral arteritis), the goals were to establish suitable rules for identifying seroconversion in order to estimate the number of cases and outbreaks detected by a surveillance system in France between 2006 and 2013, and to assess the sensitivity of this system by estimating the total number of outbreaks that occurred during this period (including unreported outbreaks) using a capture-recapture model. Data from horses which exhibited at least one positive result in serology using viral neutralization test between 2006 and 2013 were used for analysis (n=1,645). Data consisted of the annual antibody titers and the location of the subjects (towns). A consensus among multidisciplinary experts (specialists in the disease and its laboratory diagnosis, epidemiologists) was reached to consider seroconversion as a change in antibody titer from negative to at least 32 or as a three-fold or greater increase. The number of seroconversions was counted for each town and modeled using a unilist zero-truncated binomial (ZTB) capture-recapture model with R software. The binomial denominator was the number of horses tested in each infected town. Using the defined rules, 239 cases located in 177 towns (outbreaks) were identified from 2006 to 2013. Subsequently, the sensitivity of the surveillance system was estimated as the ratio of the number of detected outbreaks to the total number of outbreaks that occurred (including unreported outbreaks) estimated using the ZTB model. The total number of outbreaks was estimated at 215 (95% credible interval CrI95%: 195-249) and the surveillance sensitivity at 82% (CrI95%: 71-91). The rules proposed for identifying seroconversion may serve future research. Such rules, adjusted to the local environment, could conceivably be applied in other countries with surveillance programs dedicated to this disease. More generally, defining ad hoc algorithms for interpreting the antibody titer could be useful regarding other human and animal diseases and zoonosis when there is a lack of accurate information in the literature about the serological response in naturally infected subjects. This study shows how capture-recapture methods may help to estimate the sensitivity of an imperfect surveillance system and to valorize surveillance data. The sensitivity of the surveillance system of equine viral arteritis is relatively high and supports its relevance to prevent the disease spreading.

Keywords : Bayesian inference, capture-recapture, epidemiology, equine viral arteritis, infectious disease, seroconversion, surveillance
Conference Title : ICEID 2016 : International Conference on Epidemiology and Infectious Diseases
Conference Location : Paris, France
Conference Dates : July 25-26, 2016