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SIMULATION OF THE RISK OF THE AIRBORNE SPREAD OF FOOT-AND-MOUTH DISEASE VIRUS FROM A HIGH SECURITY LABORATORY RELEASE

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La transmission aérogène est l'une des origines de certaines maladies (fièvre aphteuse, maladie d'Aujeszky). Le but de cette étude est de déterminer le risque qu'impliquerait pour une population de brebis une fuite de virus de la fièvre aphteuse du laboratoire du CISA, situé à Valdeolmos (Madrid). Malgré le fait que le laboratoire est équipé avec des systèmes de haute securité avec filtration de l'air, on a essayé de simuler la probabilité d'infection pour les troupeaux qui se trouvent à proximité. Les calculs ont été faits en considérant que la quantité de virus libéré serait de 10^4 $TCID_{50}$ et les conditions météorologiques de température, humidité relative , fréquence de direction et vitesse du vent prises pendant une année. En cas de fuite, la probabilité totale d'infection pour les quatre troupeaux les plus proches, situés entre 300m et 2Km, serait de 0.359%.

Airborne transmission has been identified as the source of epidemic outbreaks for several diseases (foot-and-mouth disease, Aujeszky's disease). Nevertheless, few studies have been conducted to forecast dispersion of pathogens by the air.

The objective of this study is to determine the risk that would imply for livestock a foot-and-mouth disease virus escape from the Centro de Investigación en Sanidad Animal (CISA) laboratory in Valdeolmos. This laboratory is located 40Km far from Madrid in an area with a low livestock density, mainly sheep.The model was performed using the ALOHA program (Areal Locations of Hazardous Atmospheres) based in a Gaussian model of gas dispersion that has been already applied to the study of airborne transmission of viruses (Casal et al, 1995).

CISA laboratory is equiped with a high security system designed to make nearly impossible virus releases. However in this simulation we intended to examine the likelihood of the occurrence of an epidemic outbreak if a viral escape occurred. Initial hypothesis is based in an air filtration system breakdown producing a virus release lasting at least ten minutes to be arranged. In this time the amount of virus released has been assumed to be 10^4 $TCID_{50}$.

Foot-and-mouth Disease virus is rapidly inactivated when relative humidity is lower than 55%-60% (Donaldson, 1972). Taking into account meteorological conditions of the region it has been considered that the virus survival is not possible in July and August neither during the day or night and in June and September during the day. Calculations have been done considering wind direction and speed frequencies taken by a meteorological station in the same laboratory during 1993-1994. The infective dose considered for a sheep has been 10 $TCID_{50}$ (Gibson and Donaldson, 1986) . It has been supposed that the infective dose is travelling together in the same droplet. This is the most appropriate situation to favor effective transmission of the virus. The probability to inhale an infective dose by an animal has been calculated acording to the Poisson distribution.The probability of infection in the whole herd has been calculated as following a binomial distribution. Probabilities of infection have been only calculated for the four herds closest to the laboratory, since the likelihood of infection decreases close to zero for the fourth herd.

In case of a virus release, the overall probability of infection for these four farms would be 0.359%. The riskiest month is May with a probability of infection of 0.71%. This is attributable to the fact that in this month the frequency of slow winds flowing to the closest farm is quite high.The herd that shows the main risk (0.285%) is located 300m north and is a flock of 700 sheep. Two herds are located 1Km far from the laboratory, one is northwards and the other is located southwest. There is also a third herd 2Km far in the northwest. Probabilities of infection are 0.0468%, 0.0196% and 0.0078% respectively.

In conclusion, the risk of a foot-and-mouth disease outbreak originated from the laboratory is very low and can be calculated multiplying the probability of a damage in the filter system by the above calculated probability of herd infection.

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