Risk of introducing exotic disease through importation of animals and animal products

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Summary: Between 1870 and 1929, nine separate outbreaks of foot and mouth disease (FMD) occurred in the United States of America (USA); additional outbreaks in North America include one in Mexico (1947) and two in Canada (1870 and 1952). In 1930, the United States Congress enacted a law prohibiting importation of live ruminants or swine or fresh meat from these species into the USA from countries affected with FMD or rinderpest. Although the effect of this prohibition may be debated, the USA has remained free of FMD since its enactment. A hidden benefit of this prohibition was probably the limitation on importing other disease agents from countries of the world where FMD was present. As many regions of the world make progress towards the control and eradication of FMD, North America must take greater cognizance of other disease agents with which it has not been concerned to date, as these existed only in regions of the world affected with FMD and/or rinderpest. One of the methods of dealing with these other diseases is by using risk assessment and risk management methodologies. For risk assessment to work, however, the available management technologies must be examined, and levels of risk assigned to match the available technology. The authors explore risk analysis options for the importation of animals and animal products in a manner which will continue to protect the livestock industry in the USA. They also examine the role of veterinary biologicals as a management tool to mitigate the attendant risks.


INTRODUCTION

The United States of America (USA) is relatively free of many of the diseases of livestock which have plagued much of the world. Prior to the 19th century, unless disease agents or their hosts could survive the relatively long journey, they could not generally be transported to the New World from Europe, Africa or Asia. Many diseases which could survive in animals during the long ocean voyage in sailing ships did become established in the Americas, but many other exotic diseases did not. Prior to the development of steamship travel in the 19th century, therefore, the western hemisphere remained free of foot and mouth disease (FMD), and it has never been infected with...

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rinderpest. The first recorded appearance of FMD in the western hemisphere was in 1870, when the disease appeared in both North and South America (6). Between 1870 and 1929, FMD was introduced into the USA on nine occasions (2) and was stamped out each time. In South America, the disease became endemic and eventually affected the entire continent. Following the 1929 epidemic in the USA, the United States Congress attached an amendment to the Smoot-Hawley Tariff Act of 1930, prohibiting the importation of live ruminants, live swine, or fresh, chilled or frozen meat from ruminants or swine into the USA from any country affected with FMD or rinderpest (10). Although this Act was later amended to permit the importation of zoo animals under permanent quarantine and, later, importation of livestock through an off-shore quarantine centre, the Act remained virtually unchanged until 1993, when ratification of the North American Free Trade Agreement (NAFTA) provided for recognition of disease-free regions within a country. The agreement recently ratified by the General Agreement on Tariffs and Trade (GATT: now World Trade Organisation [WTO]) provides further relaxation, permitting imports from regions of ‘low prevalence’.

The 1930 Tariff Act amendment cannot be proved to have contributed to preventing the introduction of FMD into the USA. However, the fact that no epidemics of FMD have occurred in the USA for over sixty years, since the Act became law, constitutes compelling anecdotal evidence that the Act was effective. Nevertheless, it might be argued that the livestock industry in the USA was simply fortunate during this period, and that any effects of the Act were minimal or serendipitous. Although virtually the same import policy was operated in Canada, an epidemic of FMD occurred in Alberta in 1952, the probable origin of which was traced to smuggled or undeclared meat products (3). The same sequence of events could have happened just as easily in the USA.

The following problems are associated with implementing a complete ban on importation of animals or animal products from countries known to be affected by exotic diseases:

- increased smuggling of products and animals subject to the embargo
- retaliatory trade measures by affected countries
- loss of access to new genetic information in the livestock population
- lack of recognition of zones within any country which may not be affected or may have a low prevalence of the disease agent
- loss of economic benefits resulting from free trade.

USE OF RISK ASSESSMENT IN IMPORTATION OF ANIMALS AND ANIMAL PRODUCTS

Ever since the importation of animals and animal products was recognised as a potential source of disease, some form of risk assessment has always been conducted before such importation. Most risk assessment procedures in the past were intuitive and often subjective. The first law to control or prevent introduction of diseases in the USA was the Animal Industry Act of 1884, which stipulated that the Secretary of Agriculture shall act to prevent introduction of diseases of livestock into the USA. Some of the
scientific logic behind this law included the newly-emerging science of bacteriology and the 'germ theory' of disease causation.

In 1930, the United States Congress reviewed the recent occurrences of FMD, and their sources, and made the decision that importation of live animals and fresh meat from countries affected with FMD was an unacceptable risk. In the case of FMD, the decision was at least based on empirical evidence that the disease agent had been introduced into the country by these means. The addition of rinderpest to the statute was not based on any experience with the disease in North America, however, and must be considered a purely intuitive and subjective risk assessment.

More recently these purely intuitive, subjective assessments for the evaluation of levels of risk associated with imports from different countries and regions, have begun to be replaced by qualitative, semi-quantitative and quantitative risk assessment procedures (5).

**BIOLOGICALS AS A RISK FACTOR IN EXOTIC DISEASE**

**INTRODUCTION**

One of the major difficulties in risk assessments of vaccination concerns modelling the effect of extensive vaccination in masking or hiding infection by preventing clinical disease. A vaccinated animal may still become infected, may become a temporary or permanent reservoir, and may either continuously or intermittently excrete the infectious agent and thus infect other animals. *Brucella abortus* strain 19 vaccine is very effective in preventing abortion when administered properly to female calves, but these calves can still become infected and carry virulent *B. abortus* for long periods of time, shedding the organism at parturition (8). Foot and mouth disease vaccines have also been reported as masking infection with virulent virus, by preventing the development of obvious clinical lesions, while allowing the animal to develop a pharyngeal infection which may or may not result in virus shedding and exposure of other animals (4).

Contamination of an otherwise safe vaccine with either heterologous agents or virulent variants of the virus is a potential risk in any vaccine. Two outbreaks of FMD in the USA in 1902 and 1908 were traced to a single contaminated consignment of vaccinia seed virus imported for the production of smallpox vaccine in calves for subsequent use in people (1). While improvements in manufacturing practices and quality control of biologicals have greatly reduced incidents of contamination, a recent well-publicized introduction of bluetongue virus in breeding canines in the USA resulted from contamination of a multiple component vaccine, which was thought to have originated from bovine serum contaminated with bluetongue virus, although this was not proved (12).

When vaccines are moved internationally or moved from one region of a country to another, there is always a risk that pathogenic agents which are exotic to a region, or new exotic strains of an agent, may be introduced. The presence of virulent viruses or bacteria in putative ‘killed’ vaccines constitutes a risk which has been all too common in the past. The use of formalin to kill viruses was a problem for many years, as it was sometimes inadequately employed, resulting in the transmission of virulent virus to populations (7).
Despite the risk of introducing exotic diseases into a region, biologicals can play an important role in decreasing the reservoir of infected animals, reducing the level of infectious agent shedding in a population of animals or, in some cases, preventing the development of reservoirs. Many serious diseases of both humans and animals have been reduced or eliminated by the combined use of high quality vaccines and other disease control measures. The success of smallpox eradication in humans was greatly dependent on the use of the vaccinia virus to achieve high levels of protection. Polio virus has reportedly been eliminated from the western hemisphere, primarily through the use of attenuated oral polio vaccines. Vaccination of domestic pets against rabies has greatly reduced human exposure to this disease in the USA, although sylvatic rabies is still prevalent in some regions. Use of bait vaccines for wildlife may further mitigate this risk and could eventually eliminate or greatly reduce the incidence of sylvatic rabies.

In livestock populations, biologicals have been a major mitigating factor in several diseases which are considered exotic in North America. It is doubtful that FMD could have been eliminated in Mexico in the 1950s without the use of vaccination (9). In the USA, the massive vaccination of millions of horses in 1971 successfully stopped the progression of Venezuelan equine encephalomyelitis after this disease had reached southern Texas (11). The development of improved vaccines against FMD, rinderpest and other serious diseases of livestock has greatly reduced the world-wide distribution of these diseases. Since the early 1980s, Chile and other countries of South America – in particular those countries which make up the Rio Plata Basin Initiative – have either eliminated or greatly reduced the incidence of FMD. While FMD was widespread in continental Europe just a few decades ago, Western Europe is now largely free from this infection. Much of the credit for this progress must be given to the development of high-quality vaccines and diagnostic biologicals. Similarly, the development of high-quality vaccines has greatly reduced the world-wide distribution of such diseases as rinderpest. In many regions of the world, political instability and the lack of infrastructure to administer programmes are the only barriers to complete elimination of these diseases, as the technological capabilities for vaccines and diagnostics are now largely available.

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Résumé : Entre 1870 et 1929, les Etats-Unis d'Amérique ont connu neuf foyers indépendants de fièvre aphteuse. D'autres foyers ont été observés dans le sous-continent : au Mexique en 1947 et au Canada en 1870 et 1952. En 1930, le Congrès des Etats-Unis d'Amérique a promulgué une loi interdisant l'importation de ruminants et porcins vivants ainsi que de viande fraîche de ces espèces animales en provenance de pays touchés par la fièvre aphteuse ou la peste bovine. Aussi discutables que soient les effets d'une telle interdiction, les Etats-Unis sont néanmoins restés indemnes de fièvre aphteuse depuis son entrée en vigueur. L'un de ses avantages indirects est qu'elle a probablement permis de limiter l'importation d'autres agents pathogènes de pays où la fièvre aphteuse était présente. Comme de nombreuses régions dans le monde ont progressé dans la prévention et l'éradication de la fièvre aphteuse, l'Amérique du Nord
doit désormais étudier de plus près les autres agents pathogènes auxquels elle n'a pas été confrontée jusque-là, dans la mesure où ils n'existent que dans les régions touchées par la fièvre aphteuse et/ou la peste bovine. Les méthodes d'analyse et de gestion des risques constituent l'un des moyens d'éviter ces maladies. Toutefois, pour une bonne analyse des risques, il faut examiner les technologies de gestion existantes ainsi que les niveaux de risque correspondant à ces technologies. Les auteurs examinent les différentes options d'analyse des risques liés à l'importation d'animaux et de produits d'origine animale pour une bonne protection du secteur de l'élevage aux États-Unis d'Amérique. Ils montrent également comment les produits biologiques à usage vétérinaire peuvent constituer un outil de gestion permettant de limiter les risques associés.


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Resumen: Entre 1870 y 1929 se dieron en Estados Unidos de América nueve brotes distintos de fiebre aftosa; en cuanto al resto de América del Norte, México sufrió un brote de dicha enfermedad (1947) y Canadá otros dos (1870 y 1952). En 1930, el Congreso de los Estados Unidos promulgó una ley que prohibía la importación tanto de rumiantes y porcinos vivos como de la carne fresca de dichos animales desde países afectados por la fiebre aftosa o la peste bovina. Aunque cabe cuestionar el efecto de tal medida, los Estados Unidos se han visto desde entonces libres de la fiebre aftosa. Es probable que esta prohibición conllevara una ventaja inadvertida: la de limitar la importación de otros agentes infecciosos procedentes de los países del mundo afectados por la fiebre aftosa. A medida que muchas regiones del mundo progresan en el control y la erradicación de esta enfermedad, América del Norte debe tomar más en cuenta otros agentes patógenos de los que hasta la fecha no se había preocupado, ya que sólo existían en regiones del mundo afectadas por la fiebre aftosa y/o la peste bovina. Una de las posibles formas de enfrentarse a estas nuevas enfermedades consiste en el uso de metodologías de evaluación y de manejo de los riesgos. Sin embargo, y para que la evaluación de riesgos funcione, es preciso examinar las tecnologías de manejo disponibles y asignar los correspondientes niveles de riesgo a dichas tecnologías. Los autores exploran diversas opciones de análisis de riesgos para la importación de animales y de productos pecuarios de forma tal que la industria ganadera de Estados Unidos no deje de estar protegida. Examinan también el papel de los productos biológicos de uso veterinario como herramientas de manejo para reducir los riesgos asociados a la importación.


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