THREATS AND NEW TRENDS IN PREVENTING EPIZOOTIC DISEASES IN LIVESTOCK AND POULTRY IN THE EUROPEAN UNION

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INTRODUCTION

Important changes occurred in the European Union (EU) in the recent past years. The enlargement of the EU to 27 Member States (MS) does not facilitate the conditions of management of the livestock health status and increase the risk of introduction of a major epizootic agent; indeed, the length of the new borders of the EU, the increase of the trade flow associated with the increase of the number of MSs induce more difficulties to implement efficient control measures for the prevention of the onset of epizootic diseases.

I) RECENT CHANGES LEADING TO AN INCREASE THREAT FOR (RE) APPEARANCE OF EPIZOOTIC DISEASES

Numerous factors have to be taken into account to assess the risk for the emergence of an epizootic disease.

1) Legal and illegal movements of live animals and products of animal origin

Although it is not possible to establish, in absolute terms, the extent to which the current controls on declared imports have prevented the introduction of animal diseases in the Community, there is a consensus that the overall EU procedures and requirements for declared commercial imports from third countries have been effective and that without the current import controls, there would have been more outbreaks of serious animal diseases (Evaluation Report, 2006). Nevertheless, undeclared and fraudulent trade has been identified as an important and largely unaddressed issue. The recent Foot and Mouth disease epizooty in UK en 2001 seems to be related to the illegal use of swill in a pig farm coming from an Asian restaurant. The subtype of the virus isolated allows assuming that an illegal import of food from animal origin could have been the cause of the introduction of the virus (Gibbens et al, 2001).

- **In regard to the highly pathogenic avian *Influenza* virus (HPAI) H5N1, the legal or informal trade of live domestic birds and, may be; of poultry products is certainly a major factor of introducing a virus when appropriate measures were not taken.** The ban of any import in E.U. seems to have been efficient.
- **illegal trade** is certainly a key route of introduction of the H5N1 virus in countries none previously infected. The *International Herald Tribune* (14/04/06: Promed 136) reported that in Italy, police seized avian poultry products introduced illegally. Tons of poultry products coming form China were also seized by the Dutch customs. For many experts, the origin of the African epizooty is related to the import of infected chickens in one flock in Nigeria. The epizooty was limited to poultry farms and did not affect wild birds.

It is obvious that, in the framework of the Word Trade Organisation (WTO), the flow of imported items (food, live animals) increased in the EU these last decades. Meat and animal products originating from infected animals imported illegally probably pose a greater risk to EU than imports from countries with and established and regulated meat trade with EU.

Specifically, there is an increasing trade-driven movement of livestock commodities from FMD-endemic areas in Asia. The supply demand gradient for livestock commodities in these regions seems to gravitate towards either Europe or countries in EU neighbouring regions (North Africa, Middle East). For example, commercial exports of pork and beef by respectively China and India cover the Eurasian zone, including countries which are close to the EU including pork meat to Moldova (4,000 tons in 2004), Ukraine (8,000 tons), Albania (3,500 tons) and beef from India to Georgia (12,600 tons in 2004) and Turkey (2,300 tons) (EFSA opinion AHAW Panel, 2006).

With possible further trade liberalisation as a result of the current Doha Round of WTO trade negotiations, the prospect for increased trade volumes in meat and meat products may bring more challenges to safeguarding animal health status within the EU.

Thus, there will be a continuing tension between trade policy objectives and animal health objectives which will increase the need for a more risk based approach to border inspections as well as for shifting responsibility and improving risk management at third country level. (Evaluation Report, 2006)

2) Evolution of human behaviour and food consumption

Human populations are moving more and more in the framework of migrations resulting from high levels of poverty in third countries and from wars, but also from tourism and easier travelling conditions. When immigrants are well integrated in one E.U. MS, relatives visit them frequently from their country of origin and take with them traditional food to offer to their family. These cultural and cooking specificities create risks as it induces often illegal even marginal introduction of unexpected hazards. There is a steady flow of small quantities (about 5 kg on average) of animal product being brought in by 1% to 5% of travellers from Asia or Africa. As far as FMD-endemic areas, largest numbers of passengers enter the EU on flights from the far East and from the Middle East and Near East (EFSA opinion, 2006). Assuming only 1% of the travellers bring in an average of 5 kg of animal product given the millions of travellers originating from these areas, this may amount to some 2,000 tons of animal product per year.

3) Wild fauna

Several infectious diseases have emerged in the last few decades:

– The **Highly Pathogenic Avian Influenza Virus H5N1** is spreading all around the world since 1996. From the recent events occurred in the world and in the E.U., it can be assumed that **3 routes are responsible of the introduction of the A.I. virus in a naïve country;** among these three routes (including legal and illegal trade), the wild birds following migratory or non migratory routes as, obviously, it happened inside the E.U was the route of introduction of the virus. The aquatic wild birds seem to play a major role in this introduction of the virus. Aquatic wild birds are obviously healthy carriers even if several key points have to be elucidated such as species involved, duration of virus persistence and excretion.

– **Nipah virus**

From 1998 to 1999, a new highly contagious respiratory and neurological disease of pigs was reported on the Malaysian peninsula. There was a simultaneous epidemic of viral encephalitis among employees on affected pig farms and abattoirs. A novel paramyxovirus, distinct from Hendra virus was isolated from both porcine and human victims and named Nipah virus (Bengis et al, 2004). Evidence from virological and serological techniques implicated fruit bats of the genus *Pteropus* as the natural host and reservoir of the virus.

– **West Nile Virus (WNV) infection**

Since 1999, WNV has emerged from North America presenting a threat to human and equine health as well as the health of certain wild bird populations–WNV a well known flavivirus of Europe, Western Asia and Africa, which is maintained in a wide species range of wild birds and birds feeding mosquitoes. Between 2002–2003, the WNV infection was detected in more than 4,000 horses in USA, of which some 20% developed neurological disease (Bengis et al, 2004).

– **Classical Swine Fever (CSF)**

In several MSs of the EU, wild boars appear as the reservoir of the CSF virus in spite of the eradication of the infection in the domestic pig population in most of the EU MSs. The transmission of the virus between wild boars and pigs can occur through direct contacts between these animals, the wild boars being attracted by sows in oestrus when no double fences were put in place to prevent these direct contacts (Artois et al, 2006). But, it seems highly likely that in numerous cases, illegal distribution of swill from wild boar waste could be done to domestic pigs.

4) The climatic changes and the global warming

– **Example of the Blue-Tongue (BT)**

In 1998, the BT virus (Orbivirus from the family of *Reoviridae*) appeared again in Western Europe after several decades of absence. The recent epizooty differs from the previous transitory appearance of the BT viruses. Indeed, the BT is now present since 9 years in the Mediterranean basin. 8 serotypes of the BTV have been implicated in the different epizooties observed in the South of the EU. The last introductions (including BTV8 with a probable subsaharian origin) came from the south: South Africa (BTV8) and the East (via Turkey). The main vector is a midge named *Culicoïdes imicola* which is found more and more in northern countries (Toussaint et al, 2006). The global climatic changes and, more specifically, the climatic warming, have an influence on the adaptation and the increase capacity of vectors increasing the risk of appearance of new vector borne diseases.

The same applies to other diseases such as water borne diseases or parasites (AFSSA Report, 2005).

5) Evolution of the farming structure and of the herds management

For the last 3 decades, under the social pressure, the demand from consumers and economical factors, in several types of production (poultry, pigs, goats...), two models of farming are often opposed with a certain confusion of risk factors associated with the onset and the spreading of infectious diseases.

Recent events with HPAI H5N1, epizooty highlighted the increased risk of contamination related to outdoors farming allowing more frequent contacts with wild birds. It is obvious particularly in Asia, when aquatic domestic and wild birds are sharing the same pools.

Indeed, it is therefore likely that high levels of infection in clinically normal domestic ducks were an important factor that contributed to the epidemic, owing the widespread "seeding" of the virus in countries such as Thailand, Vietnam and Southern China, where ducks are commonly present on farms and range freely on ponds and rice paddies. (Sims et al., 2005)

Always, in regard to HPAI H5N1, at the opposite of the previous model, the industrial indoors farming allows, in an easier way, to implement efficient bio-security measures for preventing contamination. It is obvious that such a situation could protect against HPAI the industrial sector in Thailand where efficient bio-safety measures were put in place.

But, if the protection measures fail with a delayed detection of the first outbreak, it is obvious that the high number of animals present at the same place, combined with a high density of farms, favour a quick spreading of highly contagious viruses with a multiplication of outbreaks. Such factors were involved in the HPAI H7N7 epizooty which occurred in Netherlands in 2003.

Conclusion

The previous examples show that the EU is faced to new challenges and new threats. For preventing the introduction of a pathogen or the emergence of known or new hazards, the implementation of a set of measures and tools adapted to these new challenges and risks will be absolutely necessary.

II) CONDITIONS FOR PREVENTION OF THE ONSET OF AN EPIZOOTY

1) Preventive measures

These measures will depend on the epidemiological situation of the infectious agent to be controlled: enzootic or absence

– Movements of the animals and trade

Several recommendations which are all essential for the future of the animal health status have been elaborated by the consortium in the framework of the evaluation of the CAHP: Community Animal Health Policy (Evaluation report, 2006):

To reduce the movement of live animals within the Community
To increase and reinforce the Border Inspection Posts Controls (BIPs)

An approach based on three pillars appears to be more appropriate than the present ones involving: greater emphasis on risk analysis and profiling risk based border controls; strengthening cooperation between custom authorities and veterinary services; harmonising the operation of BiPs across the Community.

– Bio-security

This is a key issue for the future. Whatever the type of farming, it is essential to improve the implementation of bio-security measures in all the farms and to sensitise the farmers about the importance of their implementation. For outdoors and indoors herds, it is essential to prevent any introduction of agents through passive vectors: boots, straw, wheels, trucks, clothes). For outdoors herds, it is essential to implement systems allowing preventing any contact with wild birds and wild fauna: nets, double fence, winter “gardens”... It seems also essential to impose a minimum distance between two different herds to limit the airborne transmission.

– The vaccines

A new generation of vaccines has appeared allowing to differentiate vaccinated from infected animals (D.I.V.A.). These vaccines with companion diagnosis tests can be used to control: Foot and Mouth Disease (FMD), Classical Swine Fever (CSF), Aujeszky's disease (AD), Avian *Influenza*, Infectious Bovine Rhinotracheitis (IBR), (Vannier et al, 2007).

In spite of the major progress these marker vaccines are inducing, it would be a mistake to consider that their use could simply replace sanitary prophylactic measures. Indeed, past experience is very useful to assess the limits and the advantages of the use of these marker vaccines, which could be a powerful tool in a set of measures to control and eradicate a contagious disease. However, the use of such vaccines has to be adapted to the epidemiological situation, the contagiousness of the disease concerned and to the presence or absence of conditions with the capacity to control the spread of infection. To control a disease, the key point is to detect clinically unapparent infected animals (healthy carriers) which can infect in-contact susceptible animals. When vaccination is used, the critical stage of alert induced by the appearance of clinical signs is removed or suppressed. For this reason, such vaccines have to be as efficient as possible not only to protect vaccinated animals against clinical signs, but also to prevent, as far as possible, the excretion of the virus by vaccinated and subsequently infected animals. Moreover, the sensitivity of the diagnostic kits should be as high as possible to reduce to the greatest possible extent, the probability of false negative results; indeed, in such a strategy, the epidemiological consequences of false positive results are less significant than false negative results as positive results are generally confirmed, in a second, complimentary phase, by a reference laboratory using another diagnosis tool.

The longest experience about the use of marker vaccines has been accumulated in relation to the control and eradication of **Aujeszky’s disease**. In this case, the use of deleted marker vaccines has represented a considerable advance in programmes to control Aujeszky’s disease in several countries.

First, these vaccines have made mass vaccination possible, whilst retaining the means for serological detection of infection. This has enabled vaccinated herds which subsequently become infected to be pinpointed so that the necessary measures can be applied to prevent the field virus from spreading further.

Second, it has become possible to implement sanitary measures in a gradual manner in vaccinated, infected herds, by culling the infected sows at varying speeds, as required. These infected sows were detected through serological screening using the ELISA technique, which enabled vaccinated pigs to be distinguished from those that have been vaccinated and then subsequently infected.

This means that vaccination has a combined effect which allows a programme of prophylactic treatment to be carried out in total safety. Mass vaccination, conducted several years in succession, limits the quantity of virus shed into the air by the infected pigs, thereby considerably reducing the probability and scale of the air-borne spread of contagion between herds (100, 142). Furthermore, systematic vaccination avoids economic losses due to a poorly controlled infection. Consequently, after several years of vaccination in a country or region, the prevalence of infection gradually diminishes by introducing sanitation measures into the infected herds and continually culling the oldest infected sows; also, the incidence of infection remains very low and is kept under control. However, the cost of vaccination must be taken into account when calculating the total cost of a prophylactic treatment. Where the prevalence of infection in a given territory is high, or there is a high density of pig herds, mass vaccination with effective deleted vaccines is the only means of reducing prevalence; however, although these measures are necessary, they are not in themselves sufficient to eradicate the infection. Identification, screening and culling of the infected breeding animals appear to be essential to successful eradication whilst continuing to systematically vaccinate the animals at least 2 years after elimination of the last infected pig. In the latter case, it is advisable to control the movements of piglets, pigs for consumption and breeding animals as much as possible.

At the opposite, and independently of the performances of the vaccines and the companion kits (which are key issues to determine the use of such tools), other examples show that the use of marker vaccines would not have changed in depth the control of the situation. Following the serious **Classical Swine Fever** epizootic that hit several European countries in 1997, many people believe that the use of these new generation serological marker vaccines could prevent a further animal health catastrophe. An analysis of the situation that existed when the first CSF outbreaks appeared in the Netherlands revealed that more than 22 herds were already infected when the primary outbreak was identified in the region of Venhorst on 4 February 1997. The situation rapidly became dramatic for the region because farmers had already sold piglets before the veterinary administration could isolate the infected zone. This led to a rapid spread of the infection in the south of the country.

Under such circumstances, the use of a serological marker vaccine would not radically alter the basic nature of the problem, as it does not obviate the need for intervention on potentially infected animals, to identify them, to take a sample of serum before any animals are transported, in other words, to strictly control the movement of pigs. Indeed, at the start of an epizootic, the success of control measures depends on their being rapidly implemented after the appearance of the first outbreak and before extensive, undetected spread has occurred. Vaccination is no substitute for basic measures to control contagious diseases

At the start of an epizootic, in regions with a high density of pig herds, ring or zonal vaccination can also be envisaged in order to prevent the virus from replicating too rapidly and to limit the cost of preventive slaughter. However, in this case, transmission of the virus must be limited and control measures must be properly applied and effective.

Such an approach is particularly pertinent for highly contagious diseases such as **Foot and Mouth Disease** in those circumstances under which the airborne transmission is one of the main epidemiological factors for spreading of the virus. So, if the first outbreaks appear in an area with a high density of susceptible herds, under epidemiological conditions that favour airborne spread, a ring vaccination, decided on the basis of the results of models and assessment to determine the risks and directions of spreading, could be useful to try to limit the speed and the extent of the dissemination of the virus. However, due to the ability of vaccination to mask the appearance of clinical signs without preventing infection, vaccinated herds, even with a serological monitoring programme, represent a greater risk for undetected spread than unvaccinated herds, where monitoring can be based on clinical inspection alone.

A successful programme can be based on vaccination, but should also include sanitary measures. Furthermore, when vaccination is part of a control programme, it should be implemented only for a certain period of time. Most of the time, when the prevalence of the infection decreased significantly and when the epidemiological unit is correctly protected from outside introduction of the agent, vaccination should be replaced by sanitary measures.

Oral vaccination of wild fauna proved to be very effective against **rabies** as it lead to the eradication of rabies in fox population in the Western Europe (Brochier et al, 1996). More contrasted results were obtained on wild boars for Classical Swine Fever. Improvement of the tools seems to be necessary.

2) Early warming system: detection and prophylactic measures

The detection of the first outbreak in the first few hours after the infection of the herd by newly introduced agent is the key element determining the control (or not) of the spreading of the infection.

A set of tools and measures is needed to fulfil such a requirement which request considerable means as well an organisation in a country as a structure of the state services which are not found in developing countries.

So, different requirements have to be fulfilled such as:

- active and passive surveillance in the wild fauna, if it is involved in the risk of contamination of the livestock as it is the case for HPAI,
- an appropriate information and sensitisation of the farmers and the veterinarians,
- the existence of an efficient network of field veterinarians owing to an early warning of competent authorities in case of a suspicion of an outbreak,
- the existence of a system allowing a rapid compensation of the losses of the farmers in case of an outbreak,
- an early notification of an outbreak,
- the existence of an efficient and competent network of diagnosis laboratories including an easy and quick transportation of samples from the field to the laboratories,
- the existence of structured veterinarian official services associated with an organized state having a real power of decision with the tools of action to implement effective control of measures including stamping out, control of movements, and assessment of the efficiency of the measures decided…

These conditions are essential to allow an effective control of the spreading of an infection. The onset of an epizooty or the quick disappearance of the infection will depend on the precocity of the detection of the first outbreak (Index case) and on the quickness and the strength of the measures taken by the competent authority.

GENERAL CONCLUSION

Thanks to the knowledge acquired from the past and the onset of modern vaccinal and diagnosis tools, a set of measures can be implemented to prevent or to react when a highly contagious agent, mainly virus, is introduced in the EU. For most of the known agents, these tools and adapted measures appear as sufficiently efficient to allow a quick eradication of the infection. But, in the past, in spite of the existence of efficient tools, dramatic epizooties occurred and can be considered as a failure of this apparatus. Causes of this failure are described in this text. Causes of the adverse events occurring in the EU should be systematically analysed to allow implementing appropriate measures to prevent their reoccurrence.

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