Fighting transboundary animal diseases: a battle for global food security

Previously our team discussed the role of One Health in understanding and controlling zoonotic diseases in Australia. While zoonotic diseases threaten the well-being of animals and humans and/or public confidence in food safety directly, diseases that have serious negative impact on food security through hampering various stages of our food system (from farm to fork) are also central to the role of One Health in this century. Eradication or control of these animal diseases can help ensure global food security. Interestingly, many of these diseases have been around for decades or centuries and are not necessarily zoonotic by nature, e.g. foot-and-mouth disease (FMD), Peste des petits ruminants (PPR), contagious bovine pleuropneumonia, classical swine fever, Rift Valley fever, avian influenza, Newcastle disease, bluetongue and others. They are commonly referred to as transboundary animal diseases (TADs) nowadays.

TADs are diseases of socio-economic, trade and/or food security significance for more than one country. They are capable of spread between countries and can reach epidemic proportions. Their control and management, including eradication, requires cooperation between several countries. In the recent years, global efforts to control TADs have been further challenged by increasing globalisation in animal trade and other socio-economic activities as well as ecological change. These challenges have variably and indirectly exacerbated the overall impact of TADs on livestock productivity and food security; this is an emerging area that has dominated the attention of various national and international veterinary authorities, including the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO). By 2030, global food demand is expected to increase by 50%. Increased food demand places pressure on food security and means that control of TADs in production animals is even more critical, whether these animals are used for domestic or export production. It is worth noting that in many developing countries livestock species are used not only as a source of protein, but also draught animal power for cropping. Therefore, improved animal health and production contributes to greater food security as animals provide dietary protein, cash income and savings and contribute their draught power and manure toward agricultural production.

According to the OIE trade-related disease list, there are 107 diseases (or disease groups) for terrestrial animal species and 26 for aquatic animal species (including aquarium species not for human consumption). Among these diseases, rinderpest was officially declared in 2011 to have been eradicated globally. This represents the first animal virus (or the second virus after human smallpox) in history to have been wiped out by human effort and is one of the great achievements in modern veterinary history. This global disease freedom status did not come easily; it was truly the result of continued joint effort between 198 countries and territories with susceptible animals over several decades. Rinderpest historically occurred in Europe, Africa and Asia and was a TAD with high impact on food security and international trade. In 2008, FAO reported that since 1986, approximately US$610 million had been spent on animal health programs in Asia and Africa, primarily targeting rinderpest but covering other diseases and infrastructure. The full spectrum of global socio-economic benefits from eradicating rinderpest is yet to be assessed but can be appreciated by the recent estimation of an at least 16-fold financial gain through reduced cattle deaths and herd productivity alone. The potential annual benefit for Africa alone was estimated at US$1 billion. The process and achievement of eradicating this disease clearly shows that socio-economic issues, including food security, can be a significant driving force for global actions against specific animal diseases.

In Focus

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Other major TADs which are still endemic in many regions worldwide and able to cause significant negative impact on food security are shown in Table 1. These diseases have long been identified by FAO and OIE as priority candidates for global eradication or control. In particular, the colossal impact of FMD on food security can be appreciated through its direct impact on the numbers of animals alone. With the current control measures in place, the worldwide numbers of major livestock affected by the disease were recently estimated (in million per year) at 20.59 (cattle), 0.68 (buffalo) 9.71 (sheep), 11.97 (goats) and 11.63 (pigs). During the 2001 FMD outbreak in the United Kingdom, 6.1 million livestock were slaughtered. The outbreak in South Korea in 2010–2011 also led to the destruction of more than 3 million livestock. Global production losses and the application of vaccines due to FMD can amount to US$5 billion a year. Such economic impact will adversely affect other associated industries which may further worsen food security issues in some poorer countries. In Australia, FMD has been described as the single greatest disease threat to its livestock industries. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) recently estimated that over a ten year period there would be severe direct economic losses (up to AU$16 billion) to the livestock and meat processing sector from an FMD outbreak.

Table 1. Major transboundary animal diseases with significant negative impact on global food security.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Aetiology</th>
<th>Major domestic animal host</th>
<th>Brief disease description</th>
</tr>
</thead>
<tbody>
<tr>
<td>African swine fever</td>
<td>Asfivirus (Asfaviridae)</td>
<td>Pigs</td>
<td>Highly contagious, generalised disease with variable mortality rates</td>
</tr>
<tr>
<td>Avian influenza</td>
<td>Influenza virus A (Orthomyxoviridae)</td>
<td>Poultry and other bird species</td>
<td>Highly contagious disease characterised by respiratory, gastrointestinal and/or nervous signs in land poultry</td>
</tr>
<tr>
<td>Bluetongue</td>
<td>Orbivirus (Reoviridae)</td>
<td>All ruminants</td>
<td>Midge-borne haemorrhagic disease characterised by catarrhal inflammation of mucous membranes</td>
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<tr>
<td>Bovine brucellosis</td>
<td>Brucella abortus</td>
<td>Cattle, horses</td>
<td>Chronic disease causing abortion in cattle</td>
</tr>
<tr>
<td>Classical swine fever</td>
<td>Pestivirus (Flaviviridae)</td>
<td>Pigs</td>
<td>Highly contagious generalised disease with variable mortality rates</td>
</tr>
<tr>
<td>Contagious bovine pleuro-pneumonia</td>
<td>Mycoplasma mycoides subsp. Mycoides SC (bovine biotype)</td>
<td>Cattle, buffalo</td>
<td>Acute or chronic disease characterised by sero-/fibrinous pleuropneumonia</td>
</tr>
<tr>
<td>Foot and mouth disease</td>
<td>Aphthovirus (Picornaviridae)</td>
<td>Cattle, buffalo, pigs, sheep, goats, other cloven-hoofed species</td>
<td>Highly contagious vesicular disease</td>
</tr>
<tr>
<td>Newcastle disease</td>
<td>Serotype APMV-1 Avulavirus (Paramyxoviridae)</td>
<td>Poultry and other bird species</td>
<td>Highly contagious disease characterised by respiratory, gastrointestinal and/or nervous signs</td>
</tr>
<tr>
<td>Peste des petite ruminants</td>
<td>Morbillivirus (Paramyxoviridae)</td>
<td>Goats, sheep, cattle, pigs</td>
<td>Gastrointestinal and respiratory disease with high mortality rates; often subclinical infection in cattle and pigs</td>
</tr>
<tr>
<td>Rabies</td>
<td>Lyssavirus (Rhabdoviridae)</td>
<td>All mammals</td>
<td>Disease characterised by fatal encephalitis</td>
</tr>
<tr>
<td>Rift Valley fever</td>
<td>Phlebovirus (Bunyaviridae)</td>
<td>Sheep, goats, cattle, buffalo, camels</td>
<td>Mosquito-borne disease characterised by abortion and high mortalities in young animals</td>
</tr>
</tbody>
</table>

*Not a complete list.*
Food security is often the primary driver for TAD control and eradication in developing countries while in developed countries, such as Australia, trade is a major consideration. Regardless of the type of driver, both developing and developed countries can collegially contribute to ensuring global food security through reducing or eliminating TAD related risks and threats in different ways. The Australian Government is currently developing its first ever national food plan to help ensure that the government’s policy settings are right for Australia over the short-, medium- and long-term. The aim of the plan is to foster a sustainable, globally competitive, resilient food supply that supports access to nutritious and affordable food. To achieve this outcome, proposals to minimise and manage potential risks to Australia’s food security and to contribute to global food security are high on its agenda.

Australia remains free from many of the major TADs that affect food systems around the world. Therefore, maintaining and enhancing its disease free status through strengthening Australia’s preparedness for major TADs will confer significant benefits including trade and market access and global food security. Experience from rinderpest eradication has provided many valuable lessons and probably a roadmap for future global actions against other TADs. It is certain that the biological and clinical characteristics of a TAD (e.g. host range, pathogen variants, incubation period, carrier status, clinical presentations for detection, etc.) and the availability of an effective vaccine and reliable diagnostic tests are a key determinant of its suitability for global eradication or control. Undoubtedly, political willingness, supportive regulatory regimes, sustainable resources or infrastructure, strategies and coordination are vital to the ultimate success of any global TAD eradication and control program. Unfortunately, most of these institutional factors are often vulnerable to various national or international political and economic changes. In many countries, they do not have control of TADs because of poor infrastructure and investment in veterinary services governance as there are competing claims for scarce resources. In some countries, natural crises, civil unrest and wars may also have a role in further compromising their ability to control TADs.

From the veterinary perspective, there are various scientific and technical aspects that are relatively less influenced by some major institutional factors and can be enhanced to meet specific challenges for improving the chance of success in a global TAD control, eradication and/or preventive program. These aspects may include, but are not limited to, capability and capacity building through developments and innovations for field/laboratory diagnostics, vaccines/vaccination, surveillance/monitoring, communications/information systems, and training/awareness programs. In fact, some of these activities or advancements themselves may even become a driver of favourable institutional changes. To further illustrate this point it is worth drawing on some of the lessons from rinderpest and smallpox eradication. Indisputably the biological and clinical characteristics of rinderpest virus did render the disease very suitable for global eradication but its success still owed much technically to the development and use of an effective vaccine and appropriate vaccination strategy as well as quality-assured laboratory testing support and various training programs.

Similarly, two particular technical elements were also highlighted as a key to the success of global smallpox eradication in humans: they are the use of an effective vaccine in a ring vaccination program and an effective surveillance program able to quickly and reliably detect emerging cases.

As PPR is closely related to rinderpest, it is a strong candidate for global eradication and strategic planning to this end is underway. This also shows how the flow-on benefit from one disease to another itself could become an enabler for global cooperation. From the perspective of biosecurity risk level and global food security, the TAD that is more relevant to Australia and perhaps many other parts of the world is still FMD. OIE and FAO, in response to a number of resolutions from their joint conferences on FMD held in 2009 and 2012, are currently developing the global strategy for FMD control. While the overall objective of such a strategy is to gradually reduce the incidence of FMD in endemic countries, it is hoped that this effort would eventually lead to the feasibility of eradicating the disease within the near future.

In late 2011, a report based on the review of Australia’s preparedness for the threat of FMD conducted by Ken Matthews was released. It contains a number of specific recommendations to enhance Australia’s preparedness across the biosecurity continuum (pre-border, border and post-border). The Australian Government Department of Agriculture, Fisheries and Forestry has since supported a number of projects or activities in response to these recommendations. A significant number of them involve the strengthening of national technical capacity especially for disease surveillance and response. These can be progressed without necessarily requiring substantial institutional changes. As an example, to address the need for national surge capacity for a large-scale emergency or proof-of-freedom response, a project is being developed to establish the capability for initial screening tests that involve no live virus or virus proliferation on samples in interested state/territory government laboratories for use during an FMD outbreak.

The global food security system relevant to products of animal origin is very complex and may involve areas such as availability of food, access to food and effective and safe utilisation of food. There is no doubt that global food security issues will continue to shape the economic and political landscape towards livestock production, trade and biosecurity worldwide. On the other hand, different economies, including Australia, will have their own contributions to
make towards ensuring global food security for public good and/or trade purposes. In this regard, while controlling or eradicating TADs plays a key role in global food security, its success largely depends on the ability to get strong commitment to regional approaches which recognise the relevant drivers in member economies. For animal health professionals, the challenge is to integrate control of TADs into broader development goals. Strengthening our scientific and technical capacity, especially through innovative technology and strategy, presents a useful way to help meet the challenge.

References


Biographies
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