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The impact of foot and mouth disease

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Summary

The global impact of foot and mouth disease (FMD) is colossal because of the huge numbers of animals affected. This impact can be separated into two components: direct losses due to a reduction in production and changes in herd structure; and indirect losses that relate to the significant costs of FMD control and management and poor access to markets and limited use of improved production technologies. The paper estimates that the annual impact of FMD in terms of production losses and vaccination alone are in the region of US$ 5 billion.

Keywords


Introduction

Foot and mouth disease (FMD) is endemic in almost all developing countries. The seven different FMD serotypes circulate within regional viral pools with periodic incursions into virus-free developed countries. FMD causes high morbidity and low mortality, although high mortality among young stock does occur. Clinical signs are generally more severe in temperate breeds associated with intensive farming, particularly in immunologically naive populations. The disease affects all the major non-avian livestock species, with cattle being the most susceptible and pigs the best amplifier of virus. Infection in wildlife can further complicate control efforts.

When this ease of biological transmission is combined with widespread and long-distance movements of animals, FMD can move quickly and spread effectively. The importance of trade, both legal and illegal, in the spread of the disease implies that any FMD control strategy must have policies and actions to limit risks of FMD spread from an outbreak and the introduction from neighbouring countries and trading partners. These movement controls for FMD management have an economic impact of limiting trade that is local, national and international in its reach. The most extreme and costly impacts are the lack of access to lucrative international markets for countries where FMD is not controlled.

The paper presents the main impacts of FMD from production losses, costs of control, poor technology development and trade. It uses a framework to assess the impact of disease (see Rushton, 2009, pages 193–197 [12]). It also makes an estimate of the global impact of the disease in terms of production losses and vaccination costs.

Economic impact of foot and mouth disease

Although other diseases can cause more severe disease in individuals, in order to appreciate the impact of FMD, one must step back and look at the disease at the population level. FMD is widely prevalent, with the disease circulating in an estimated 77% of the global livestock population. In this population it affects a large proportion of animals during an outbreak and affects many species. Collectively, these factors lead to a huge burden of disease.
Direct costs – visible and invisible losses

Production losses directly due to FMD include:

- reduced milk production, affecting both the humans and calves that depend on it. This can account for 33% of losses in endemic settings;
- reduced livestock growth;
- mortality among young stock, typically reported to be between 2% and 5%;
- loss of traction power where draught animals are used. If this occurs during harvest the effects can be particularly severe (9, 11);
- abortion: the cost of a single abortion is high as the farmer will have to pay to keep the cow without it producing anything for another year or more, or cull the animal;
- although FMD typically has a short-term effect on an animal’s health, chronic FMD typically reduces milk yields by 80% (1, 2, 3, 15).

Visible production losses are most prominent in pigs in intensive production systems followed by dairy cattle. These two systems are important sources of animal protein in poor countries and their importance continues to grow. Extensive systems of production do not have such pronounced losses, and some species, such as sheep and goats, show limited clinical symptoms and minor economic losses.

Foot and mouth disease (FMD) causes problems which are less easily quantified. With fertility, the most obvious problems are the abortion losses explained above, but there are longer lasting impacts of this loss of foetus and a reduced probability of conception. These both translate into the need to have a greater proportion of breeding animals in a population, implying that for every kilogram of meat or milk produced there is an additional fixed cost to cover more breeding stock.

Indirect costs – additional costs and revenue forgone

The cost of control measures carried out by the state Veterinary Services, such as vaccination, outbreak control and sometimes culling and compensation, are borne by the tax payer.

- An estimated 2.6 billion doses of FMD vaccine are administered annually (8), with vaccine drug and delivery costs at between US$ 0.4 and US$ 3 per dose including delivery costs, depending on the setting (1, 4, 13).
- Some national FMD vaccination programmes vaccinate all bovines three times a year and all sheep and goats once a year, which limits resources available to combat other diseases.
- In endemic settings significant amounts are spent on privately funded vaccination and control.
- In some areas, wildlife is kept out of FMD-free zones with extensive fencing at great financial cost, not to mention the impact this restriction has on wildlife.

In Africa, it has been estimated that more is spent on controlling FMD than on any other veterinary disease (5). Even if a country is FMD free, there are ongoing costs due to:

- efforts to reduce the chance of disease re-introduction, including border and import controls and inspections and sometimes vaccination;
- efforts to maintain the capability for early detection and control of FMD, including surveillance, ensuring sufficient organisational capacity in the Veterinary Services which are tested by outbreak simulation exercises and permanent restrictions on the livestock sector (such as post-movement standstills);
- dealing with outbreaks, which may involve culling, movement restrictions and vaccination. Outbreaks among animals lacking prior immunity to FMD are particularly dramatic;
- control measures can affect other industries, for example the United Kingdom (UK) 2001 outbreak restricted public access to the countryside, costing in the region of US$ 4–5 billion in lost tourism revenue (14);
- the impact of culling-based control measures can have other non-financial impacts. For example, suicides increased among farmers of culled farms during the UK 2001 outbreak and in South Korea there was concern...
that the burying of large numbers of culled animals would pollute water supplies. Culling healthy animals is a politically sensitive issue and is seen as unnecessary and inhumane by much of the wider public; and

- movement restrictions disrupt production and may even lead to welfare problems that lead to further culling.

In addition to the costs of vaccination and culling, there are also costs incurred with the need to control movement and perform diagnostics to confirm the presence or absence of disease. There are no specific data on these additional items.

In terms of revenue forgone, the most important issue is market access (see Rushton, 2009, pages 199–204 [12]):

- livestock trade is limited; those affected by FMD receive lower prices for their stock and those wishing to purchase animals from FMD-free herds face a restricted supply;
- countries infected with FMD cannot trade live animals with FMD-free countries. Typically, the countries with the best meat prices are FMD free;
- the trade of livestock products is also restricted. If regular outbreaks occur, only processed, tinned products can be exported to free countries; if FMD is effectively controlled with vaccination by a competent Veterinary Service able to detect outbreaks then deboned meat can be exported;
- trade of fruit and vegetables can also be affected by FMD status;
- the FMD status of nations that a country trades with also affects a country’s ability to trade with FMD-free countries irrespective of its own status;
- a lack of access to lucrative markets restricts the development of commercial farming; consequently, employment and tax revenue from this area is limited by FMD status;
- investment in the livestock sector is limited if there is a perceived risk that FMD may occur; and
- livestock and livestock products cannot be imported from FMD-infected countries; this limits supply, and, although this is good for domestic producers, it limits choice and leads to increased market prices for consumers.

Impacts at the national level ultimately affect the individual farmer and vice versa. Similarly, impacts on the livestock producer have ripple effects along the entire market chain, affecting other players, such as markets, abattoirs and dairies (5). There can also be major disruption to economies. The overall cost to the UK economy was estimated to be US$ 9 billion (14); furthermore, it spread to the Netherlands (costing over US$ 1 billion) and Ireland and France (costing further hundreds of millions of dollars in losses). Rich and poor countries alike go to great lengths to combat the disease in order to obtain the rewards associated with FMD-free status. Although slaughtering animals to combat a non-fatal disease may initially seem illogical, the size of these indirect benefits may justify the use of control measures that have a greater negative impact than the direct costs of the disease (10).

Finally, this disease can lead to farmers and the livestock industry as a whole choosing sub-optimal technologies. Highly productive breeds are typically more susceptible to FMD. The risk of FMD therefore:

- restricts the use of these breeds and
- prevents the development of more intensive production systems based on these breeds.

A global estimate

The authors have made an estimate of the impact of FMD globally as of 2011. This focuses on the numbers of animals that have FMD and the associated losses in terms of death and production and the costs of control, focusing on an estimation of vaccination and the costs of vaccine production and delivery.

In summary, FMD affects 27 million livestock units each year, which is approximately 0.64% of the total livestock units globally. In an attempt to minimise the economic losses of this disease, 2.35 billion vaccines are produced and applied. The overall economic impact was calculated based on the costs of a vaccine and its application being US$ 1 and that any livestock unit affected by FMD would cause a loss in production equivalent to US$ 100. The latter estimate takes into account the death of an animal and loss in weight gain, milk production and draught power, and is felt to be a conservative estimate. The total annual impact of FMD is calculated to be US$ 5 billion.
The majority of FMD impact occurs in China, India and Africa. The impact in South America is largely due to the costs of vaccination applications, a control measure to limit the production and trade losses this region would suffer if FMD was prevalent.

The estimated impact does not include the losses due to trade restrictions, which are large at both local and international levels but are difficult to estimate with any accuracy and tend to be very variable. It also does not take into account that the development of the livestock sector tends to be restricted by the presence of FMD in terms of production system technology and breed advancement and investment slaughter, processing and marketing systems. Finally, there was no estimate in these calculations in terms of the costs of diagnostics and surveillance required to prevent and control FMD. Therefore, US$ 5 billion is likely to be a very conservative estimate of the global annual impact of FMD.

**Conclusions**

Wealthy countries that have eradicated FMD face ongoing costs from periodic outbreaks and the costs of being prepared to rapidly detect and deal with these outbreaks via means of movement controls, culling and/or vaccination. Many countries reduce the impact of the disease with extensive ongoing or intermittent vaccination programmes; the global scale and costs associated with these programmes is vast, with an estimated 2.6 billion doses administered annually (8). The impact of FMD in endemic countries has received less attention than the impact of outbreaks in free countries, despite the huge numbers of animals affected by the disease and the importance of livestock to the economies of endemic countries. Direct losses due to death and disease are easy to appreciate; however, in endemic countries, the burden of FMD often manifests as widespread and ongoing losses that limit development opportunities for developing the livestock sector.

Overall, the production losses and the application of FMD vaccines around the world cause an annual impact of US$ 5 billion, with additional costs on restrictions to trade and adoption of improved technologies across the livestock sector. FMD affects livestock all over the world, particularly in poor countries. In many places, little is done to control FMD, largely because of a lack of resources and a failure to recognise the benefits that control brings. FMD prevents agricultural development and reduces food security; in many countries it leads to massive losses owing to control costs and in some cases by limiting export market access. These estimates are considered to be of a very conservative nature, as the Government of India (6, 7) states that the direct loss from foot and mouth disease (FMD), due to milk and meat, is estimated at Rs 20,000 crore per annum. Indirect losses due to reduced work capacity abortions, subsequent infertility and sterility (that account for the subsequent reduced milk production) have not been quantified. These losses in India alone, not considering any control costs, total US$ 4.8 billion.

Equipping poor countries with the tools necessary to control FMD will involve the development of state Veterinary Services that in turn will deliver wider benefits to a nation, including the control of other livestock diseases. Only through a sustained global effort can the risk of FMD and the heavy burden that it inflicts be controlled for rich and poor countries alike.

Further details of cost–benefit analyses of FMD control and the wider implications of this disease will be made available in a forthcoming article by the authors.

**References**


