Prospects for FMD control

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Food and Agriculture Organization (FAO) of the United Nations,
United Kingdom Special Inquiry on FMD, 1925
(after a massive epidemic in which stamping out had temporarily been abandoned)

Preface

The real trouble with foot-and-mouth disease is not its deadliness but its extra-ordinary infectivity, and we do not have to consider its effects upon the animals actually attacked but upon the flocks and herds of the United Kingdom as a whole. Movement, both human and animal, is now much more extended than it used to be, and infection would constantly be carried from one part of the kingdom to another.
2012: Bangkok Conference and Jerez Open Session

Extra-ordinary infectivity results in a very high global burden

30 (-100+?) million LIVESTOCK UNITS per year (2% of world's cattle population)

Global burden of FMD in cattle; burden of FMD in sheep and goats had a similar distribution. Measured as a prevalence score based on estimates of incidence, population distribution and other risk factors, adapted from Sumption et al. (2008).
Erice, 2008 and the Ecosystems approach: 7 virus pools, Regional Roadmaps for each pool

The Ecosystems approach ("7 virus pools")
- pools where FMDV lineages and epidemics occur independently.

Given the scale of infectivity and global burden – what are the prospects of extending control beyond the current free regions?
The development of FMD Control: five ages

1. The age of isolation and quarantine (+prayer: 1514 to 1890)

2. The age of stamping out and keep-it-out policies 1890-(1955): successful application in control in the United Kingdom from before the virus was discovered.

Until mid-1950s, use of isolation/quarantine was the response in most of continental Europe, but epidemics involved thousands of infected farms.

Fracastoro: principles for control by isolation from the “’spores - and spread by fomites’”
The development of FMD Control: five ages

3. Regional control through generalised vaccination: develop vaccines (1925-65) and control through generalised vaccination, 1955-1980 (Europe, later S America, elsewhere)

4. Development of free regions: Europe (later S America) pushes for FMD free regions without vaccination: 1980- (Advanced countries/OECD)

5. The Progressive Control age (PCP); the move to widen access to the benefits of FMD control for the many, progress in attainable steps, reducing global risk (Global Strategy 2012-2027)
The Progressive Control Pathway for Foot and Mouth Disease (PCP-FMD):

Objective: Assist countries where FMD is endemic to progressively reduce the impact of FMD

Progressively increase the level of FMD control over 5 stages
In use since 2008
Joint FAO-EuFMD-OIE Tool
Application of the Progressive Control Pathway for FMD in 2014

Legend
- Orange: PCP Stage 1
- Yellow: PCP Stage 2
- Green: PCP Stage 3
- Blue: OIE endorsed control programme
- Pink: PCP project
- Red: Roadmap planned
- Light Blue: Established project applying PCP

- West and South Eurasia Roadmap
- E. Africa Roadmap
- S. Africa Roadmap
- SAARC Roadmap
- Countries in the SEACFMD 2020 Roadmap

PCP based projects supporting the Hemispheric Plan for Eradication - PHEFA
Foot and Mouth Disease control

Past ages have shown what works – in advanced countries
Controlling Disease ..and Controlling FMD virus circulation..are different Outcomes
Free countries usually want to control circulation rapidly – to eradicate virus.
Endemic countries may want to control the disease –to reduce impact.
Sectors in each category may have different desired outcomes
The Progressive Control Pathway (PCP-FMD) is a policy development tool – for sustainable strategies
Market based solutions might provide a new way to widen access to FMD vaccines in the lower PCP stages

No magic formula fits all settings
PCP Stage 2 and upwards: countries must have Risk-Based Strategic Plans

1. Situation analysis
2. Benefits of FMD Control
3. Goal, objectives, tactics and activities
4. Monitoring and evaluation
5. Operational plan
6. Technical assistance
Prospects for extending FMD Control beyond currently free regions: overview
• Successful control models
• Regional successes
• >120 years experience
• Deep knowledge base
• Vaccination options
• Processes/pathways to freedom (PCP-FMD)
• Global Strategy (FAO/OIE)

• Global demand for livestock (productivity, trade)
• Private producer demand for FMD control at the base of the pyramid
• Benefit/cost of control POSITIVE
• Awakened Government interest (Export - Africa and Eurasia)
• Economic development (a new Africa...)
• Appropriate policy setting tools (PCP-FMD)
• Stage of vaccine development
• Communication revolution

• Extreme infectivity
• Instability (borders, gains rapidly lost)
• poor adoption of state control models (~100 countries)
• Barriers to access quality vaccines
• Quality of national policy and strategy
• Duration of immunity (vaccine)
• Expertise and knowledge transfer

• Protectionism (vaccines, trade)
• Reduction in R&D
  • low hanging fruit
  • ROT
• Weakening UN /international technical support to countries
• Wars and instability
Strengths

✓ Successful control models
✓ Regional successes
✓ >120 years experience
✓ Deep knowledge base
✓ Vaccination options
✓ Processes/pathways to freedom (PCP-FMD)
✓ Global Strategy (FAO/OIE)

Control options from Herd to Global Level

- Herd level: Quality vaccines now far cheaper
- National level
  • Processes for gaining freedom (OIE)
  • OIE Code: standards for safe trade
  • Pathways out of endemicity (PCP-FMD)
  • Tested emergency management systems (options include vaccination, to regain freedom)
- Eco-system and Regional level (Roadmaps in each POOL)
- Global level
  • Strategy for FMD (Strengthened animal health systems) from 2012
  • International framework (GF-TADS - FAO/OIE)
Strengths

- Successful control models
- Regional successes
- >120 years experience
- Deep knowledge base
- Vaccination options
- Processes/pathways to freedom (PCP-FMD)
- Global Strategy (FAO/OIE)

Successful National and Regional control models

- Western Europe, Americas
- One Serotype (C) disappeared (globally gone?)
Strengths

- Successful control models
- Regional successes
- >120 years experience
- Deep knowledge base
- Vaccination options
- Processes/pathways to freedom (PCP-FMD)
- Global Strategy (FAO/OIE)

- Deep knowledge base

- Controlled in the UK before the virus was identified
- British experience- focus on isolation, tracing and slaughter; understand every outbreak and improve control of the next
- >100 years of research on transmission
**Strengths**

- Successful control models
- Regional successes
- >120 years experience
- Deep knowledge base
- **Vaccination options**
- Processes/pathways to freedom (PCP-FMD)
- Global Strategy (FAO/OIE)

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**Vaccination options**

Vaccines used in emergency (rings) since 1938 and preventively since WW2 (Frenkel, NL)

**Emergency vaccination (free countries)**
- (EU) with or without slaughter (DIVA) of vaccinates
- EU vaccine/antigen bank

**Preventive vaccination programmes, non-free countries:**
- Strategic options
  - Disease reduction (PCP2) vs eliminating virus circulation (PCP3)
  - Outcome level: Herd, zone, risk targeted, national

**Duration of immunity:** limited - little improvement since 1938?

**Cost:** fell greatly 1950-1980, then little change (quality producers)
Strengths

- Processes/pathways to freedom (PCP-FMD)
- Global Strategy (FAO/OIE)

![Diagram showing the stages of FMD control and elimination.](image-url)
The GLOBAL FMD CONTROL STRATEGY
Adopted in Bangkok, 2012
Action plan

THREE Phases of 5 years
Aim: every country to progress by 2 PCP Stages

By 2027 all countries to be in minimum PCP Stage 2 (= implementing control programmes)

Action plan (typical activities) were worked out
☐ At country level - for each of the PCP stages and for each of the Strategy components
☐ At regional level
☐ At global level

The Global FMD Control Strategy and supporting documents are available on the websites
www.FMDconference2012
http://www.oie.int
FMD Global Strategy - Financial implications in USD as calculated by the World Bank for the first 5 years

- Cost of national FMD programmes 68 M
  (to support 79 initial PCP 0-2 Stage countries)
- Vaccination cost 694 M
  (to support 45 initial PCP 1-3 Stage countries)
- Regional level 47 M
  (reference labs/epidemiology support and networks)
- Global level 11 M
  (coordination, evaluation)

SEVERAL RESULTS:
• EC VIA EUFMD: INCREASED FUNDING TO PIRBRIGHT TO COORDINATE THE GLOBAL FMD LAB NETWORK
• MORE FREQUENT REGIONAL ROADMAP MEETINGS - EURASIA, MID-EAST, EAST AFRICA
Weaknesses

- Extreme infectivity
- Instability (borders, gains rapidly lost)
- Poor adoption of state control models (~100 countries)
- Barriers to access quality vaccines
- Quality of national policy and strategy
- Duration of immunity (vaccine)
- Expertise and knowledge transfer
Weaknesses

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• Barriers to access quality vaccines

Barriers to accessing quality FMD vaccines

**Demand-side (buyer)**
1) Lack of trust: in suppliers and products
2) Limited resources (Government, private)
3) Lack of delivery to point of need
4) Lack of perceived benefits
5) FMD as one of many concerns

**Supply-side (Vaccine producer to local deliverer)**
1) Lack of harmonised registration systems (Africa, Asia)
2) Impediments to pharmaceutical importation (cost of registration, bureaucracy, corruption, local monopolies)
3) Exclusive government capture of FMD control (private sector excluded)
4) Risks relating to spatial distribution of consumers and Temporal distribution of demand
5) Lack access to appropriate epidemiological info
FMD – a consequence of barriers to accessing FMD prevention options

- Decreased resilience
- Negative livelihoods impact
- Decreased market access
- Limited ability to trade products internationally

Disease outbreak

Increased circulation of virus

Minimal/no preventive rural control

Poor access of rural livestock holders to quality FMD prevention options

Underlying socioeconomic issues create the environment for disease to persist
Weaknesses

- Extreme infectivity
- Instability (borders, gains rapidly lost)
- Poor adoption of state control models (~100 countries)
- Barriers to access quality vaccines
- Quality of national policy and strategy
- Duration of immunity (vaccine)
- Expertise and knowledge transfer

- Limited duration of vaccinal immunity
- Three times per year in some risk settings
- Protection further reduced where vaccine not well matched to challenge
- Guidance on vaccination intervals comes mainly from vaccine producer
- Few laboratories qualified to undertake antibody kinetic tests to predict optimised regimes
Weaknesses

- Expertise and knowledge transfer

Farmers can cope with FMD. Government has other things to do. FMD is too complex.

FMD is good for antibiotic sales. But there is no vaccine.

How close is FMD to me? What can I do? Internet or local vet?
Opportunities

✓ Global demand for livestock (productivity, trade)
✓ Private producer demand for FMD control at the base of the pyramid
✓ Benefit/cost of control POSITIVE
✓ Awakened Government interest (Export - Africa and Eurasia)
✓ Economic development (a new Africa..)
✓ Appropriate policy setting tools (PCP-FMD)
✓ Stage of vaccine development
✓ Communication revolution
THE GLOBAL NEED FOR ANIMAL PROTEIN WILL INCREASE BY 70% IN 2050
Global ranking of food and agriculture commodities in value terms (2010)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Commodity</th>
<th>Production value ($ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rice, paddy</td>
<td>180</td>
</tr>
<tr>
<td>2</td>
<td>Cow milk, whole, fresh</td>
<td>180</td>
</tr>
<tr>
<td>3</td>
<td>Indigenous Cattle Meat</td>
<td>172</td>
</tr>
<tr>
<td>4</td>
<td>Indigenous Pig meat</td>
<td>168</td>
</tr>
<tr>
<td>5</td>
<td>Indigenous Chicken Meat</td>
<td>122</td>
</tr>
<tr>
<td>6</td>
<td>Wheat</td>
<td>81</td>
</tr>
<tr>
<td>7</td>
<td>Soybeans</td>
<td>66</td>
</tr>
<tr>
<td>8</td>
<td>Tomatoes</td>
<td>55</td>
</tr>
<tr>
<td>9</td>
<td>Sugar cane</td>
<td>54</td>
</tr>
<tr>
<td>10</td>
<td>Maize</td>
<td>54</td>
</tr>
</tbody>
</table>

Source: FAOSTAT
Opportunities

- Global demand for livestock (productivity, trade)
- Benefit/cost of control POSITIVE
- Private producer demand for FMD control at the base of the pyramid

Knight-Jones and Rushton, 2013:
- Average cost per vaccination: 1 USD
- Average loss per case (cattle): 100 USD
- Benefit/cost usually >>1 in free countries; in endemic countries, few studies - but positive in affected systems (cattle)
- Endemic setting, pastoralists, Sth Sudan: 11.5
- Global loss: US$ 11 billion (6.5 to 21 billion, 90% range)
- Global estimate burden:
  - 32 million livestock units (LSU; range 28 -79 million) (based on reported cases; true cases (serology) much higher (e.g. 8 fold- Iran)
- Estimated 2% of world's cattle population has FMD in a year (90% uncertainty range: 2-5%)

<table>
<thead>
<tr>
<th>Region</th>
<th>Production losses</th>
<th>Vaccination</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Median</td>
<td>90% range</td>
</tr>
<tr>
<td>China</td>
<td>1.9 billion</td>
<td>2.2 billion</td>
<td>2.3-7 billion</td>
</tr>
<tr>
<td>India</td>
<td>1.9 billion</td>
<td>0.2 billion</td>
<td>1-4 billion</td>
</tr>
<tr>
<td>Rest of Asia</td>
<td>1.2 billion</td>
<td>0.7-3 billion</td>
<td>1.3 billion</td>
</tr>
<tr>
<td>Africa</td>
<td>2.3 billion</td>
<td>1-5 billion</td>
<td>2 billion</td>
</tr>
<tr>
<td>Europe and Turkey</td>
<td>35 million</td>
<td>0.03-0.1 billion</td>
<td>0.08 billion</td>
</tr>
<tr>
<td>Middle East</td>
<td>0.2 billion</td>
<td>0.1-0.5 billion</td>
<td>0.22 billion</td>
</tr>
<tr>
<td>South America</td>
<td>0.1 billion</td>
<td>0.5-1.4 billion</td>
<td>0.8 billion</td>
</tr>
<tr>
<td>Total</td>
<td>7.6 billion</td>
<td>2.5 billion</td>
<td>6.5-21 billion</td>
</tr>
</tbody>
</table>
Opportunity: Market-based solutions (MBS)

Most of the world's population are consumers with relatively little purchasing power

- Globally: 4 billion people living on <$2.50/day
- Ethiopia: $84 billion of wealth in the BoP\(^3\), 22 million rural poor
- Kenya: 15 million rural poor\(^4\)

Target this consumer class through high volume/low value business models

Opportunities

- Global demand for livestock (productivity, trade)
- Benefit/cost of control POSITIVE
- Market based solutions - meet demand for FMD control at the base of the pyramid
- Awakened Government interest (Export - Africa and Eurasia)
- Economic development (a new Africa...)
- Appropriate policy setting tools (PCP-FMD)
- Stage of vaccine development
- Communication revolution
The new market place is the BoP
(Base of the Pyramid)

The World Economic Pyramid

<table>
<thead>
<tr>
<th>Annual Per Capita Income*</th>
<th>Tiers</th>
<th>Population in Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than $20,000</td>
<td>1</td>
<td>75-100</td>
</tr>
<tr>
<td>$1,500-$20,000</td>
<td>2 &amp; 3</td>
<td>1,500-1,750</td>
</tr>
<tr>
<td>Less than $1,500</td>
<td>4</td>
<td>4,000</td>
</tr>
</tbody>
</table>

*Based on purchasing power parity in U.S.

Source: U.N. World Development Reports

A new business model for FMD: Viewing the poor as a conscious consumers - as opposed to victims

**Rapid and continued growth projected for Sub-Saharan Africa**

- trend of privatization
- the poor as a conscious consumers as opposed to victims
- Challenge the idea that the poorest are not willing to pay for goods and services
- Design interventions targeting those at the BoP
  - Many consumers - low purchasing power
- Impact investments also include a social dimension
WB – FAO – ILRI – AU-IBAR Livestock Data Innovation in Africa Project

Objective: ‘set up mechanisms and institutional linkages to improve the (quantity and) quality of livestock data and promote pro-poor investments in the livestock sector’

Sub saharan Africa: The majority of rural households keep livestock

% rural households keeping livestock

- Niger: 85%
- Madagascar: 80%
- Malawi: 65%
- Tanzania: 60%
- Uganda: 55%
- Ghana: 50%
- Nigeria: 40%
Characterising livestock keeping

1. Business-oriented livestock farming
   • cash from selling meat, milk and other products to the market

2. Livelihood-oriented livestock farming
   • food, manure, insurance, etc. as a step in a ladder out of poverty
1. Business-oriented livestock farming

- cash from selling meat, milk and other products to the market)
- relatively large herds / flocks (e.g. > 3 cattle equivalent)
- livestock key for income ($\geq 25\%$ of cash income from livestock)
- major incentives to tap into the growing market for animal foods
The majority of rural households are livelihood-oriented - few are business-oriented (from 5% to max 25%)
<table>
<thead>
<tr>
<th>LIVESTOCK PRODUCER</th>
<th>DEMAND FOR INPUTS</th>
<th>SUPPLY OF OUTPUTS</th>
<th>Implications - FMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livelihoods-oriented</td>
<td>Many farmers with low purchasing power / low-cost technologies / scattered / demand is irregular</td>
<td></td>
<td>× Public (State) subsidised</td>
</tr>
<tr>
<td>Business-oriented</td>
<td>Few farmers with ‘medium’ purchasing power / small-scale affordable tech / scattered / demand is regular</td>
<td>Low volume / heterogeneous quality</td>
<td>Willingness to pay depends on risk: Market potential, PPP</td>
</tr>
</tbody>
</table>
FMD control: What is the potential market? One example

- Focus on cattle in the East African region, specifically Ethiopia and Kenya:
  - Ethiopia – 54 million head\(^6\)
  - Kenya – 17 million head\(^7\)
  - 14.5 million dairy cattle combined

- Business of $142 million per year for control strictly through vaccination

Robinson and Siembieda, 2011
Opportunities

- Global demand for livestock (productivity, trade)
- Benefit/cost of control POSITIVE
- Market based solutions - meet demand for FMD control at the base of the pyramid
- Awakened Government interest (Export - Africa and Eurasia)
- Economic development (a new Africa..)
- Appropriate policy setting tools (PCP-FMD)
- Stage of vaccine development
- Communication revolution

BLUE- areas producing surplus bovine (potential export)
Robinson, 2010
Opportunities

- Global demand for livestock (productivity, trade)
- Benefit/cost of control positive
- Market based solutions - meet demand for FMD control at the base of the pyramid
- Awakened Government interest (Export - Africa and Eurasia)
- Economic development (a new Africa...)
- Appropriate policy setting tools (PCP-FMD)
- Stage of vaccine development
- Communication revolution

Policy setting:
Who will benefit? Who is willing to pay? Reduce disease (PCP2) or reduce virus circulation (PCP3)?
Government as facilitator – of access to vaccines and information - or service provider and enforcer?
Opportunities

✓ Stage of vaccine development (fruits of recent research)

✓ Communication revolution

5.9 billion of 7 billion people use a mobile phone (2013)

In 2014, we can reach almost all livestock producers with biosecurity information, by cell phone. What an opportunity!
Livestock ownership and trade is almost all in private hands - our biggest opportunity is to enhance their participation in FMD risk management.

Private benefits and incentives are crucial to participation.

FMD is common and damaging disease - but who benefits and who should pay for control?
Threats

• Protectionism (vaccines, trade)
• Weakening UN /international technical support to countries
• Wars and instability
• (Agro-terrorism)

• OH .And

➢ Reduction in R&D - low hanging fruit ROT And Perish the Thought
➢ Failure to maintain global expertise and centres of excellence

And Woolly thinking
Shipping Forecast
Veteriologica Forecast at 0900 GMT 29th October 2014

Assigned Prevalence Index
- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- 100 +

[Map showing the distribution of the assigned prevalence index across the world with different color codes for different ranges.]
Conclusions

1. The **challenge of progressive control is to extend access** to those who need it in the rest of the world
2. Global demand for livestock products will result in an increasing demand for FMD control
3. Market based solutions (MBS) hold promise for delivery to the business oriented livestock producers
4. **Removing barriers affecting availability of quality vaccines needs international attention**
5. The complexity and cost of eradication programmes is formidable barrier – the drivers to achieve this may weaken as countries become net meat importers.
6. Adopters of the PCP approach are found in every continent - **but support is needed to share experience and develop management capacity**
7. Optimising control programmes to control virus circulation is complex
   - and needs more epi and economic modelling - and experts
8. **The communications revolution is a huge opportunity to develop the expertise needed in every country – and engage owners in risk management**
9. **Threats to global progress are real** – and include the downturn in funding on FMD research.