2010 FMD Epidemic
West Eurasia

EuFMD/FAO/ Turkey and Iran Epi working group ("Ankara Working Group")
Outline

1. Looking back:
   - What happened?
   - Why did it happen?
2. How can FMD control be improved to avoid large epidemics?
3. What is the current FMD situation in Iran and Turkey?
Large surge in outbreaks in 2010

- Increase started in March-April in both Turkey and Iran
- Lasted until sharp decrease in Oct in Turkey, end of June in Iran
Epidemic curve: Turkey

2009: 181 outbreaks
2010: 1613 outbreaks

- All outbreaks
- Serotype A
- Serotype O
- Untyped
Iran: FMD reports (epi-unit)

1388

• 2009: 2602 reports,
• 2010: 5242 reports

• Biggest increase in reporting in the NE of country

1389
Looking back...what happened?

Turkey outbreaks

Anatolia serosurveillance> Samples collected March/May 2010
Numbers represent WRLFMD Ref. Nos. (e.g. 88 = O/IRN/88/2009)
FMDV O in Iran 2010

Numbers represent WRLFMD Ref. Nos. (e.g. 8 = O/IRN/8/2010)

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Slide from Nick Knowles, WRL
Why did it happen?

Factors:

- Waning post-infection immunity
- Antigenic drift: strain evolution, incursion(s) of new strain(s)
  - Vaccines available not protective
  - Strain more virulent
- Vaccine effective but not applied optimally
- Increased transmission opportunities:
  - Animal movements increased due to meat prices
Factor: Waning post-infection immunity

- Post-infection immunity can last several years
- After an epidemic, population immunity will decline: Population turnover, natural waning
- Last type O epidemic in the region in 2007
- Outstanding Questions:
  - relative contribution to FMD control of natural immunity versus vaccine-induced immunity?
  - Would there be cross-immunity between 2007 & 2010 strains?
Progressive Major Epidemic In Turkey

DISTRIBUTION OF NUMBER OF OUTBREAKS BY YEAR (1993-2010)


NUM. OF OUTBREAKS 838 670 461 950 360 1000 1652 812 524 282 315 295 316 890 607 252 209 947

Legend:
- TOTAL
- ASIA-1
- O
- A

Types of Epidemics:
- TYPE O
- A Iran 96
- Asia-1 Shamm
- A Iran 05
- O PanAsia II
- O PanAsia I
- Alfa05/beta 05

Slide from SAP Institute
Hypothesis: Available vaccines not protective

Vaccine Matching 2009-2010 WRLFMD: Serotype O

- Vaccines not protective in some samples
- Samples not be representative of population
Factor: Vaccine effective but not applied optimally

- Policy: vaccinate large ruminants 2x (Turkey) 3x (Iran) per year and sheep 1/year
- Vaccine provided free of charge
- Huge task and resource intensive
  - Iran: 44.9 million doses in 2009 and 55.4 million in 2010
    - 148% yearly coverage in LR
    - 55% yearly coverage in SR
    - 92% coverage reported within an epi-unit
- Turkey: 51 million in 2010 (monovalent)
Proportion of epi-units vaccinated per district in 2010 (Iranian year 1389)

- 68% villages vaccinated at least once, 36% vaccinated 3X
- Regional variability
- Coverage within-epi unit?
Factor: Vaccine effective but not applied optimally: Role of unvaccinated sheep?

Iran:
- 8 million cattle and 81.6 million sheep (2005 census)
- Yearly vaccination coverage = 55%, so 44.9 million SR unvaccinated
- Sheep and cattle curves rise at same time, sheep surpasses cattle
Factor: Vaccine effective but not applied optimally: Role of unvaccinated sheep?

Anatolia 2010:

<table>
<thead>
<tr>
<th>Age group</th>
<th>LR</th>
<th>SR</th>
<th>Total</th>
<th>SR/LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-12 mo</td>
<td>0.12</td>
<td>0.14</td>
<td>0.13</td>
<td>1.17</td>
</tr>
<tr>
<td>12-18 mo</td>
<td>0.10</td>
<td>0.18</td>
<td>0.15</td>
<td>1.91</td>
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<tr>
<td>18-24 mo</td>
<td>0.13</td>
<td>0.25</td>
<td>0.17</td>
<td>1.88</td>
</tr>
<tr>
<td>&gt;24 mo</td>
<td>0.17</td>
<td>0.24</td>
<td>0.21</td>
<td>1.38</td>
</tr>
<tr>
<td>Total</td>
<td>0.11</td>
<td>0.17</td>
<td>0.14</td>
<td>1.45</td>
</tr>
</tbody>
</table>

- 17% overall NSP seroconversion, rate ~1.5 times higher than cattle
- What risk do they pose?
  - Extent of transmission from SR to cattle?
  - Spread to other regions by SR?
Factor: Vaccine effective but not applied optimally

- No booster to young animals
  - Immunity only last 1-2 months
- Previous studies\(^1\) from Turkey concluded that:
  - High level of movement and trade in young animals
  - Young animals responsible for most FMDV transmission
- Therefore effective immunization of young animals is critical

\(^1\) 2007 project including outbreak investigation, serosurveillance and market chain analysis
Factor: Increased transmission opportunities

- Due to large scale animal movements
  - Leads to viral incursions, contact between infected and susceptibles
  - price differentials provide incentive for movements into Turkey & Iran
  - Difference heightened in 2010

Prices (in USD per kilo) for live cattle and beef (young male animals)

<table>
<thead>
<tr>
<th>Country</th>
<th>Live</th>
<th>Meat</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>Turkey</td>
<td>3.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Iran</td>
<td>2.3</td>
<td></td>
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<tr>
<td>Georgia</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Armenia</td>
<td>1.6</td>
<td>2.7</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>4</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Outline

1. What happened?
2. Why did it happen?
3. How can disease control be improved to avoid large epidemics?
4. What is happening now?
How can disease control be improved to avoid large epidemics?

1. Learn from the past
2. Improved data analysis to understand risk
3. Include other control measures: biosecurity
4. Maximise effectiveness of limited resources
5. Early warning, Regional cooperation:
Learn from the past/ Understand risk

• Use available data and epidemiological studies to develop understanding
  – Training in data management and epidemiology
  – **Routine** data analysis
  – Analysis of vaccination coverage and vaccine efficacy
  – Risk factors:
    – Further use of outbreak investigation
    – Multivariable statistical models: risk factors

• Explore relative contribution of factors:
  – Waning post-infection immunity, available vaccines not protective, vaccine effective but not applied optimally, increased transmission potential
1. Understand risk (con’t)
2. Include other control measures
3. Maximise effectiveness of limited resources

1. Value chain analysis: identification of risk hotspots and critical control points
   - Targeting control measures based on risk
   - Emphasis on feasibility
2. Enhance biosecurity: increase awareness, movement controls, hygiene
3. Target control to high-risk groups
   - Young animals
   - Markets, border regions, …??
5. Early warning, Regional cooperation:

Enable preparedness, early response through:

- enhanced understanding of drivers of FMD transmission and regional cooperation

Initiatives:

- Data sharing
  - West Eurasia countries, starting with Iran and Turkey
- Laboratory and epidemiology networks
  - Facilitate serotype and strain characterization
- Routine data analysis and define triggers for alert
Early warning: Development of data sharing protocol

- Agreement in principle for Iran and Turkey to share outbreak data on monthly basis
- using Empres-i platform
- urgent notification of ‘significant epidemiological event’ (to be defined: eg new serotype detected)
- Extend initiative to other interested countries in region
Early warning: Define triggers for alert

Quantitative and qualitative criteria (under development)

- **Quantitative:**
  - Plot cumulative sum of (observed-expected) over time (CuSum)
  - And/or technique to detect spatial clusters (SatScan)

- **Qualitative:**
  - New serotype/strain in a province
  - Outbreaks in well vaccinated units/area (eg 80% of epi-units with > 80% of individuals, maximally 4 months before).
  - Other? Based on molecular epidemiology?
Early warning: Define triggers for alert

- Sensitivity/specificity
  - Balance false-positives and possibly missing situations
- Intended as trigger for closer look, not to raise alarm instantly!

Smoothed epidemic curves - Turkey
5 week rolling average

Outbreaks
0 10 20 30 40 50
0 10 20 30 40 50

week

2009 2010
Early warning: Define triggers for alert

FMD outbreaks reported to OIE: Turkey

- Observed outbreaks
- CuSum
Outline

1. What happened?
2. Why did it happen?
3. How can we improve for the future?
4. What is happening now?
FMD infection

- Type A may be on the rise
- Asia-1 has been confirmed in Bahrain, Pakistan and Iran
  - Vaccine matching results Asia 1-Shamir vaccine not protective

Serotype results from Iran, late 2010-early 2011

- October
- November
- December
- January
- February

Number of samples: 0-70

Serotype: O, A, neg, unsuitable
Summary

- Large type O epidemic in 2010
  - due to multiple factors (virological change, waning natural immunity, increased animal movement)

- Actions to improve FMD control
  - Early detection of conditions likely to lead to epidemic
  - Most effective use of limited resources: risk-based
  - Employ full complement of available of control measures: biosecurity, movement control, vaccination

- Requires transdisciplinary approach
  - Incorporate virology, epidemiology and economics
Proposed next steps

• Support risk managers
  - Early detection of increased risk:
    • Data sharing initiative - Empres-i
    • Promote use of regional labs
    • Facilitate sample submission from region to SAP Institute (strain characterization, vaccine seed strains)
    • Define triggers for alert/further investigation
  - Define risk in order to target control
    • Data collection and database management
    • Develop epidemiology capacity
    • Multivariable analysis
    • Value chain analysis - risk and feasible control measures
    • Outbreak investigation protocol