The 2007 UK FMD outbreak: field investigation perspective

Nick Juleff, Institute for Animal Health
UK 2007 FMD Epidemic

- Virus escape from Pirbright site (IAH and Merial vaccine plant)
- 8 infected premises, most consisting of multiple holdings
- Mainly extensive beef production
- Most farms in semi-urban areas
- Part-time/hobby farmers
- 1578 animals on IPs culled
- 278 animals infected
IP1: 3 holdings

- 29th July: farmer notices an animal “off colour”

- 2nd August: several cattle lame & drooling. PVP tells farmer to contact Defra directly.

- 3rd August: Defra vet examines & takes samples; +ve for FMDV

- 4th August: cattle at all 3 holdings killed; virus identified as O1 BFS 1860 (used at Pirbright site)
**IP1: main holding**

- 38 cattle, all infected
- Lesion ages: 3 to 10 days old
- Beef store cattle grazing on open pasture 4km from Pirbright site
- No handling facilities: Defra brought in gates & straw bales to make corral
- Shot with rifles then pithed
**IP1: two other holdings**

- 4 cattle at home farm: no FMDV

- 22 cattle on open pasture: no FMD lesions; one animal PCR +ve (viraemic)

- Only link between premises: farmer

- First time preclinically viraemic animals detected using PCR in an outbreak

- Logistical problems again: straw bales, rifles

- Carcases transported by sealed lorry to incinerator 70 miles away
IP2: three holdings

- 49 cattle 1km from IP1; 58 at home farm; 12 on third holding

- 6th August: farmer notifies Defra, samples taken from holding with 49 cattle: +ve

- 25 killed that night, the rest on next day

- Cattle examined & bled post-mortem
49 cattle: 44 had lesions, 2-7 days old
- Logistical probs: no handling facilities, no water, rifles, journalists

58 cattle on 2nd farm: no FMD lesions BUT
- 15 of 58 viraemic by PCR/VI

12 cattle at 3rd holding: no FMD
Phase 1: August

- 3 Aug: IP1 (3 locations)
- 6 Aug: IP2 (3 locations)
- 3 contact herds culled
- 24 Aug: PZs lifted
- 8 Sep: SZ lifted
- Origin: contamination from Pirbright site
Likely times of lab escape of virus from Pirbright site in 2007

- 20th July: flooding
- 23rd July: best airborne spread day
- 22nd July: 1st centrifuge waste discharged
- 25th July: 2nd centrifuge waste discharged
- 20th July: 4 lorries via Westwood Lane
- 25th July: 2 lorries via Westwood Lane
Effect of lesion age and incubation period on time of infection

<table>
<thead>
<tr>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>25</td>
<td>17</td>
</tr>
<tr>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>29</td>
<td>21</td>
</tr>
<tr>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td>31</td>
<td>23</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>31</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

**NB** Could be further lag between escape of virus and exposure of cattle
Difficulties

- Assuming lesion of 12 days and longish incubation then likely release times too late
- Flooding period fits best as time of release most consistent with lesions and incubation
- But flooding and first lorry movements precede likely virus release through drains
- Second period of lorry movements more likely associated with viral contamination, but too late to have infected farm
Phase 2: September

IP3

- Confirmed 12th Sept
- 8 locations: 2 FMD+ve
- 36/47 cattle had FMD lesions, 1-5 days old
- 9/29 cattle had lesions at 2nd holding, 1-5 days old
- Other holdings all FMD negative
- Culling completed 16 Sep (4 days later)
- Logistical probs on out-farms:
  No handling facilities, escapees, police
IP4

- Separated from IP3 by narrow stream
- Diagnosed Sept 13th (farmer report)
- 54/54 beef cattle had FMD lesions, 5-10 days
- 800 pigs kept 500m away: no FMD
- Farmer had been on holidays for 10 days – unclear who checked cattle
- Excellent handling facilities – fast cull
IP5: the missing link

- After IP3 & 4, 3km PZ implemented
- All sheep bled, cattle & pigs “clinically inspected” – often just observed over fence
- 17\textsuperscript{th} Sep: IP5 sheep tested seropositive
- IP5: 16 sheep, 22 cattle, 2 pigs
- Farmer retired & unwell; animals were pets
- FMD lesions ~ 3 weeks old (large error margin)
- Virus detected in probangs – 10/16 sheep carriers
Intensive patrol areas:
• Animals examined every 2 days (in theory)
• Blood samples: real time PCR to detect viraemic preclinicals
• Small no. of farms
• Some premises: clinical examination very difficult (no facilities)
**IP6**
- 21<sup>st</sup> Sept, Defra inspection
- 34 cattle, 2 locations
- 2/32 cattle with 3-4 day lesions
- Another 5 viraemic

**IP7**
- 24<sup>th</sup> Sept, Defra inspection
- 16 Dexter cattle, wild & unhandled
- Hobby farmer: retired architect
- 14 with 1-5 day lesions
- All FMDV +ve
- Use of LFD on farm
- Logistical probs: xylazine darts, rifles; urban area

**IP8**
- 29<sup>th</sup> Sept, Defra inspection
- 54 beef cattle at infected site
- 1 with lesions, 2 days; 15 viraemic
- 134 cattle, 16 sheep
- 4 locations, 134 cattle, 16 sheep
- Other sites FMDV -ve
Shared IAH / Merial Facility
Source of virus: Pirbright site

- Virus: O1 BFS1860 (1967 UK outbreak)

- 3 strains used on Pirbright site:
  - IAH1 (v. small quantities, Institute for Animal Health research)
  - IAH2 (v. small quantities, Institute for Animal Health research)
  - MAH (6,000 litre batches for vaccine production, Merial Animal Health)

- Molecular epidemiology reveals transmission pathways
Genealogy and infection profiles


- Lesion age estimation
- Incubation period (<14 days)
- Most likely date of infection (2-5 days before clinical disease)
- Merial vaccine waste inactivation method not validated for large volumes

- Permitted by Defra (UK Govt) – MAH did not breach their licence

- Dispute over responsibility for pipes

- Unresolved questions:
  How did virus get from Pirbright to IP1?
  How credible is the pipe/soil/lorry theory?
  How did it get from IP1/2 to IP5?
Lessons from the field

- Epidemiological benefits of lesion ageing, extensive sampling, sequencing virus isolates in real time
  - 2nd phase of outbreaks (IP3 – IP8) shares all the unique changes common to 1st phase
  - Therefore outbreaks are linked and not due to independent sources
  - IP5 (farm with FMD serology positive cattle and sheep) bridges gap between two phases of the outbreak

- Diagnosis of preclinical viraemic animals using real-time PCR

- Hobby/part-time farmers with inadequate handling facilities: implications for neighbouring farmers?
Acknowledgments

David Paton
Donald King
Eoin Ryan
Bryan Charleston
Colleagues at the IAH