Vaccine matching and selection of vaccine strains for the control of foot-and-mouth disease in Kenya

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Introduction

- FMD is Endemic in Kenya
  - Yearly outbreaks (some not reported)
  - 5 serotypes recorded
    - O & A (1932)
    - SAT2 (1956)
    - C (1957)
    - SAT1 (1971)
Introduction (2)

- Most reported outbreaks -
  - are those observed in cattle in dairy farming areas

- Role of small ruminants
  - largely ignored
  - Not included in vaccinations
  - Limited information on role in epidemiology

- Role of wildlife
  - not well studied
  - African buffalo known to harbour SATs
Distribution of Reported FMD Events 2012
FMD Control in Kenya

• FMD is a notifiable disease (Animal Diseases Act)

• Vaccination and Movement control

• Not very effective
  – Low vaccine coverage
  – Poor enforcement of movement controls
FMD Control Institutions

National reference laboratory for FMD, Embakasi, Nairobi

• Established in 1957 with the support of the Wellcome Trust as the Wellcome Institute for Research on FMD (WIRFMD)

• To serotype & research on FMD in close collaboration with Pirbright, UK
FMD Control Institutions (2)

FMD lab

• Diagnostics – Virus Isolation, Antigen and antibody ELISAs, VNT, PCR

• Vaccine research & development

• Vaccine certification
FMD Control Institutions (3)

• Joint venture with Wellcome Trust in 1963 established the Vaccine Production Laboratory (VPL) now KEVEVAPI (1991)
  – Vaccine production commenced in 1964
  – Serotypes O, A, C, SAT1 and SAT2 produced
  – Inactivated aqueous vaccines (capacity for 50 million mono-equivalent doses)
  – Mono/Bi/Tri/Quadrivalent
Vaccine performance

• Field
  – Outbreak investigations (post vaccination)
  – serological surveys

• Lab
  – Measuring antigenic match by serology
  – Serological methods – CFT, VNT, ELISA
Vaccine matching at Embakasi

• Subtyping
  – establishing the relationship between the field isolates and the vaccine strains

• Relationship (r) values between pairs of viruses
  – one way \((r_1)\)
  – two way \((r_2)\)

• The cross-serum neutralization ratio (r) and the cross-relationship value (R %) were determined
### CHRONOLOGICAL CHANGES IN KENYAN SAT1 AND TYPE C VACCINE VIRUSES

<table>
<thead>
<tr>
<th>SEROTYPE</th>
<th>STRAIN DESIGNATION</th>
<th>YEAR OF ISOLATION</th>
<th>DATE INCORPORATED IN VACCINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT1</td>
<td>SAT1 T155/71</td>
<td>1971</td>
<td>1971</td>
</tr>
<tr>
<td>C</td>
<td>CK267/67</td>
<td>1967</td>
<td>1967</td>
</tr>
</tbody>
</table>

NB: No change  
Origin of SAT1 Isolate – Arusha, Tanzania  
Origin of C Isolate – Laikipia, Kenya
Type A r1 values by VNT – AK5/80 and AK35/80 Sera

Virus Isolates

AK5/80
AK35/80
AK64/93
AK4/95
AK15/96
AK13/97
AK51/98
AK12/99
AK62/99
AK4/00
AK28/01

AK5/80
AK35/80
## Chronological Changes in Kenyan Type A Vaccine Viruses

<table>
<thead>
<tr>
<th>Serotype</th>
<th>Strain</th>
<th>Year of Isolation</th>
<th>Date Incorporated in Vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AK 18/66</td>
<td>1966</td>
<td>1967</td>
</tr>
<tr>
<td></td>
<td>AK 179/71</td>
<td>1971</td>
<td>1972</td>
</tr>
<tr>
<td></td>
<td>AK 5/80</td>
<td>1980</td>
<td>1982</td>
</tr>
<tr>
<td></td>
<td>AK 35/80</td>
<td>1980</td>
<td>1982</td>
</tr>
</tbody>
</table>
### CHRONOLOGICAL CHANGES IN KENYAN TYPE O VACCINE VIRUSES

<table>
<thead>
<tr>
<th>SEROTYPE</th>
<th>STRAIN DESIGNATION</th>
<th>YEAR OF ISOLATION</th>
<th>DATE INCORPORATED IN VACCINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>OK 120/64</td>
<td>1964</td>
<td>1965</td>
</tr>
<tr>
<td></td>
<td>OK 83/79</td>
<td>1979</td>
<td>1980</td>
</tr>
<tr>
<td></td>
<td>OK 77/78</td>
<td>1978</td>
<td>1981</td>
</tr>
<tr>
<td></td>
<td>OK 82/98</td>
<td>2000</td>
<td>2000</td>
</tr>
</tbody>
</table>
## CHRONOLOGICAL CHANGES IN KENYAN SAT2 VACCINE VIRUSES

<table>
<thead>
<tr>
<th>SEROTYPE</th>
<th>STRAIN DESIGNATION</th>
<th>YEAR OF ISOLATION</th>
<th>DATE INCORPORATED IN VACCINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT2</td>
<td>SAT2 KEN3/57</td>
<td>1957</td>
<td>1969</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 TAN5/68</td>
<td>1968</td>
<td>1970</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 K183/74</td>
<td>1974</td>
<td>1976</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 R1215</td>
<td>1976</td>
<td>1980</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 K183/74</td>
<td>1974</td>
<td>1981 (Second time)</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 K65/82</td>
<td>1982</td>
<td>1983</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 K52/84</td>
<td>1984</td>
<td>1994</td>
</tr>
</tbody>
</table>
Challenges

• Vaccination
  ▪ Not very effective
    • Low coverage
    • Mono/Bi/Tri/quadrivalent inactivated vaccines (O/A/C/S1/S2)
    • Only cattle vaccinated
    • Vaccine performance monitoring
FMD Vaccine used in 2010 countrywide

<table>
<thead>
<tr>
<th>FMDV SEROTYPE</th>
<th>STRAIN DESIGNATION</th>
<th>Doses Used (2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AK 5/80</td>
<td>303,000 (Bi/Tri/Quadri – A/O/S1/S2)</td>
</tr>
<tr>
<td>O</td>
<td>OK77/78</td>
<td>918,000 (Bi/Tri/Quadri – O/A/S1/S2)</td>
</tr>
<tr>
<td>SAT1</td>
<td>SAT1 T155/71</td>
<td>755,000 (Mono/Tri/Quadri – S1/O/A/S2)</td>
</tr>
<tr>
<td>SAT2</td>
<td>SAT2 K52/84</td>
<td>841,000 (Tri/Quadri – O/A/S1/S2)</td>
</tr>
</tbody>
</table>
## FMD susceptible livestock population
(2009 census)

<table>
<thead>
<tr>
<th></th>
<th>Cattle</th>
<th>Sheep</th>
<th>Goats</th>
<th>Pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>KENYA</td>
<td>17,467,774</td>
<td>17,129,606</td>
<td>27,740,153</td>
<td>334,689</td>
</tr>
</tbody>
</table>
Challenges

• Lab capacity
  – Very low funding
  – Inadequate Research & networks
Way forward

• We welcome
  – Research collaboration and networks
    • Diagnostics
    • epidemiology
    • Vaccine performance improvement
    • Other FMD research
Acknowledgement

- GFRA
- Embakasi lab team/KEVEVAPI