SPREAD OF FMD SEROTYPE O-PANASIA2 IN A DAIRY COMPLEX IN IRAN

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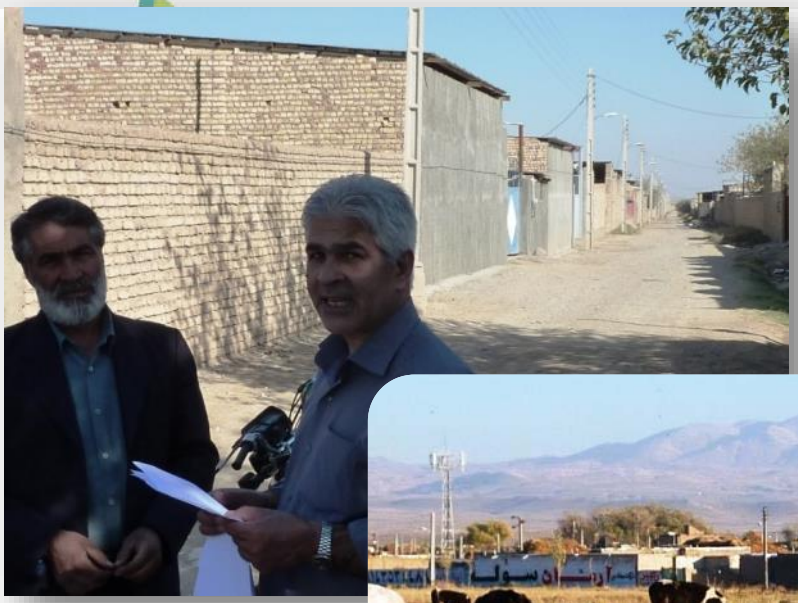
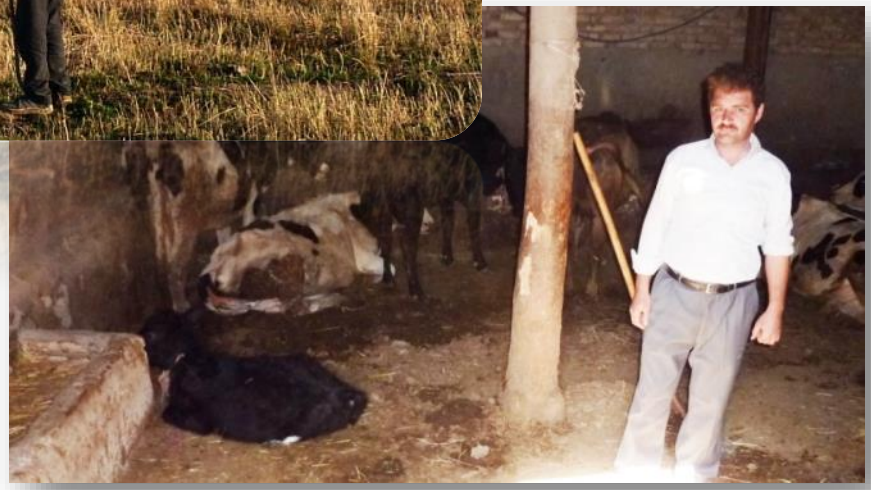
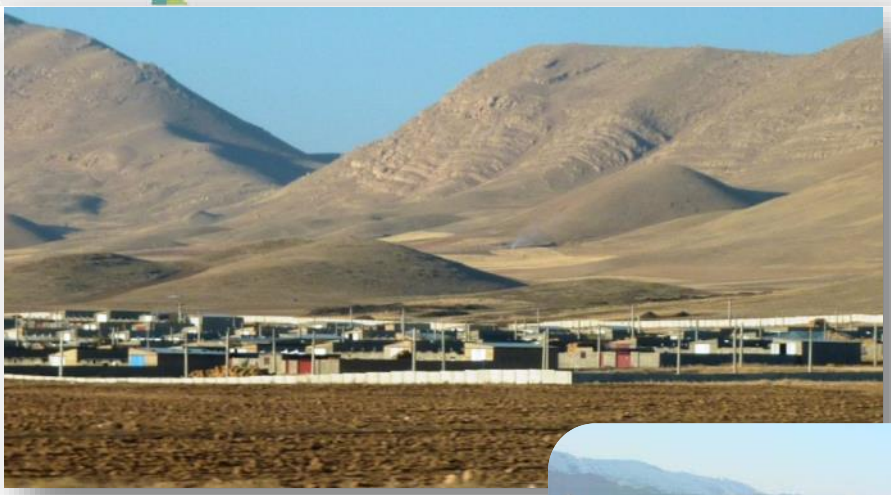
Study objectives and results

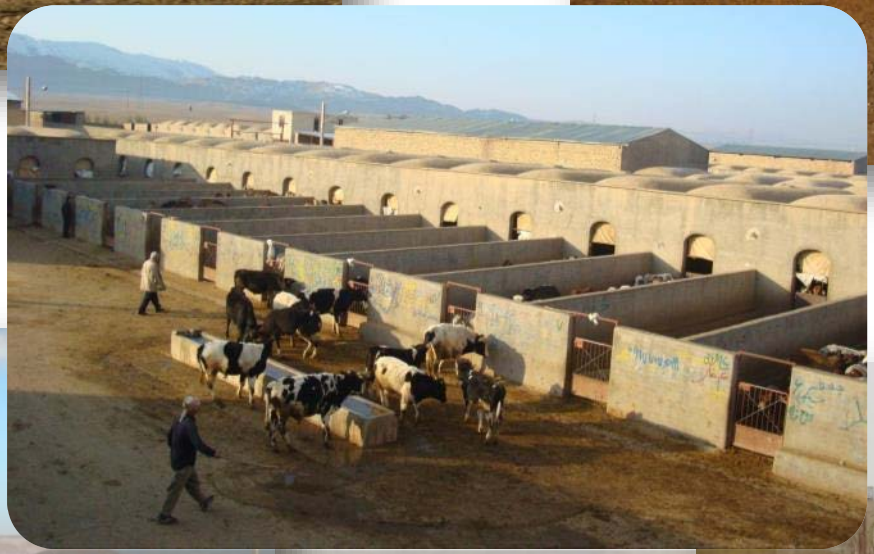
- Follow-through a severe clinical FMD outbreak in an animal complex in Iran
- Quantification of economic losses and reproduction number (R_0)
  - Number of secondary infections/clinical cases caused by a primary infection/clinical case
    - β: transmission rate parameter
    - α: average infectious period



Iranian village



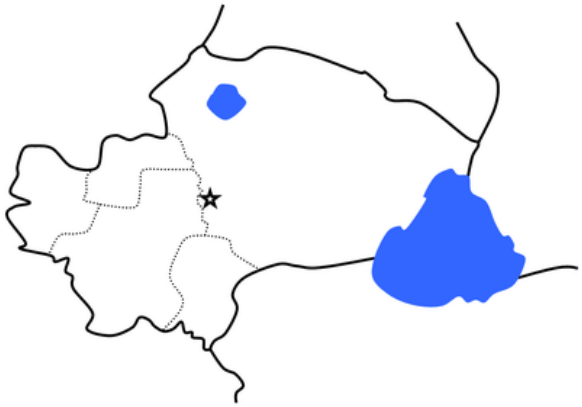




Animal complex

Laban animal complex, Qom province

- 393 units constructed
- At the time of the FMD outbreak, 127 occupied
- Totaling 9245 heads of cattle
  - Average 73, range 5 to 250 heads per unit
- 116 units had dairy cattle (40%)
- Last FMD tetravalent vaccination *(O-Manisa, Asia1-shamir, A-Iran05 and A-22),* 40 days prior to index case



FMD outbreak

- Reported FMD between 12 February and 15 April 2010 (65 days duration)
- Serotype O Panasia2
- Owner unit A67 also owns an unit at Damshahr animal market (biggest in Iran) where clinical FMD was first seen on 23 January 2010.

Control measures undertaken

- Disinfection of
  - affected and neighboring units.
  - area among units.
  - milk collecting platform
- Animal movement restrictions (Standstill)
  - Immediate stop to introduction of livestock
  - Market closure of weekly domestic market within complex.
  - Only transport of affected animals to slaughterhouse out of complex
- Prohibition of manure disposal and implementation of disinfection measures on the manure collecting vehicles
- Activating of carcass burning furnace for all dead animals
- Stopping of all tuberculation and brucellosis tests
- School closure of children of workers of farms within complex

Material and methods

- Weekly questionnaire on mortality, culling, milk production, treatment, based on daily records by livestock owners
- Weekly collection of records and inspection of units by government veterinarians
- Data validated with private vets
- FMD confirmation based on samples taken on
  - 23, 25, 27 and 28 February, 12 and 14 March, total of 10 samples

Estimation of the reproduction number $R_{0\text{-}WU}$ – within units

- The attack rate (percentage of unit population eventually affected) is linked to reproduction number

$$R_0 = -\ln(1-p)\,/p$$

- For each unit the number of cattle affected was recorded

Estimation of the reproduction number $R_{0\text{-}BU}$ - between units

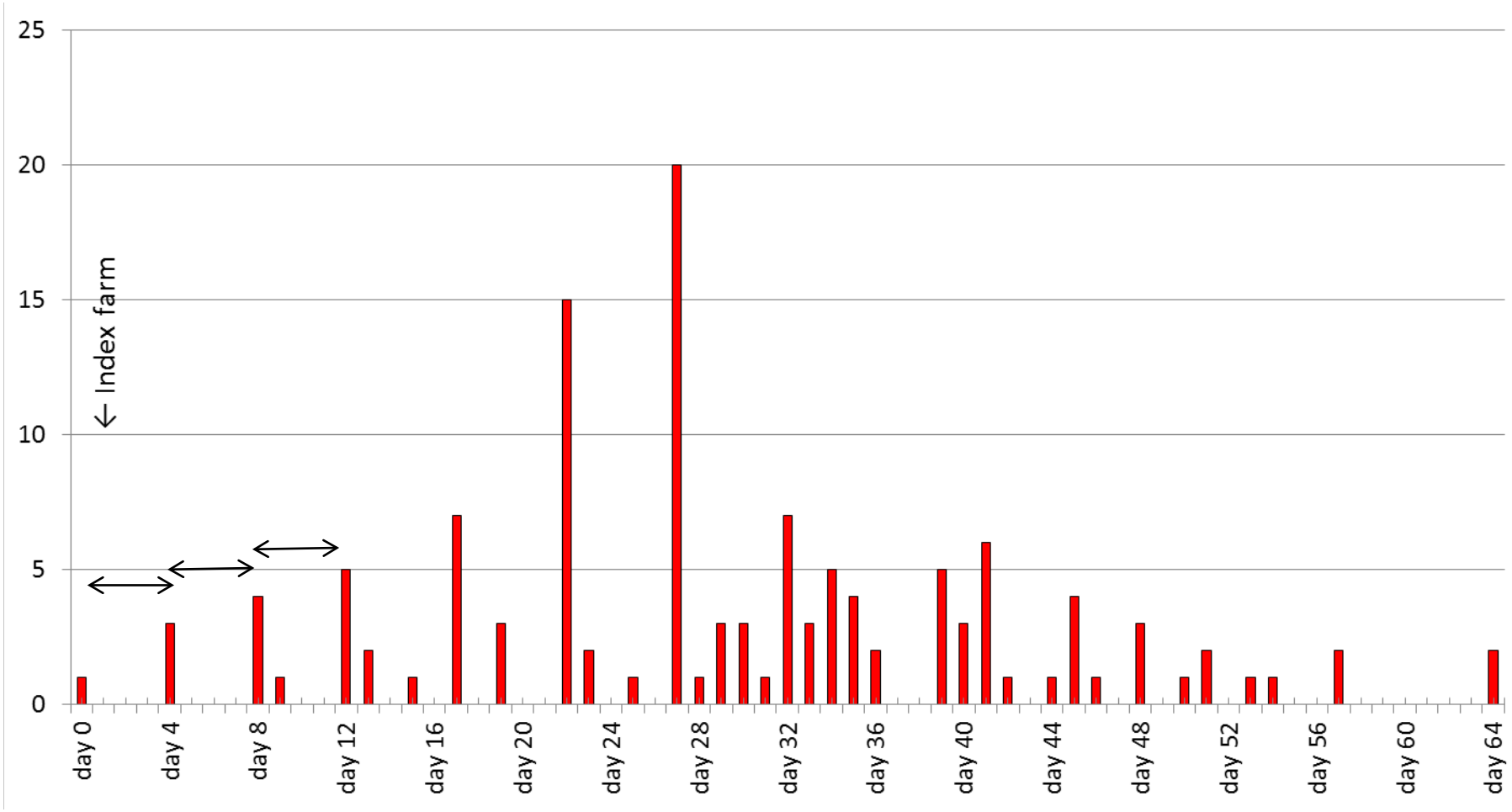
- Use of epidemic curve to estimate generation time
  - Time between infection of primary case and infection in one of the secondary cases
  - Generation time substituted by Serial interval distribution: time between symptoms onset
    - Gamma distribution
    - Making use of epi-curve at level of units (as opposed to individual animals)
    - Assuming there was a single source entry of FMD virus
- Calculating the $R_{0\text{-}BU}$ from this data
  - Use of exponential growth algorithm (R0 in R package)

FMD outbreak

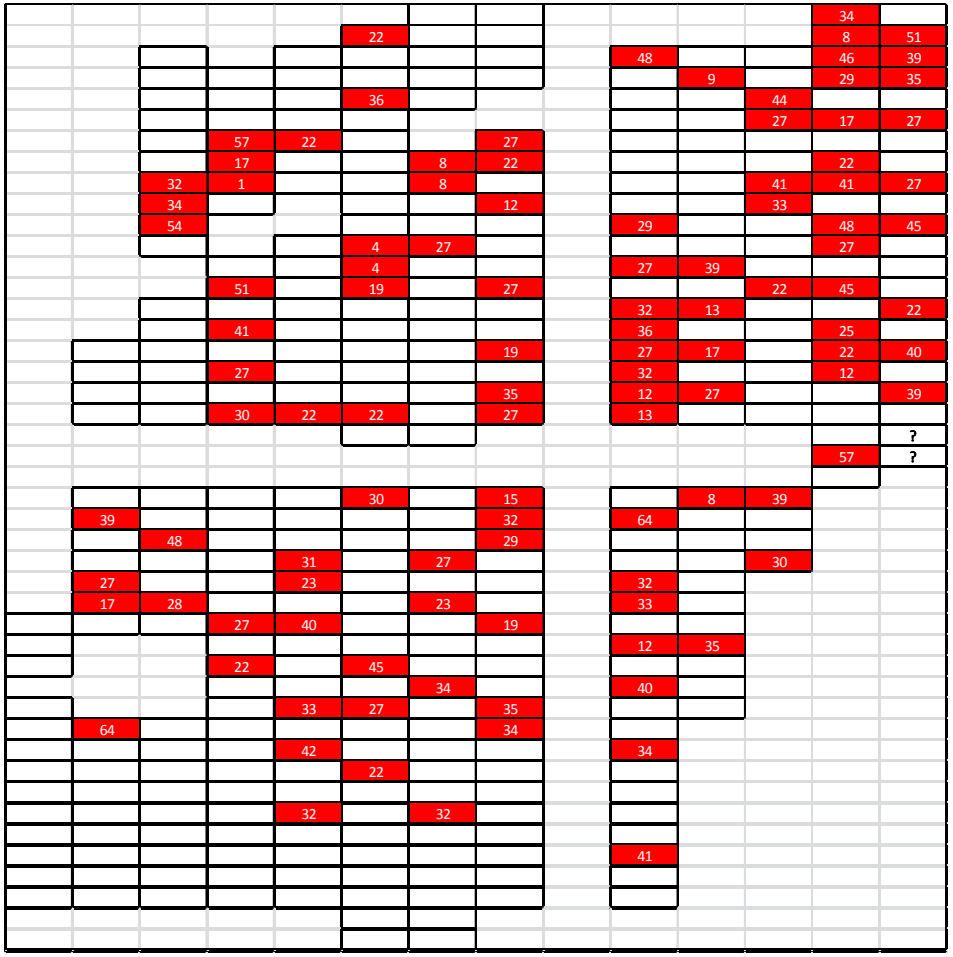
- 75% of cattle (6973 heads) showed clinical signs of which 532 died and 481 were culled
- Mortality occurred in 111 units, culling in 76 units
- Average number of days with clinical signs was 31 (7-60 days).

Cattle group	Total number	Recorded sick (%)	Recorded dead (%)	Recorded slaughtered (%)
Lactating cattle	3214	2055 (63.9)	51 (1.6)	126 (3.9)
Cattle, non-lactating	1538	1246 (81.0)	38 (2.5)	31 (2.0)
Youngstock (13-22 months of age)	1422	1217 (85.6)	110 (7.7)	24 (1.7)
Calves (0-12 months of age)	3071	2414 (78.6)	333 (10.8)	301 (9.8)
Total	9245	6932 (75.0)	532 (5.8)	481 (5.2)

Temporal distribution



Spatial distribution



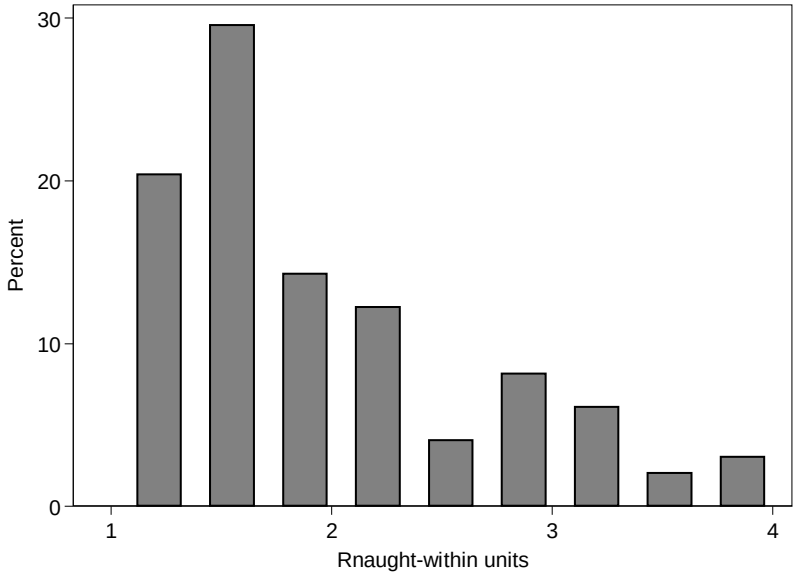
Estimated economic losses

- Milk production loss: 7.3 kgmilk per day
- Morbidity: 10 – 100% (8 units)
- Mortality: 1 – 45% in 111 units
- Culling: 0 – 88% in 76 units
- Application of disinfection
- Application of antibiotics

	Per head present (N=9245)	Per unit (N=127)
Milk production	81.00 US$	6,461 US$
Mortality	42.33 US$	3,082 US$
Culling	87.50 U$	6,371 US$
Antibiotics	15.80 US$	1,147 US$
Disinfection	3.40 US$	247 US$
Total	230 US$	16,749 US$

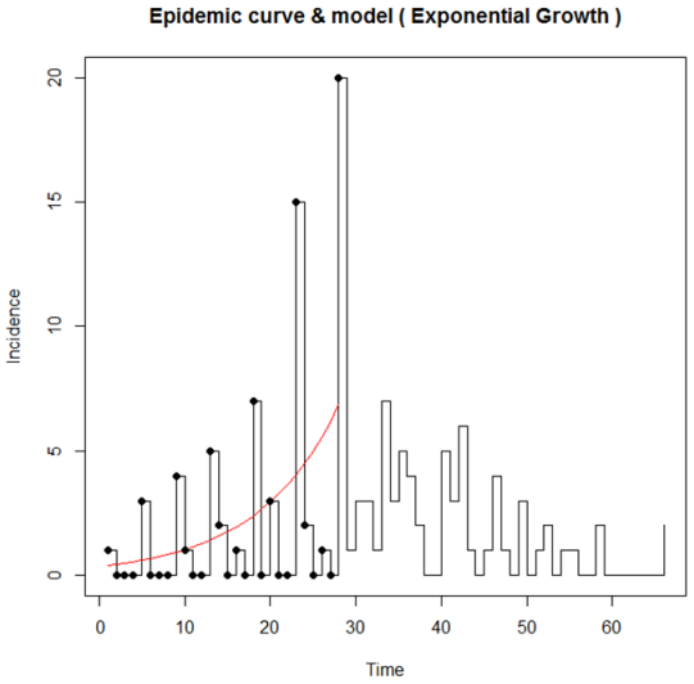
$R_{0\text{-}WU}$ – within units

- The range of $R_{0\text{-}WU}$ was from 1.03 to 4.17, with a mean of 1.93 and median of 1.68



$R_{0\text{-}BU}$ – between units

- The $R_{0\text{-}BU}$ estimated to be 1.6 (95%CI 1.4-1.8)
  - It was assumed that the generation time was 4 days
  - Exponential growth rate (for first 28 days)
    a sensitivity analysis applied with very similar outcomes



Discussion

- FMD spread rampantly, affected all 127 units
- Control measures not effective
  - Emergency vaccination
  - Movement standstill
  - Biosecurity measures and supportive treatment
  - Prior FMD vaccination did not protect against new strain
- $R_{0\text{-}BU}$ reflects 'local' spread of FMD virus
  - Spread by people, materials, fomites, windborne
  - Contamination is accounting for 40% of spread (Carla Bravo de Rueda, 2014)
- $R_{0\text{-}BU}$ estimated for 'dairy units' assuming their transmission behavior is similar to 'individuals'


Thank you