VRA 22: What are the risks of causing new outbreaks of foot and mouth disease (FMD) by infection and onward transmission by camelids?

1. SUMMARY OF OVERALL RISK

This risk assessment was compiled according to terms of reference provided by the Scottish Government regarding time of delivery, title of veterinary risk assessments (VRAs) and level of detail required. EPIC scientists created a generic framework suitable for the VRAs; collated and updated existing information on risks; filled gaps in the documents (including references where appropriate); and drafted new VRAs where necessary. These documents may require updating as new information becomes available or legislation develops, or if more in-depth assessment is necessary.

The purpose of this document is to qualitatively assess the risk of new outbreaks of FMD due to infection and onward transmission by camelids in the face of an FMD outbreak in the UK. The assessment includes proposed actions to mitigate the risks associated with the specified activity, and which could form the basis of licence conditions where necessary.

DEFINITIONS OF RISK LEVEL (OIE, 2004; Defra, 2011):
- **Negligible**: So rare that it does not merit consideration
- **Very low**: Very rare but cannot be excluded
- **Low**: Rare but could occur
- **Medium**: Occurs regularly
- **High**: Occurs very often
- **Very High**: Events occur almost certainly

The risk is:

<table>
<thead>
<tr>
<th>Activity</th>
<th>PZ</th>
<th>SZ</th>
<th>RZ</th>
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<tr>
<td>Transmission via camelid premises</td>
<td>low</td>
<td>very low</td>
<td>very low</td>
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<tr>
<td>Movements between premises</td>
<td>not permitted</td>
<td>not permitted</td>
<td>low</td>
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<tr>
<td>Shows</td>
<td>not permitted</td>
<td>medium</td>
<td>low/medium</td>
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<tr>
<td>Selling wool</td>
<td>not permitted</td>
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<td>very low</td>
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2. LEGISLATION, DEFINITIONS & ASSUMPTIONS

Statutory disease control requirements are applicable to livestock premises on suspicion and confirmation of FMD. When suspicion of disease cannot be ruled out, and diagnostic samples are taken, a Temporary Control Zone is put in place (TCZ) surrounding the suspect premises. On confirmation of disease, a national movement ban (NMB) is enforced by introducing a national Restricted Zone (RZ). A 3 km Protection Zone (PZ) and 10km Surveillance Zone (SZ) are implemented which place restrictions on movements and activities around infected premises to prevent spread of disease. Later in the outbreak, restrictions may be relaxed either through reducing the size of the RZ or through allowing some resumption of normal activities under licence within the RZ, SZ or PZ. In this VRA, RZ is used to refer to areas which are within the RZ, but do not also fall within the PZ or SZ.

Camelid species are not covered by the legislation which requires other livestock species to be identified and their movements recorded. Premises holding only camelids therefore are not required to be registered and do not have a country parish holding number. Some camelid owners register their animals with UK camelids societies. Camelids are not required to observe movement standstill periods which are in place for other susceptible livestock.
Camelids are included under the definition of animals susceptible to FMD in the Foot-and-Mouth Disease (Scotland) Order 2006, and are therefore subject to most of the same control measures as other susceptible livestock during an outbreak.

For this VRA, the camelid species referred to are the small new world species often kept as pets or for small scale production i.e. llamas (*Llama glama*), alpacas (*Vicugna pacos*), guanacos (*Lama guanicoe*) and vicunas (*Vicugna vicugna*).

3. HAZARD IDENTIFICATION

a) Hazard: FMD virus (FMDV)

b) Risk hypothesis:
What is the risk of camelid species becoming infected with FMD virus and transmitting the disease to susceptible livestock species in close proximity, or via movements of camelids or camelid products?

4. POTENTIAL RISK PATHWAYS

![Flowchart Diagram]

5. EXPOSURE ASSESSMENT

<table>
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<tr>
<th>Factors which are likely to affect this probability of exposure are:</th>
<th>Comments and risk estimates if/where appropriate</th>
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<td>Infection source: A1 Camelids are infected with FMDV</td>
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### Susceptibility of camelids to FMDV

- Accurate data are sparse on the susceptibility of camelids to FMD, with most information from experimental studies on small numbers of animals, or anecdotal evidence from the field.

- Experimental infection of llamas by inoculation has produced infection with moderate to severe clinical signs including pyrexia, oral lesions, salorrhea, digital vesicles, moderate to severe lameness and inappetence (Lubroth et al., 1990). Experimentally, transmission from infected animals to in-contact llamas resulted in no or mild clinical signs although virus could be identified in oesophageal/pharangeal fluid (OPF) (Lubroth et al., 1990). In another study, only two out of 30 llamas exposed to inoculated pigs developed clinical signs, and the signs were very mild (Fondevila et al., 1995). Virus was identified in OPF from these two animals.

- Regarding natural infection, there is only one reported example of alpacas showing mild clinical signs in conjunction with an FMD outbreak in cattle (Wernery and Kaaden, 2004). A number of studies have failed to find clinical signs, or evidence of virus in OPF, in camelids kept with susceptible livestock during FMD outbreaks (reviewed by Wernery and Kaaden, 2004). Similarly, a number of serological studies have not identified antibodies to FMD in camelid species kept with susceptible livestock where FMD occurred (Puntel et al., 1999; Wernery and Kaaden, 2004).

- Regarding onward transmission, in experimental situations FMDV has been transmitted from inoculated llamas to susceptible in contact pigs, and to other llamas (Lubroth et al., 1990). When llamas infected by contact, with only mild clinical signs, were exposed to llamas, pigs, calves, goats and sheep, no onward transmission occurred (Fondevila et al., 1995). It appears that infection can be transmitted to in-contacts when the virus burden is sufficiently great, as occurs following inoculation, but following natural infection from in-contact animals, the likelihood of onward transmission is low.

- An animal in which live FMDV can be identified for more than 28 days post infection is defined as a carrier (Kitching, 2002). FMDV has never been isolated from OPF or blood from llamas or alpacas more than 14 days post infection (Lubroth et al., 1990; Wernery and Kaaden, 2004). Although this finding is based on a small number of studies, when considered with the low susceptibility described above, it is unlikely that these species can be responsible for transmission over longer periods of time.

- In summary, alpacas and llamas appear to be mildly susceptible to FMDV but have low potential for onward transmission, unless perhaps if exposed to particularly high virus loads. They may be infected but show no or only mild clinical signs. They do not appear to become carriers.

### Presence of infected livestock at same premises

- Camelids kept in contact or in close proximity to infected livestock are at greatest risk of infection.

- The number of camelids that live on premises with susceptible livestock species, and the number of these shared premises is not known in the UK.

- Once FMD is diagnosed on a premises, control measures
are applied to both the livestock and camelid populations. Therefore, the risk to camelids is of undiagnosed disease in livestock. The likelihood that undiagnosed disease is present in livestock is influenced by a number of factors, including the stage of the outbreak, previous movement history, type of livestock and proximity to areas where FMD is present.

- Infected pigs produce the greatest amounts of FMDV and hence are likely to present the greatest transmission risk to camelids, followed by cattle and sheep (Donaldson et al., 2001). However, as infection in sheep can be subclinical and sheep are often less frequently/thoroughly inspected, the risk of undiagnosed disease is greater in sheep (Hughes et al., 2002).

- Proximity to premises with FMD

- Risk of camelids being infected is next greatest if the premises is adjacent to premises with FMD.
- Risk of airborne transmission decreases rapidly with distance from the premises with FMD and is only likely to occur over significant distances if many infected animals (especially pigs) are present (Donaldson and Alexandersen, 2001).
- Premises with FMD may be already detected ("infected premises"), or as yet undetected.
- In a PZ there are known infected premises which may be at varying stage of diagnosis, slaughter, cleansing and disinfection. The risk of local transmission from detected infected premises is medium.
- In a SZ, there are no detected infected premises. The smallest distance at which infected premises could be located would be 3km away. The risk of local transmission from detected infected premises is low.
- In a RZ, there are no detected infected premises. The smallest distance at which infected premises could be located is 10km so the risk of local transmission from detected infected premises is negligible.
- In addition there may be premises where FMD is present but has not yet been detected.
- The risk of undetected infection is highest in a PZ, followed by a SZ then a RZ.
- Since camelids are not very susceptible to infection, direct contact with infected animals is likely to be necessary for transmission to occur. The risk of transmission occurring via indirect contact or contaminated fomites is very low.

- Likelihood of infection and transmission is influenced by FMDV strain

- The susceptibility of llamas and alpacas to different strains of FMDV has not been fully assessed; experimental studies have used type O, A and C but only involved small numbers of animals (Lubroth et al., 1990; Fondevila et al., 1995).
- There are 7 serotypes of FMDV: O, A, C, SAT1, SAT2, SAT3 and Asia 1. In susceptible livestock species the different serotypes (and different strains within each serotype) have different characteristics for example in terms of host species susceptibility, length of incubation period, ease of detecting clinical signs and likelihood of air borne transmission ((Kitching and Hughes, 2002; Gloster et al., 2008). On confirmation of FMD, the serotype and strain would be identified by The Pirbright Institute. This information would help to inform estimates
• Extent and timing of movements of susceptible animals from areas where FMD is present
  • Movement of susceptible livestock species (including camels) is limited by a national movement ban (NMB) when FMD is suspected and confirmed.
  • There is a risk that disease is introduced to new areas from animals with undetected or incubating infection that have already been moved before the NMB is put in place.
  • Movements of livestock species must be recorded and these data can be used to help assess risk both by looking at general movement patterns and by identifying specific movements prior to the NMB. Camelid movements are not recorded. There are no data available to give a general picture of camelid movements, and it would not be possible to identify specific movements in a disease outbreak situation.

• Biosecurity of camelid premises
  • FMDV is very sensitive to approved disinfectants. Cleansing and disinfection will reduce the risk of FMDV entering a premises via fomites. Separation of groups of animals and quarantine facilities for new animals may help reduce FMDV transmission within a premises. This does not benefit an individual premises (as all animals would still be culled if FMD was detected) but may reduce the overall virus production on the premises, therefore reducing the risk of onward transmission to other premises. Other biosecurity measures (such as double fencing to prevent contact with neighbouring premises) also reduce the risk.

A2 Camels (or associated vehicles, personnel or equipment) are contaminated with FMDV

• Ability for camels to act as mechanical vectors
  • Although camels have low susceptibility for FMDV, they can still act as fomites and carry viable virus on the coat, skin or feet (in the same way as dogs/horses).

• Presence of infected camels or livestock at same premises
  • The most likely route for camels to become contaminated is the presence of other infected animals at the same premises or in close proximity.

• Contamination of vehicles, personnel or equipment
  • Contact with infected premises or areas where there is a high risk of undetected infection represent the greatest risks.

• Movement history of vehicles, personnel or equipment
  • Movement to other premises, particularly those where susceptible livestock are kept, increases the probability of contamination. Visiting multiple premises increases the risk.

• Biosecurity, including cleansing and disinfection of personnel, equipment and interior and exterior of vehicles
  • See A1.

Risk of transmission: B1 Camels pass infection to susceptible livestock on other premises

• Presence of animals with undetected or incubating FMDV infection, or failure to report FMD, or presence of animals contaminated with FMDV
  • Animals with detected FMD are subject to FMD control measures, so only animals that have undetected or incubating infection, or animals contaminated with FMDV, present a risk.
  • Camelid species are often kept in small groups or as pets and, if present, clinical signs are likely to be detected more easily than in large groups of livestock.
  • In experimental studies, some animals became infected without showing any clinical signs (Lubroth et al., 1990). These animals do not appear to be important in onward transmission but this risk cannot be eliminated. There is little information on the incubation period of FMD in camelids, but it appears to be consistent with other
species of 1 - 14 days for in-contact transmission. It is not known if FMDV can be transmitted from camelids during the incubation period, but given their low capacity for onward transmission, this risk is likely to be very low.

- Numbers and distribution of camelids
  - There are around 30,000 alpacas (www.bas-uk.com) and between 2000-4000 llamas (www.britishllamasociety.org) currently registered in Great Britain, but numbers of non-registered camelids in GB are not known. Information on the distribution of camelids would help to inform the assessment of risk.

- Proximity to susceptible livestock
  - Camelids with undetected infection may act as a "bridge" to allow infection to pass between premises with susceptible livestock. As premises which only hold camelids are not required to be registered, camelids form a population of susceptible animals (though with low susceptibility) which cannot be easily characterised or identified for disease control purposes.

**Risk of transmission: B2** Camelids move to other premises (where livestock may be kept) for sale or for breeding purposes

- Camelid movements
  - Camelids may move for purposes of sales, breeding or agistment (livery).
  - Movements of camelids would be restricted by FMD control policy, but movements may occur before the NMB or be permitted under licence. The time and circumstances under which licences would be issued to allow movements of camelids could differ from movements of other livestock species.
  - Movements of camelids are not recorded. Therefore risky movements, such as movements from premises with undetected FMD, would be much harder to detect than for susceptible livestock species.
  - Camelids are not required to undergo standstills as other susceptible livestock species are.

- Number of animals moving
  - Greater numbers of movements, or movement of larger groups of camelids, increase the risk of moving infected or contaminated animals.
  - Collecting animals from multiple premises increases the risk.

- Risk level of origin and destination premises
  - Animals moving from areas where FMD is present to lower risk areas are more likely to move infection to new areas.

- Presence/proximity of susceptible livestock at destination premises
  - Presence of susceptible livestock increases the risk that FMDV will be transmitted to susceptible hosts. The greatest risk is presented by moving camelids to premises where camelids are kept with, or close to, susceptible livestock.
  - Close proximity to other premises increases the risk of onward transmission by direct (such as over-the-fence) and indirect (via fomites) transmission.
  - High density of livestock in the local area increases the risk of onward transmission.

- Biosecurity
  - Biosecurity arrangements, such as quarantine of new animals, reduce the risk of onward transmission.

**Risk of transmission: B3** Camelids go to events where camelids and/or susceptible livestock from multiple locations are brought together, such as shows or fetes. Direct transmission could occur to susceptible livestock if present, or fomite transmission if people return to premises where susceptible livestock are present

- Likelihood of events occurring
  - Outwith FMD outbreaks, there are a number of specific camelid shows each year, ranging from small local events
Camelids also often attend agricultural shows. Owners often bring together camelids from several premises for other events such as treks. During an FMD outbreak, gatherings of susceptible livestock are restricted, but can be permitted under licence in a SZ or RZ.

- Number of animals
  - Greater numbers of animals attending increases the likelihood that some of the animals may be infected or contaminated.

- Number and location of origin premises
  - Greater numbers of origin premises increases the risk that an animal may be infected or contaminated. Animals originating from premises in higher risk areas have a greater likelihood of being infected or contaminated.

- Presence of other livestock
  - If other livestock are present at the site of the meeting, there is a much increased risk of transmission (from camelids with undetected infection to other susceptible livestock), either via direct transmission or via fomites.

- Number of people attending
  - Large events with many people attending, particularly if people are likely to have come from or travelled through areas where FMD is present, present a greater risk.

- Biosecurity
  - Good biosecurity reduces the risk of onward transmission, particularly regarding separation of camelids from susceptible livestock, separation of animals from different premises, cleansing and disinfection.

**Risk of transmission:** B4 Camelid products (such as wool) are moved leading to new outbreaks of disease on other premises

- Likelihood of camelid products being moved
  - Many camelids, especially alpacas, are reared for wool production. Alpaca wool is a niche market which is small but increasing in size. Many producers process and sell wool directly from their premises.
  - During an outbreak, selling wool would be restricted but is permitted in the RZ.

- Likelihood of camelid products carrying FMDV
  - FMDV can survive on contaminated sheep’s wool for up to 55 days at 4°C, or 10 days at 18°C (Bartley et al., 2002). Whilst there are no data available on alpaca wool, it is likely that FMDV survival would be similar, if the wool were to become sufficiently contaminated with virus.

- Destination of products
  - For onward contamination to occur, FMDV-contaminated product would have to come into contact with susceptible livestock. The likelihood of this happening with wool is low, but would be most likely to occur if contaminated wool was moved to another livestock premises for processing or sale. FMD could arise through exposure of susceptible livestock to contaminated products, or indirectly, for example through contamination of a livestock keeper’s hands or clothing.

6. CONSEQUENCE ASSESSMENT
Spread of FMD to uninfected premises.
7. RISK MANAGEMENT OPTIONS

This VRA has considered the susceptibility of camelids to FMD and the likelihood of onward transmission to susceptible livestock. The VRA considers transmission via premises which hold camelids, and via three additional routes: movement to other premises; attendance at shows; selling of products such as wool. It has not considered other activities that could present a risk such as:

- Movement to slaughterhouses. There are slaughterhouses in Scotland licensed to process alpacas and llamas, but the numbers processed are small.
- Visits by or to veterinary practices
- Other services including artificial insemination, embryo transfer, shearing and foot trimming.

This VRA did not review all the potential risk factors that may influence the likelihood of infection to other species which are covered by other VRAs, but only the important risks that involve or are affected by camelids.

Camelids are included as susceptible animals in the Foot-and-Mouth Disease (Scotland) Order 2006 and are therefore subject to the same legislation as livestock with respect to many aspects of FMD control. However, there are some features of camelids or camelid ownership that may represent a specific risk: (i) Camelids are not covered by general livestock regulations. Premises which only hold camelids are not required to be registered, so there is no complete information on the numbers and locations of these premises. (ii) In addition, no compulsory animal identification tagging or movement recording is required and little information is available on the numbers, distribution and movement patterns of camelids. This means it is difficult both to characterise the general patterns of camelid distribution and movements, and to identify specific high risk movements during an outbreak. Camelids are also not required to observe the movement standstill periods which are in place for susceptible livestock species; (iii) Camelids are usually kept in small groups as pets or for small scale production. Owners may be less aware of biosecurity protocols, or have fewer facilities available for biosecurity, than farmers who are involved in commercial production.

Although little information is available on FMD in camelids, a review of the existing literature suggests that camelids have mild susceptibility to FMD but low potential for onward transmission. They may become infected without showing clinical signs. They do not become carriers. Camelids present a greater risk for onward transmission than species such as horses and dogs which can carry FMDV mechanically only, but less of a risk than species such as cattle, sheep and pigs.

The risk is:

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<tr>
<td>Transmission via</td>
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These risk levels were assigned based on scientific literature available and expert opinion where appropriate by considering the risk pathways and the factors affecting each risk pathway, as listed in sections 4 and 5.

8. SUGGESTED RISK MITIGATION MEASURES

No specific measures were considered in this VRA.

9. SOURCES OF EXPERT ADVICE

None.

10. AUTHORS

Compiled by: Harriet Auty, Lisa Boden (EPIC CEADO) Date: 21/12/12
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11. REFERENCES


12. NOTES
None

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