Appendix 14

Problems in stamping-out and rendering practice: suggestions for improvements and alternatives

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Summary
In general, upon outbreaks of FMD, many efforts are made to contain the disease on outbreak farms. Here, in addition, the principles and rules that have been developed for the high-containment laboratory, are translated for suspected and outbreak farms, the killing of livestock, the transport of carcasses, and the rendering plant.

For the transport of carcasses a (closed) container system is proposed, enabling the lorry and its driver not to become contaminated. It is also proposed to start the rendering process during transport and to operate the rendering plant like a high-containment laboratory (including the same strict rules for its staff).

Introduction
During the last 30 years a whole set of principles and rules for bio-safety and for high-containment laboratories have been developed. Many of these principles and rules are already implemented for virus containment on outbreak farms however, one may ask whether more could be done. In this context the transport of carcasses and their rendering are considered as well.

Primary containment
The main principle of the high-containment laboratory and FMD vaccine production plant is “keep the devil in the bottle” and kill or catch it where it might have escaped. Another principle is that virus cannot escape from rooms where there is no virus. In other words keep the rooms - even though protected by negative air pressure and air-filtration etc. – as virus-free as possible. This will also mean that under normal conditions staff will not become heavily contaminated preventing the associated risks. Wherever “open” manipulations have to be performed e.g. with bottles or tubes containing virus, this should be carried out in a bio-safety cabinet. How far is this “primary containment” already practised on suspected and outbreak farms?

On the outbreak farm, in general, the diseased animals will excrete the virus in enormous quantities (Sutmoller et al. 2002). The virus behaves like a fine desert dust and probably even worse. On the farm it contaminates all surfaces (outside and inside) including clothes and vehicles. It follows that the most common way of dissemination is not only by infected live animals and contaminated animal products, but also by people, vehicles, and all kind of contaminated materials (fomites) that are leaving infected farms.

In general, once FMD is confirmed, the (diseased) animals are killed and the farm is disinfected as soon as possible.

For primary containment one could ask oneself whether it would not be better to start (regular) disinfecting the place already when there is suspicion of FMD? Also, is it possible to
diminish the level of virus aerosols e.g. by regular spraying with the (usual) citric acid solution supplied with acetic acid? Acetic acid is non-toxic and will easily evaporate.

Following the principle “where there is no virus it cannot spread” it may make sense if visiting veterinary staff – even when wearing protective clothing - “spray their way” to prevent as much as possible to become contaminated. It could also be good practise in order to make everybody aware of the seriousness of the situation. Changing, and if possible, showering at the gate should of course continue as a decontamination measure.

Because cleaning procedures incorporate the risk of making virus aerosols, disinfecting should always precede cleaning, (followed by a final disinfecting round).

Laboratory confirmation of suspected cases may take several days, sometimes even weeks. Because vaccination with a potent vaccine may start to protect animals already after 3 or 4 days and stop further dissemination of virus, it may make sense if upon suspicion (of secondary cases) of FMD, all animals on the farm (and contact farms) are immediately vaccinated. For that purpose oil-based vaccines could be available at (local) vaccine banks frozen at -70ºC. One could vaccinate “towards the source” - from the most remote animals towards the animals found with the symptoms (not to forget to change needles regularly and logically).

**Secondary containment**

In the laboratory, a second level of containment is provided by the technical facilities of the building: negative air-pressure maintained via HEPA filtration, (heat or chemical) treatment of sewage, airlocks, and (airlock-) showers for the staff. The air treatment is particularly important in places where the formation of virus aerosols cannot be prevented e.g. in the stables. The air-exchange rate will dilute the virus aerosols e.g. an exchange rate of 14 times per hour means that in one hour a million infectious units will be reduced by about a 1000 fold to approximately 1000 units. Often the figures will be even more favourable because air tends to flow from positive to negative pressure or, in other words, from the blowing (the disseminating animals) to the suction point (the filter unit). In the well-ventilated high-containment stables at Lelystad transmission of disease was only guaranteed if the animals had physical contacts or if the animal caretaker (purposely) acted as intermediary. Very likely, when rooms are well ventilated, virus aerosols are too much diluted to reach the minimum infective dose, the number of infectious units of FMD virus that is required to infect susceptible animals. It is already more than 30 years ago that Sellers (1971) reviewed this topic. He concluded that exposure to relatively high levels of virus does not necessarily result in infection. It is also known that the minimal infective dose of a particular virus strain varies for different animal species and the route of infection.

To prevent further spreading of disease, it might help if besides the regular spraying with disinfectant (see above) suspicious farms or farms at risk place small, commercially available (HEPA) filter units in the stables. Anyhow, it seems worthwhile to try to eliminate as much as possible what is considered “uncontrollable” spread by aerosols (Donaldson, 2001).

Rules for laboratory staff and visitors on how to behave in and outside the high-containment facilities are, in general, well implemented for the suspicious and infected farms but require constant training and supervision.
**Must all animals on infected premises be killed?**

In Europe before the discontinuation of vaccination (in 1991) one of the last (type A) outbreaks of FMD occurred in 1987 on a large pig holding (approximately 5,000 pigs) in Northern Italy. Because of limited rendering capacity the authorities decided to vaccinate all the animals in the holding with a potent aluminium hydroxide vaccine emulsified in oil. The pigs in infected pens and “in-contact” pigs were killed and the premises were carefully disinfected and on the farm a sanitary regime was installed to prevent spread of the virus. The other vaccinated pigs were left alive and later went for (normal) slaughter for human consumption. Of these pigs 35 were followed for possible virus reproduction by nasal swabbing at regular intervals. Only from one pig at 7 days post vaccination a minimal amount of virus was isolated probably caused by captured virus aerosol from the environment. Active virus multiplication has not been demonstrated (Panina et al.).

A similar approach as described above was successfully followed on another huge pig holding in Northern Italy in 1989 (approximately 10,000 pigs) and in 2001 in South Africa on a very large cattle holding (about 16,000 cattle!) infected with SAT1-type virus. Also in these cases vaccination worked very well and the disease did not reoccur.

Whether on infected premises – and on “contact” farms - all susceptible animals must be killed or whether they can be saved by vaccination might be a subject of further considerations. Anyhow, when it is clear that FMD is involved, affected animals (and animals with fever) should be killed as soon as detected (“close the bottle”). If only a few animals are affected and vaccination is starting to protect the others, one could wait and see, leave the farm under quarantine for some time and start to test for carriers which can – for the sake of everyone’s peace of mind - subsequently be eliminated. This approach makes sense for large holdings in particular, not only because of the costs of compensation, but also to prevent associated risks connected with the large scale culling.

**Killing, transport, and rendering of carcasses**

Once the infected animals are killed the problem is to transport infectious material from one containment unit (the infected farm) to another (the rendering plant). For that purpose really closed (air-tight) containers/tanks should be used. Ideally, a system should be developed with containers that can be detached from the lorry at the gate of the farm. This will prevent that the lorry (and its driver) becomes contaminated.

Before transport, concentrated caustic soda could be added to the safely closed-off content of the tank. This will increase the temperature and will start the rendering process. A provision for rolling the tanks during transport could be added (like for concrete) in order to guarantee freedom of virus - or at least a very low level of surviving virus - upon arrival at the rendering plant.

If it cannot be guaranteed that the contents of the containers/tanks are virus-free, the rendering plant should be operated like a high-containment laboratory (including the same strict rules for its staff). The containers/tanks could be dropped outside the rendering plant, using a one way operational system for intake into the plant (via air-locks), disposal of the carcasses in a hall under negative air-pressure, a disinfecting-cleaning-disinfecting procedure to decontaminate the containers/tank and, finally, exclusion of the tanks via another air-lock.
**Concluding remarks**

During the past thirty years great efforts have been made to increase the safety of FMD high-containment laboratories and to prevent spreading of FMD from such institutions. However, upon outbreaks, the developed principles and technologies for the high containment laboratory are not yet fully applied for the infected/suspected outbreak farms, neither for the transport of the infected carcasses nor for the rendering plants.

Here I have proposed that – in addition to existing practice - principles, methods, and technologies available for the high-containment laboratory be brought further into practice during outbreak situations, proposals that would hopefully contribute in making FMD a more controllable disease.

**References**


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