Frequently Asked Questions (FAQs) – FMD Vaccines

This Frequently Asked Questions (FAQ) document provides information on the Foot-and-Mouth Disease (FMD) vaccine used in South Africa. This list will be updated as more questions get asked.

1. What is the advantage of using multiple FMD vaccines

- South Africa has multiple circulating SAT serotypes (SAT1, SAT2, SAT3) and diverse viral strains.
- Using different vaccines ensures animals are protected against multiple antigenic profiles and increases the likelihood of cross-protection if one vaccine's match is suboptimal.
- Multiple vaccines provide broader coverage across strains, improving overall population immunity.
- If one vaccine batch is delayed or unavailable, the other vaccines can maintain immunity coverage and prevent interruptions in the vaccination program.

2. What is vaccine matching

- Vaccine matching is the process of assessing how well a vaccine strain antigenically corresponds to circulating field virus strains to predict its likely protective effectiveness, and is expressed as an r_1-value.
- The r_1-value is determined using a virus neutralisation test (VNT) that compares how well antibodies raised against a vaccine strain neutralise a field virus.
- How it is determined:

    1. Animals are vaccinated with the vaccine strain.
    2. Serum is collected and tested against:
        - The **homologous virus** (the vaccine strain)
        - The **heterologous virus** (the field/outbreak strain)
    3. Neutralising antibody titres are measured for both.
    4. The r_1-value is calculated as:

$$r_1 = \frac{\text{Neutralising antibody titre against field virus}}{\text{Neutralising antibody titre against vaccine virus}}$$

- How is it interpreted:
  $r_1 \geq 0.3$ → good antigenic match (likely protection)

r_1 < 0.3 → poor match (reduced protection, risk of failure, but can be overcome using broadly reactive strong vaccines)

- The r_1-value is a relative measure. It does not tell you how strong the immune response is, only how well that response works against a different virus.
- r_1-values are inherently variable, even under well-controlled conditions, and that variability is often underestimated.
- r_1-values can typically vary by ±0.1–0.2 when measured within the same laboratory, with inter-laboratory differences often being greater.
- It should not be interpreted in isolation but rather interpreted in combination with the antibody titre and potency of the vaccine.

3. Can an FMD vaccine with a low r_1-value still be effective

- Yes, vaccine protection can still occur even with a low r_1-value, but this is generally only achieved when using high-potency vaccines.
- High-potency vaccines (≥ 6 PD_{50}, ideally ≥ 10 in outbreak situations) can overcome antigenic mismatch because they induce stronger and broader antibody responses, improving protection against variant strains.
- When using high-potency vaccines with a low r_1-value, a second vaccination 30–60 days after the first is often recommended to enhance immunity.

4. How often should animals be vaccinated?

- In areas where FMD is endemic or outbreaks occur frequently, vaccination is typically recommended every 4–6 months.
- Oil-based vaccines provide a longer-lasting immune response compared to traditional water-based adjuvant vaccines.
- The FMD vaccine produced by BVI is water-based and must be administered every 3–4 months to remain effective.
- Vaccines produced by the ARC, Dollvet, and Biogénesis Bagó are oil-based, and the current recommendation is to administer them at 6-month intervals.

5. How quickly does protection develop?

- Individual animals can develop protection as early as 14 days after vaccination.
- Animals may respond differently to the vaccine, so it can take longer for the entire herd to be protected.
- The vaccine is generally fully effective after 28 days.

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6. Can vaccinated animals still get infected?

- Vaccination does not prevent infection, but vaccinated animals usually experience milder or subclinical disease if infected.
- Vaccination reduces virus load, duration and severity of clinical disease and virus transmission, helping to prevent the spread of infection to other animals and herds.

7. What is herd immunity?

- Herd immunity means that enough animals in a group develop a protective immune response, preventing the disease from spreading.
- A protective immune response is generated after field strain infection (against that strain only) or after vaccination (against the strains in the specific vaccine as well as those covered through cross-protection). Due to the variable presentation of FMD in South Africa, with consecutive or simultaneous infections by SAT 1,2 or 3 (the current reality), we cannot rely on natural, post-infection immunity alone. Broad, vaccine-induced immunity is essential.
- Under most production systems, 70–80% of animals must develop a protective immune response to achieve herd immunity. However, not all vaccinated animals will develop an adequate immune response due to concurrent disease, malnutrition, high parasite load or other causes of immune incompetence. In addition, open systems such as feedlots, speculators and communal herds change constantly due to regular in- and outflows of animals. These factors must be considered when a vaccination program is implemented in particular subpopulations to ensure that it is fit for purpose. The likelihood of achieving and maintaining effective herd immunity can be improved with the use of only high potency vaccines, booster vaccinations 4-6 weeks after the first (prime) one, shorter intervals than the labelled duration of efficacy, , concurrent use of endectocides, injectable microminerals etc.
- The goal of the mass vaccination campaign is to ensure that at least 80% of the national herd is vaccinated and protected, effectively stopping virus transmission between herds and eventually eliminating the disease. This will require several rounds of preventive vaccination as well as effective rapid response vaccination to contain localised outbreaks.

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8. What side effects can one expect after vaccination with a high-potency vaccine?

- High-potency, oil-based FMD vaccines are very safe and effective but can cause some side effects.
- Most side effects are manageable, but you need to anticipate them.
- The following side effects can be expected and are usually mild:
    - Swelling or firm lumps at the site of injection. This will clear up over time and generally not require treatment
    - Mild increase in body temperature, typically for 24–72 hours after vaccination.
- More severe side effects can occur if the vaccine is administered incorrectly:
    - Lameness or stiffness when the muscle is damaged by over-aggressive vaccination techniques
    - Abscesses or granulomas caused by dirty needles and equipment. These can be treated with antibiotics.

9. What is vaccine failure and vaccine breakthrough?

- Vaccine failure occurs when vaccinated herds do not develop adequate immunity and remain fully susceptible to the disease.
- **Vaccine breakthrough** occurs when properly vaccinated animals become infected, usually because protective immunity has not yet fully developed.
- Major vaccine failures are not anticipated with the vaccines currently used in South Africa.
- Occasional vaccine breakthroughs may occur, particularly within the first three weeks after vaccination, before herd immunity is established.
- The number of vaccine breakthroughs is expected to decline over time as disease pressure (frequency and number of outbreaks) decreases.

10. What should you do when you suspect a vaccine breakthrough has occurred on your farm?

- Notify your State Veterinarian and private veterinarian immediately if clinical signs of disease are observed in a vaccinated herd.
- It is also recommended to inform the vaccine distributor of the suspected vaccine breakthrough.
- This will trigger a vaccine breakthrough investigation to identify and address any shortcomings in the vaccine or vaccination programme.

- State Veterinary Services may consider revaccination of affected or in-contact herds to reduce disease severity and limit spread. This will depend on vaccine availability and the specific circumstances on the farm.

11. How will we know that the vaccine is working?

- The impact of the vaccination campaigns is monitored using multiple complementary approaches.
- Clinical trials are typically conducted to assess whether the vaccines provide protection against circulating field strains.
- The performance of the vaccines in the field are evaluated through post-vaccination monitoring (PVM) to measure population immunity and field effectiveness.
- In general, the vaccination campaign will be considered effective if the following outcomes are observed:
    - Reduced severity of disease in vaccinated animals that become infected
    - A decrease in the number of new outbreaks reported
    - Slower spread of infection between farms
    - Increasing localisation of outbreaks, with fewer affected areas and a progressive reduction in the geographic extent of disease.

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