

What the rabbit keeper needs to know about RHDV infections, vaccines and rabbit immunity

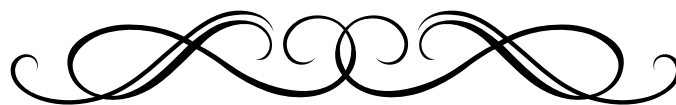
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1) How does a rabbit die from RHDV infection?

The virus enters the rabbit via the mouth, lungs, gut, eyes, and/or skin. It then moves through the body to the liver via the bloodstream. There the virus attaches itself to liver cells.

It basically hijacks the liver cells and instead of allowing the liver cell to perform its normal functions, it turns it into a virus-producing factory.

This uses up the building blocks of the liver cell and completely overextends its energy resources and within a few hours this cell and many other infected liver cells die of the same cause. RHDV infection leaves sores or lesions on the outer capsule of the liver which an experienced vet can identify.

This leaves the rabbit without any liver function within a few hours after infection and without a liver the body cannot detoxify substances and cannot supply energy to the rabbit and so the rabbit dies. The rabbit will have produced many billions of virus particles during this short infection, and now these viral particles can spread to other rabbits and infect them as well.

2) How can RHDV spread?

The most common route of infection is that RHDV is spread by means of a vector. Vectors are the mechanical carriers of the virus. A vector can be flies, on which viral particles stick to their mouthparts, the hair of a rabbit or another animal, a drinker bottle, a feeding bowl, a transport cage, a table surface, your hands and other parts of your body, your clothes, your car etc for extended periods of time because the virus particles are very stable and can survive for many months depending on conditions. RHDV can survive temperatures of 50°C and alcohol, but it cannot survive heat treatment beyond 50°C and spraying with specific antiviral sprays such as F10 and Jik.

The following are examples of direct infection routes:

a) Direct contact between infected and uninfected rabbits is the easiest infection route. This is also why during in an RHDV epidemic, possibly infected rabbits must not be transported from one rabbitry to the next. RHDV can in fact be transported over thousands of kilometres in this way.

b) Other routes of infection can be via vectors such as infected hair or hands by the rabbit keeper. Food moved from one cage to the next can act as a vector. Water can be a vector via a drinker system. The virus can be spread through feeding bowls, drinker bottles and nesting boxes. Food itself can be a vector. Grass or hay that has been cut in a field in which wild infected rabbits have been feeding and living can serve as a vector and transmit the virus. Transport boxes can be infected and transmit the virus many weeks or months after contamination. Then flies can sit on the carcasses of rabbits that have died from RHDV and the viral particles can be transferred on their mouthparts. The flies can then fly for kilometers and sit on another uninfected rabbit and transmit the virus to that rabbit in this way. Often flies try to sit on the eyelids of rabbits and this would be an ideal way of transmitting the virus. These routes must therefore be eliminated through procedures referred to as biosecurity.

RHDV therefore has an incredibly high rate of transmission, and so at the time of an RHDV outbreak, it is important to quarantine your rabbitry. Quarantining involves daily spray downs of the pen, cage or area with the correct solutions to eradicate living viral particles, it involves you wearing protective clothing that is treated so you cannot spread viral particles to anything you pick up, it involves burning or double-bagging and burying fecal matter, bedding, etc where other viral particles may be. Rabbits clean themselves so they ingest most of the matter on their hair, but a BODY rubdown with a 5% F10 solution and letting them dry is not unheard of. Never apply to the nose, eyes, or ears - avoid the head, but you can even consider bathing your rabbit.

3) The vaccines against RHDV:

The type of vaccines supplied in South Africa are DEAD and inactivated vaccines such as the Eravac vaccine. The South African Department of Agriculture will not allow the import of live vaccines such as Filavac for example, as there is a very small risk that they may multiply in the vaccinated rabbit which they want to prevent under all circumstances. Because it is a DEAD vaccine it means it cannot multiply in your rabbit when your rabbit is vaccinated.

Scientifically, the term “to shed the virus” or “viral shedding” is used to describe the release of viral particles by an infected rabbit. However, because the virus cannot multiply in a vaccinated rabbit it cannot shed the virus and therefore cannot infect other rabbits by releasing virus particles that have multiplied in that specific vaccinated rabbit.

4) How vaccination can protect your rabbit:

When your rabbit is vaccinated dead viral matter is introduced into the rabbit, which triggers the immune system of the rabbit in such a way that the rabbit sees this as a foreign harmful attack.

The immune system of the rabbit does not know that the vaccine is in fact made of dead particles, it reacts because it is triggered to respond as though it was being infected with the live RHD virus. The immune system then triggers so-called B-lymphocytes to produce antibodies and activates T-lymphocytes to become activated. Both the antibodies and the T-lymphocytes are released into the bloodstream and patrol and guard all the areas in the body of the rabbit, including the gut, the lungs, the skin, and the eyes.

The rabbit then builds up what is called “immune memory” which is retained for many months, with the result that the immune system of the rabbit is ready for action against the RHD virus should the rabbit come into contact with the live RHDV.

However, very importantly, the vaccine does not infect the rabbit and kill the rabbit as RHDV can do. Your rabbit may have a fever after the vaccination, but this does not mean that it is infected with a living virus. The fever is actually an indication that the vaccine is causing the immune system to start to react. If the rabbit is fed well before it is vaccinated this will help it to overcome these effects of the vaccination. If a vaccinated rabbit with good immunity gets into contact at a later stage with RHDV, they do not get sick as their immune system destroys the virus rapidly after it enters the rabbit.

This response in healthy rabbits will be fast, before the virus can even have time to replicate, so your healthy vaccinated rabbit do not get sick and has an excellent chance of survival.

Summary:

The basic explanation: A rabbit that has been vaccinated and has good immunity, is fully protected by the vaccine. This does not mean a bubble is created around the rabbit and RHD cannot get to them at all. This means they do not get sick, and the virus cannot multiply in a vaccinated rabbit.

5. Less likely but still important indirect routes of infection that one must take into consideration very carefully:

Scenario 1. When you stroke your rabbit, and then visit friends with unvaccinated rabbits and you stroke their rabbits, it may spread RHD to them, as you are then the VECTOR.

Scenario 2: This scenario is important and can be confusing so read this carefully. Your vet has vaccinated, healthy rabbits in his/her practice. These rabbits can come in contact with clients or other animals, and even with the receptionist or technicians, who may have had contact with the RHDV. This may result in the viral particles sticking to the hair of his vaccinated rabbits. They cannot get infected because they are protected by vaccination, and they will not die from an RHDV infection but then THEY MAY SERVE AS VECTORS.

Now you bring in your own unvaccinated rabbits to be vaccinated and they come into contact with the vaccinated rabbits, that have viral particles attached to their hair. In this way, your vet's rabbits can indirectly and quite unknowingly act as vectors and transmit the virus. Your rabbits can then get infected and die because their immune systems have not been activated by the vaccine yet. Although the vet's rabbits are vaccinated, they can act as vectors, because viral particles have been transferred to them passively. This is why many vets don't even want you to offload your rabbits.

if you take them to their practice for vaccination. They will sterilize themselves fully and wear new surgical gloves before they even touch and vaccinate your rabbits in your car. They will also ask you not to come into the practice to avoid the possibility of picking up viral particles by chance.

●●●●● This is why we keep saying to avoid any places with rabbits if your rabbits are not vaccinated.

Scenario 3: Your rabbit is vaccinated and healthy and visits a groomer. However, somewhere along the line in the past few days, you walked in a place where some RHDV-infected rabbits have walked and shed the virus, their hairs came onto your clothes and from there onto your rabbits, you are perhaps not quite so precise with your biosecurity because your rabbit was vaccinated. Now, when you take your vaccinated rabbit to the groomer, these viral particles get on her clothes, linen, on the clippers etc. All of this material then becomes a vector for the next unvaccinated rabbit that she grooms, which then becomes infected. This is not because your groomer is bad, but the virus sticks, and a lack of biosecurity allowed the virus to slip through.

●●●●● This is why we keep saying to avoid any public areas, do proper biosecurity, and avoid any places where other rabbits might have been if your rabbits have not been vaccinated

Scenario 4: Another very important example is if rabbits from different sources are mixed together as happens during shows where rabbits are placed on a show table. Suppose one unvaccinated rabbit that sheds viral particles, is placed on a show table. In that case, all of the rabbits placed on that table will come into contact with the RHDV particles that it leaves behind and other unvaccinated rabbits can become infected. A vaccinated rabbit that is placed onto a show table will however be protected as it's immune system is ready to protect it against a RHDV infection. This is why only vaccinated rabbits are allowed at shows in Europe and the UK. No unvaccinated rabbits that are capable of carrying the virus and can therefore be vectors of the virus are permitted to be at shows. However, in spite of this it is not impossible to spread the virus by mixing of rabbits at shows

We know of a rabbit judge in the UK, who took none of his own rabbits to the show, but carried the virus home on his coat which then led to the infection of his own rabbits.

●●●●● This is why we say to QUARANTINE any vaccinated rabbit by keeping it in your rabbitry for at least 60 days before moving them, even more if possible.

6. Can survivors of RHDV infection serve as carriers and vectors?

Let us say that you have an unvaccinated rabbit that has contracted RHD and survived thanks to some form of natural resistance (remember that there is often a percentage of survivors after an RHDV outbreak in a rabbitry). After surviving the viral attack, the rabbit will still carry many millions of viral particles on or in its body, because of the stability of the viral particles and it will shed these viral particles.

This makes this rabbit a possible cause of further infection for other rabbits in your rabbitry, but also by spreading to other rabbitries by the mechanisms described above. After surviving the RHDV infection the rabbit's own immunity will then build up the same immunity caused by vaccination and such a rabbit will then have high levels of antibodies and activated T cells in its blood which will protect it from the present and subsequent infections.

However, such a rabbit will benefit from being vaccinated at regular intervals to boost its immunity and not to let its immunity levels drop so far that it may get another infection of RHDV a few years later.

●●●●● In the abovementioned quite complicated way, your vaccinated rabbit can act as a VECTOR and spread the disease. However, it is not the vaccination that is causing it to be a carrier, it is as a result of insufficient biosecurity.

●●●●● Your survivor can shed the virus for a longer period of time, the longest was seen at 7 months.

●●●●● All of these facts point out that it is extremely important that your rabbit is vaccinated.

7. Factors influencing the immunity of rabbits and their ability to fight off RHDV infections.

Whether rabbits are vaccinated or not vaccinated, the following factors will all play a role in their ability to fight off RHDV infections:

a) **Nutrition:** If rabbits are not fed a diet that has a high enough protein percentage and if those proteins are not of sufficiently high quality in terms of amino acid content, then the immune system cannot fight off the disease in an unvaccinated rabbit. If a rabbit is vaccinated and its diet is protein deficient, it cannot launch a strong immune response which gives it full protection against an infection with RHDV. Furthermore, if a rabbit that is vaccinated is infected with RHDV after a few months but is not being fed a diet that has adequate proteins, then the immune system may also not be able to fight off the disease. Immune memory as explained before is influenced by nutrition and if inadequate it may not last as long as it is specified to do (in the case of Eravac for 12 months until the next booster vaccination is required).

Another factor is that if a rabbit has not been fed correctly when it was small, and its growth was inhibited resulting in stunting, then such a rabbit may also not have a properly developed immune system and may therefore be able to respond properly to vaccination and may be more

susceptible to RHDV infection than rabbits that have been grown out under optimal feeding conditions.

●●●●● Think about humans in refugee or concentration camps where they are malnourished. Many more people die from diseases in such camps for this reason.

b) Age: The immune system of rabbits under the age of 3 weeks is insufficiently developed for them to start their own immune response against RDHV and are therefore very susceptible. If their mothers have been vaccinated, then they are protected because maternal antibodies are transferred to the babies by means of the milk. This will protect them up to at least 8 weeks, by which time their immune systems are also properly developed and they can then be vaccinated themselves.

Rabbits older than 6 years old will have an immune system that is showing signs of aging and is not as versatile and as quick in responding and may therefore die more easily from RHDV infection, although some rabbits can have a good immune system until they reach a good old age (as old as 12 years in some cases). They may also not respond adequately to vaccination and may not be protected for the full period as specified by the vaccine producer (12 months in the case of Eravac).

●●●●● Think about older humans, many older humans die of infections like pneumonia because their immune systems don't work as well as when they were younger.

c) Infections with other diseases. The immune system at any given point "concentrates" on the most important threat against the rabbit at that given time. If your rabbit has another infection such as Pasteurella, coccidiosis, ear mites, *Encephalitozoon cuniculi* (the disease that causes rabbits to twist their heads and lose balance) or even pododermatitis (sore hocks caused by the wrong type of wire flooring) the immune system focusses on the counterattack against those diseases first and not on RHDV. If RDHV infects it, and an RHDV infection spreads rapidly, then the rabbit may not have sufficient reserves to fight it off and may die. This applies to both vaccinated and unvaccinated rabbits.

d) Water quality: If your water comes from say a bacterially contaminated river source, then the immune system may be fighting a constant battle against some bacteria such as E. coli and if RHDV infects them suddenly then that may be too much for the rabbit to cope with. This also applies to both vaccinated and unvaccinated rabbits.

e) Stress: Immunologists have discovered that chronic stress is one of the biggest reasons for reduced immunity. Stress can come from the following:

- i) too small cages resulting in barbering behaviors such as running up and down in the cage.
- ii) too many rabbits in one cage resulting in dominance and competition problems. This may apply in a high-density commercial rabbitry.
- iii) exposure to too low temperatures and high wind speeds, in other words, incorrect housing
- iv) exposure to too high temperatures, again incorrect housing.
- v) inadequate flooring, in other words, too coarse mesh floors which caused foot pad stress.
- vi) inadequate cage hygiene, in other words too infrequent cage cleaning again leading to infections with other diseases.

f) Genetics, and here there are two considerations:

- i) Inbreeding is known to influence the immune system negatively and if rabbits are very inbred they may not be capable of responding strongly to the vaccine or to an infection with RHDV even if vaccinated. If you have done a lot of brother-sister mating in your rabbitry, your rabbits may not be able to respond to the disease strongly and may also not be able to respond to the vaccination.

ii) In some very rare cases, a rabbit may have a genetically compromised immune system which may not allow it to respond strongly to the vaccine or to a subsequent infection with RHDV even if vaccinated.

g) A combination of any of the abovementioned factors compounds the problem and the situation very quickly becomes too much for the rabbit to be able to fight off a vicious disease such as RHDV and may therefore die.

8. Summary and conclusions: There have been many statements made about the effect of RDHV vaccinations on rabbits in South Africa. One of these is that vaccinated rabbits can spread the virus. From the above, you can see that vaccinated rabbits may transfer the virus passively, in other words through contact because of inadequate biosecurity, but it is not because of the vaccination that this can occur. The vaccination of a rabbit does not cause it to become a source of the virus, and this is a very important point, otherwise vaccination would in fact be detrimental and counterproductive.

Why would big international pharmaceutical companies bother to produce a RHDV vaccine in the first place if this was the case, this would make no sense.

If a healthy, well-fed rabbit of an age between 8 weeks and 6 years (or even older) is vaccinated, it is well protected against RHDV thereafter as long as it is given a booster vaccination at the interval as recommended by the vaccine producer (in the case of Eravac at yearly intervals). If, however, you as the rabbit keeper don't give sufficient attention to the husbandry of the rabbit (all of the factors listed in 7), then your rabbit may still contract RHDV despite being vaccinated.

Malnutrition, stress, inbreeding, etc can all cause your rabbit to be more vulnerable to RHDV infection despite being vaccinated. Ultimately the effect of all of the factors listed in point in (7) is reduced in a vaccinated rabbit, vaccination does protect the rabbit much, much better against RDHV infection, but the vaccine is not absolute in its protection, the general condition of the rabbit and the maintenance of biosecurity also play a big role in deciding if a vaccinated rabbit will survive. Eventually, it all still comes down to good husbandry without which rabbits cannot survive in the long run. I sincerely hope this will clear up the many misconceptions that are doing the rounds, please ask should you have any more queries.

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