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Rabbit haemorrhagic disease virus

> The mystery of that damn virus has been generated by the $2 billion a year they spend on it.
> Kary Mullis, Nobel Prize winner, writing on HIV

Rabbit haemorrhagic disease virus is a member of the virus family *Caliciviridae*. As it shares many characteristics with European brown hare syndrome virus and rabbit calicivirus, it is convenient to refer to this whole sub-group of viruses as members of the *Lagovirus* genus. This name is derived from lagomorph, the general name given to the hare and rabbit family.

There are four other genera recognised in the calicivirus family so far, namely *Vesivirus*, *Norovirus* and *Sapovirus*, with a new single-virus *Nebovirus* genus recently added (Clarke *et al.* 2012). The *Vesivirus* genus includes San Miguel sea-lion virus, a virus that spread into domestic swine that had bizarrely been fed meat from infected sea-lions, and feline calicivirus, which is well known because it affects domestic cats throughout the world. The next two genera are human viruses: *Norovirus*, a group of viruses including Norwalk virus, which causes winter vomiting disease and diarrhoea, and *Sapovirus*, encompassing viruses first isolated in Sapporo, Japan. Sapporo virus is also the cause of gastric illness, while the *Nebovirus* is a virus first isolated in Nebraska, United States, that causes gastric illness in cattle or 'bovines'.

Human norovirus infections are common and are becoming increasingly recognised, not only because they are a frequent cause of deaths of babies in countries with poor health services but also because they are troublesome in Western countries. They cause sudden illness on cruise ships and similar outbreaks, sometimes fatal, in nursing homes for aged citizens. The *Guardian* newspaper reported that the number of cases of winter vomiting disease in Britain in the very cold winter of 2012–13 was higher than normal and had exceeded one million, implying high economic costs in medical care and lost work days.

Like all the other caliciviruses, RHDV is a tiny spherical virus only 30 nm or 30 billionths of a metre across. It takes about 3000 virus particles to span the diameter of a human hair. Yet within each virus particle, a single strand of ribonucleic acid or RNA made up of 7437 nucleotide building blocks encodes all the information necessary for its persistence. By comparison, the genome of the double-stranded DNA myxoma virus contains an estimated 163 600 nucleotide base pairs (Russell and Robins 1989), and the rabbit genome is thought to contain about three billion base pairs (Fadiel *et al.* 2003).

Despite its comparatively minuscule size, RHDV is able to enter and take over rabbit cells and within a few days overrun the whole rabbit, destroying major organs and producing countless millions of virus self-copies. It is numbingly efficient and we do not fully understand why. Nonetheless, some steps in the infection process are apparent.

On entry into the rabbit's cells, a virus protein linked to the single RNA strand draws the virus genome into close contact with all the cell machinery needed for making new proteins