GLOBAL ERADICATION OF RINDERPEST : THE FINAL ACT

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Rinderpest is a contagious viral disease affecting all cloven-hoofed animals, mainly cattle and Asian domestic buffalo. Classical symptoms in cattle include ocular and nasal discharge, accompanied by fever, erosive lesions in the mouth, profuse diarrhoea and dehydration. In wildlife species, the clinical picture is more complex with African buffalo *(Syncerus caffer)* showing similar signs to cattle but in others e.g. lesser kudu (*Tragelaphus imberbis*), the only signs might be corneal opacity and blindness (11, 14). Mortality can attain 100% in immuno-naive cattle herds and 60% in free-ranging immuno-naïve buffalo populations (11). The presentation however will focus on strains of the virus, hypo-virulent in indigenous cattle, causing so called 'mild rinderpest', with very discrete clinical signs in livestock (but often as virulent in a range of wildlife species). Veterinary science distinguishes three lineages of the rinderpest virus :

1. Lineage 1 of the virus which caused classical rinderpest in Africa.
2. Lineage 2 of the virus which caused both hypo-virulent and virulent rinderpest in Africa.
3. Lineage 3 of the virus which caused rinderpest in Asia.

While cattle and buffalo are the iconic victims of rinderpest, several other species, both domesticated and wild, are also sensitive to the virus, including sheep and goats, wild suids, giraffe and a broad range of antelopes mainly of the genus *Tragelaphus*, though with different symptomatology. Based on these sensitivity differences, the clinical and serological surveillance of wildlife has played a major role in the eradication efforts of rinderpest on the one hand because of the high sensitivity of certain species to the virus and hence, ease of (clinical) detection, but on the other hand certain species also as serological sentinel animals due to the high morbidity and post-epidemic seroprevalence at the population level. Some species show low sensitivity to the virus (and high survival rate) but often in these seroprevalence is lower, in others mortality levels might be so high that little antibody can be detected in the population as there are few survivors. This approach has been especially important in cases when and where vaccination against rinderpest was applied in livestock (2, 6, 12, 13, 19).

Rinderpest diagnosis is usually based on clinical signs (the 3 D's : diarrhoea, discharge and death), but as these signs are common to other diseases and as there exists the occurrence of mild rinderpest, serology and virus isolation are regarded as essential. Several tests are recommended by the OIE, such as cell culture, histopathology, AGID and RT-PCR, while for serology two ELISA tests and one VNT have been recommended. Rinderpest control and eventually eradication has relied on vaccination mostly, using a live attenuated vaccine, initially produced through serial passages in goats (caprinised vaccine), but since 1970 produced on tissue cultures (RBOK-BK-VERO). Vaccine – induced immunity is reliable, protective, including lactogenic transmission, and long-lasting (2, 17).

More than 1,500 years ago rinderpest emerged to take its toll on humankind's domesticated animals. It is the only animal disease credited with changing the course of history. We tend to think of rinderpest as a tropical disease, but the virus was present in most of Europe and the Far-east at some point. Rinderpest was first recognized as a distinct plague (*the cattle plague*) in 376-386 (1). Rinderpest outbreaks were later documented in paintings as far back as the early 18th century in the Netherlands and the 13th century in China and Mongolia.

The last outbreaks in Western Europe date back to the 19th century : the Netherlands (1869), France and Germany (1870), the United Kingdom (1900). In 1924, recurrent rinderpest outbreaks in some parts of Europe, including Belgium (1920), led to the creation of the *Office International des*

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Epizooties (OIE), now renamed *World Organisation for Animal Health.* The initiative was spearheaded by the Belgian Government, but it was the French Government which eventually provided the headquarters of the Organisation.

After the last of the European nations got rid of the disease well before the second World War, Africa and Asia became the new focus of eradication efforts. These efforts were conducted in Asia without too many technical set-backs, but this was not the case in Africa. Since 1962, the African States, with the assistance of the European Union (and its predecessors), had been involved in these eradication efforts, initially through the *Joint Programme 15.* The last continent-wide vaccination effort was conducted under PARC (*Pan-African Rinderpest Campaign*) from 1986 to 1999 and led to the near-eradication of the disease in most parts of Africa (7, 18) as verified through the activities of the *Pan-African programme for the Control of Epizootics* (PACE) from 2000 to 2007. While e.g. Botswana reported its last outbreak in 1899 and the Republic of South Africa in 1902, outbreaks still occurred nevertheless as late as 1987 in Nigeria and 1997 in Tanzania (4, 20).

The aforementioned silent circulation of 'mild rinderpest' in the area encompassing northern Kenya, eastern Ethiopia and southern Somalia, the so-called *Somali Eco-System,* became a major eradication challenge as soon as it became formally recognised in 1994 (15), not just because of the behaviour of the virus, but also because of the behaviour of the animals and their herdsmen (nomadic) and of the ongoing civil war in Somalia. Despite these harsh conditions, sustained serology and participative epidemiology (10) eventually led to the demonstrated eradication of the disease and the infection from both wildlife (13) and livestock in this area (in 2010).

The last occurrence of rinderpest in Asia was reported in livestock in Pakistan, in the year 2000 (4, 16), while the last confirmed outbreak of rinderpest in Africa occurred in wild African buffalo in Meru National Park (Kenya) in 2001 (5, 8, 11, 12, 13).

In 1994, encouraged by the results obtained in various parts of the world, OIE and FAO established the *Global Rinderpest Eradication Programme* (GREP). This Programme, a key element within the FAO's *Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases* (EMPRES), was conceived as an international coordination mechanism to promote the global eradication of rinderpest and verification of rinderpest freedom, while providing harmonised technical guidance to achieve these goals. From the outset, GREP was a time-bound programme, due to declare rinderpest freedom by 2011 (1, 3).

Over the years, a total of 266 country-applications from OIE Members and non-Members have been submitted and scrutinised by the OIE Scientific Commission for Animal Diseases, with various degrees of acceptance as a result (numerous applications were referred back to the countries at least once). In most of these cases, countries submitted first a case for recognition of disease freedom, i.e. shortly after the end of vaccination campaigns, and two or more years later a submission for recognition of infection freedom, i.e. the serological absence of any rinderpest related traces.

From a worldwide perspective, almost all countries known to keep rinderpest susceptible livestock have been recognized by the OIE as being officially free from rinderpest infection. A handful of remaining countries are in the process of submitting documented evidence to OIE for evaluation and the epidemiological situation in their corresponding region has not indicated any circulation of the disease or its virus in the natural host for many years.

Out of the 177 OIE Member countries and territories, only 2 have not submitted a request for official recognition yet : Kazakhstan and Sri Lanka. Another 3 are currently being processed for evaluation or awaiting clarification of pending issues, namely the Federated States of Micronesia, Kyrgyzstan and Turkmenistan. Out of the remaining 21 non-OIE Members, only one requires special efforts to enable the country to be declared free before the deadline, i.e. Liberia.

In addition, the global eradication of rinderpest demands that the international community establishes an inventory on existing rinderpest virus stocks in order to prevent the re-emergence of the disease through release of rinderpest virus from laboratory sources. To this end FAO and OIE, through a

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newly established Joint Committee, have committed themselves to establish the principles of international oversight and regulations for facilities holding rinderpest virus containing material. Specific guidelines are being developed to ensure secure handling and sequestration of rinderpest virus in the post-eradication era. Additionally, countries are encouraged to safely reduce the number of rinderpest virus repositories under official supervision in order to minimise the risk of accidental release.

The launching of GREP was founded on the scientific understanding that the eradication of rinderpest was feasible. Not only has eradication proved feasible, it has probably already been achieved. If everything goes according to plan, worldwide rinderpest eradication could be announced jointly by the two Directors General of OIE and FAO, on both occasions, during the May 2011 OIE General Session and the June 2011 FAO Conference. Thirty one years after smallpox was eradicated by the *World Health Organisation* (WHO), rinderpest will be the second disease ever to be eradicated from the planet. The same principles, though not immediately in view of world-wide eradication, are now being developed for the progressive control of foot-and-mouth disease (9).

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