Rinderpest: a case study of animal health emergency management

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Summary
The history of rinderpest and control of the disease in Africa and Asia is reviewed briefly. The present distribution of rinderpest virus in relation to its phylogenetic lineages is presented. Rinderpest-free countries bordering rinderpest-infected countries are considered to be under permanent threat of a transboundary rinderpest incursion and therefore face continuous and serious emergency situations. The nature of these emergencies in relation to the remaining foci of the three lineages is described.

It is argued that the Global Rinderpest Eradication Programme (GREP) eradication strategies now need to focus on the use of epidemiological studies to define foci of infection and guide targeted, pulsed vaccination campaigns rather than broad, routine vaccination.

The emergency posed by the re-emergence of African lineage 2 virus in East Africa and the challenge of mild rinderpest is explored in some detail as a phenomenon which may be more widespread than has been assumed. Points at which the future of GREP is threatened are illustrated and means of removing some of the dangers are suggested. The lessons which need to be learnt from the experience of the Indian National Project on Rinderpest Eradication and the Pan-African Rinderpest Campaign are discussed, including the value of strengthening surveillance systems in accordance with the Office International des Epizooties Pathway and how to cope with the problem associated with cryptic foci of rinderpest persistence - perhaps the greatest challenge facing GREP.

The value of vaccine buffer zones is considered in detail and the authors conclude that unless those zones are of considerable depth and are well maintained, they are unlikely to prevent dissemination of the virus.

The role of emergency preparedness planning in preventing the spread of rinderpest is discussed, with the understanding that effective surveillance, as a component of emergency preparedness planning, is safer than vaccination as a means of ensuring that the disease does not re-enter or penetrate a population. The swift initiation of a programme for the eradication of rinderpest from Pakistan is seen as the key issue in dealing with the Asian lineage rinderpest emergency. Development and implementation of strategies with the benefit of experience gained in Africa and India could provide a rapid resolution of the emergency.

Keywords
Introduction

It was not until 1965 that attenuated rinderpest vaccines became sufficiently plentiful to allow veterinarians to contemplate their use in the eradication of rinderpest. The success of Joint Project 15 (JP15) in dealing with rinderpest in West Africa between 1961 and 1969 (9) demonstrated convincingly the effectiveness of mass vaccination strategies in controlling the disease. However, to work efficiently such programmes had to involve all countries in the affected region simultaneously and benefit from focused donor support; a country acting in isolation was unlikely to be successful in controlling rinderpest.

Following the eradication of smallpox, the Food and Agriculture Organization of the United Nations (FAO) began to explore the possibility of repeating the process with rinderpest. In 1984 and 1987 FAO Expert Consultations concluded that all the technical pre-conditions for eradicating rinderpest had been fulfilled. In 1994, the Animal Production and Health Division of the FAO was given a mandate by the FAO Council to develop a programme to combat transboundary diseases and simultaneously to co-ordinate a Global Rinderpest Eradication Programme (GREP). Thus, the end of the 20th Century is marked, if not by outright eradication of rinderpest, at least by a growing awareness of the existence of GREP, of its strength of purpose and of its continued progress towards its declared objective.

In 1996, in order to boost the GREP programme, an international timetable was developed providing goals for individual national eradication programmes which, if achieved, would result in a rinderpest-free world by 2006 (6, 7). This GREP blueprint was deliberately created to inject a sense of urgency into the various national campaigns and to demonstrate the necessity for a higher level of international responsibility among those countries which still harboured rinderpest. The blueprint was also created so that regional co-ordinating bodies would assume responsibility for various segments of the programme and ensure that any serious departure from the timetable was treated as an emergency situation. In 1997 and 1998 the existence of several such situations has become very much clearer.

In post-JP15 Africa, the possible existence of residual rinderpest foci did not attract international concern, although in Mali at least, documented evidence of the continued survival of the virus was readily available. The continued presence of the virus in western and southern Sudan was less certain, as was the origin of the rinderpest epidemic which commenced in south-east Ethiopia in 1975. At the time of the sudden, seemingly enigmatic resurgence of rinderpest in West Africa from 1980 to 1982, no obstacles existed, or could be created in time, to prevent the virus from gaining fresh access to most of the sub-Saharan belt of Africa. This failure suggested the existence of structural weaknesses among a number of African Veterinary Services. Accordingly, when donor assistance was finally pledged in an attempt to rectify the situation, it was accompanied by a priority to strengthen these Services, at times through a structural adjustment approach. In 1986, the Pan-African Rinderpest Campaign (PARC) was launched under the co-ordination of the Organisation of African Unity Inter-African Bureau of Animal Resources (OAU/IBAR). Under the circumstances, it was perhaps inevitable that success against rinderpest came to be seen as an indication of strengthened Veterinary Services.

After 1982, Veterinary Services in West Africa not only rapidly regained control of the situation but completed the process of eradication that had eluded JP15. Thus, since 1988 no outbreak of rinderpest has been recorded in this area. In East Africa rinderpest has persisted in spite of a programme which aimed to strengthen Veterinary Services. The disease will persist unless the epidemiology-based approach adopted by PARC, now gathering momentum, is continued up to and beyond completion of the task of eradication from Africa.

National eradication programmes eliminated rinderpest from China in 1955 and, it is believed, from Indochina in 1956. Thereafter, any early thoughts of global eradication were frustrated by the problems associated with rinderpest on the Indian sub-continent. Here the quantities of vaccine required were so enormous that vaccination resulted in only a modest level of population coverage (22). Coupled with public opposition to the destruction of infected animals and hostility to interference in local trade, State Veterinary Services adopted minimalist strategies which essentially ensured the perpetuation of the virus. The eradication of rinderpest from India during the period between 1990 and 1998 is, therefore, all the more remarkable. This success will hopefully prove to be a turning point in the history of the Veterinary Services of India, while also removing one of the last major obstacles to providing a successful outcome to GREP.

While GREP deals with the strategy and co-ordination of global rinderpest eradication, the Office International des Epizooties (OIE) establishes the standards for registering a country as rinderpest-free, a process that normally takes 5 years. The OIE has issued a set of recommended standards for epidemiological surveillance systems for rinderpest, generally referred to as the 'OIE Pathway' (8, 15). This document lists the evidence that may need to be produced before a country can be qualified as rinderpest-free. All countries now intend on registering as rinderpest-free should do so according to the OIE Pathway.

Rinderpest remains a disease of awesome potential and has the capacity to re-infect territories from which it has been eliminated. With this in mind, it will be argued that rinderpest-free countries bordering rinderpest-infected countries are under a permanent threat of a transboundary rinderpest incursion. They therefore face continuous and
extremely serious emergency situations. Now, more than ever before, handling these situations requires the ability to learn a number of new lessons: how to ensure that sufficient funds are available to match the rapid pace required in rinderpest eradication; how to improve international co-ordination and how to adjust to the new virological problems associated with mild, or even sub-clinical strains of rinderpest virus that are now emerging. For GREP to fail at this stage is almost inconceivable yet the security of the programme is only as strong as that of its weaker participants. This review therefore aims to illustrate points at which the future of GREP is threatened, as well as to point out what can be done to remove some of the dangers.

The distribution of rinderpest virus in relation to its phylogenetic lineages

Using strains of virus from the FAO World Reference Laboratory for Rinderpest (Pirbright, United Kingdom), a reverse transcriptase-polymerase chain reaction (RT-PCR) technique has been used to sequence a portion of the nucleotides of the rinderpest F gene (2). Using this technique the existence of three different phylogenetic lineages of the virus has been demonstrated; two of these lineages originate in Africa and one in Asia.

From the limited historical material still available, it appears that African rinderpest virus lineage 1 has generally been restricted to East Africa, stretching from Egypt, through the Sudan to Ethiopia, Kenya and Uganda. The only evidence of a change in distribution occurred in the early 1980s when virus lineage 1 crossed from the Sudan into eastern Nigeria as part of the rinderpest pandemic that engulfed the entire sub-Saharan Africa at that time (12, 13).

In contrast, the evidence suggests that African rinderpest virus lineage 2 was much more widely distributed, covering both West and East Africa (the virus was isolated in Nigeria in 1958 and in Kenya in 1962). When rinderpest re-emerged in the early 1980s the virus that spread eastwards from Mauritania and Mali to western Nigeria was probably lineage 2. At that time, it appeared that lineage 2 was restricted to West Africa, however, it has since been demonstrated that its distribution was still continent-wide. Lineage 2 virus was present in East Africa but apparently escaped detection for 30 years because of a change in virulence which rendered the virus imperceptible.

In East Africa, the PARC programme has made significant advances through the eradication of rinderpest lineage 1 virus from Ethiopia. This virus now appears to be confined to an endemic area comprising adjoining parts of southern Sudan, south-western Ethiopia, north-eastern Uganda and north-western Kenya, within which the virus continues to circulate, occasionally extending into surrounding areas.

On the Asian sub-continent, only one phylogenetic lineage of rinderpest virus has been described. Within the last decade, this virus has been eradicated from India although it is still endemic in Pakistan and in neighbouring areas of Afghanistan. The movement of infected animals appears to have spread the Asian lineage virus westwards to contaminate livestock belonging to trade partners. Oman and the United Arab Emirates are examples of countries that have suffered brief incursions of this type without rinderpest becoming endemic. In contrast, Turkey and Saudi Arabia now have lengthy histories of contamination with the Asian lineage and could have become infected on a permanent basis, as appears to be the case in Yemen.

Permanent rinderpest emergencies at the fringes of endemic areas

Rinderpest emergencies

In 1996, the GREP Technical Consultation meeting (6) defined an international rinderpest emergency as any occurrence of rinderpest outside the endemic foci known at that time. However, considering that the ultimate success of GREP is continuously threatened by these residual foci of rinderpest, perhaps it is time that these areas (which number five or six) are classed as permanent rinderpest emergency situations. At a period in history when rinderpest is targeted between virus isolates (20), and that some isolates are either so lacking in virulence or so highly virulent as to cause problems with disease recognition in the field. Unfortunately the selection pressures leading to these modulations are not thoroughly understood, but it is clear that in Africa at least, one such pressure leads to the emergence of strains of low virulence. A sub-clinical modulation of lineage 1 virus was observed in the rinderpest virus isolated from Egypt in 1984 (20). In the field, although outbreaks persisted from 1982 to 1984, local staff experienced difficulty in diagnosing rinderpest as the country had apparently been free of the
disease since 1967. Moreover, the cases were only to be found in fattening co-operatives and did not appear to be related to an endemic situation. This aspect was explained only when laboratory tests demonstrated that the virulence of this virus could vary from severe to extremely mild. This observation suggested that in villages in Egypt, the virus caused imperceptible infections in well-adjusted cattle, but that in heavily stressed cattle, such as those which might be found in a feed-lot, the virus was capable of causing fatal infections.

Various authors have attributed the occurrence of rinderpest in Egypt to spread of the virus from the Sudan at the time of the pandemic in the early 1980s. If the highly virulent Nigerian lineage 1 isolate of 1983 was typical of the virus that was circulating in East Africa at the time, the radically different virulence profiles of the Egyptian and East African strains suggest that these two had been separated for a number of years. Furthermore, no spread of rinderpest from the Sudan into Egypt was recorded at this time. This line of reasoning suggests that a long-standing cryptic focus of rinderpest existed in Egypt prior to 1982. This focus might not have been detected had rinderpest not been introduced into groups of stressed (and therefore abnormally susceptible) cattle.

It is immensely gratifying to know that rinderpest is no longer clinically apparent in Egypt and that on this basis rinderpest vaccination has been discontinued since 1997 (the country is now on the OIE Pathway). However, should Egypt still be infected, a potential transboundary emergency situation exists. At present, a possible emergency situation can only be guarded against through serological surveillance. It is therefore vital that evidence is now obtained and evaluated to show whether or not residual pockets of concealed rinderpest infection remain in Egypt. This evidence could be obtained through the serological surveys conducted to examine the accruing population of non-vaccinated, maternal antibody-free cattle. It is essential that the serological evidence which is emerging is painstakingly analysed.

Although detailed epidemiological information is not available, it is known that a virulent form of lineage 1 virus is confined to southern Sudan and is intermittently found in adjacent areas of neighbouring countries. As recently as March 1998 this virus was identified from samples collected in south-eastern Sudan. The continued presence of the virus constitutes an emergency situation because of the risk of spread southwards into Uganda, eastwards into Ethiopia, south-eastwards into Kenya or westwards and northwards into central Sudan and along nomadic and trade routes to West Africa.

An additional complicating factor currently taxing the minds of the authorities in the PARC Co-ordination Unit is the inability of the national Veterinary Services to implement classic eradication procedures to eliminate this endemic focus. Civil insecurity and resource poverty are at the root of the problem: this is an area where traditionally there has been relatively low veterinary coverage and where recent civil strife has complicated a rinderpest eradication process which requires ready access to livestock. This eco-system could well be one of the last bastions of rinderpest in Africa. The first difficulty is in making an accurate assessment of the dimensions of the infected area, with little or no disease surveillance support available. The second is delivery of vaccine through a concerted approach and at a sufficient intensity to ensure elimination of the virus. A number of non-governmental organisations (NGOs) operate in these areas, but they have not yet been able to achieve sufficient coverage to eliminate this focus. The PARC-VAC project of PARC, which focuses on the use of community animal health workers, using the lessons learned from Operation Lifeline Sudan and other community-based programmes (for example in Ethiopia), promises to resolve some of the constraints on conventional control activities. Success will require simultaneous application of sufficient resources across a broad territory in a co-ordinated manner. It is most unlikely that zoosanitary methods can make any significant inroads into the existing situation, but a highly relevant pulsed vaccination strategy has been developed (23) which would probably ensure eradication of this virus if vigorously applied, as it did in Iraq in 1994 and Tanzania in 1997. For this immunosterilisation strategy to be effective, it is essential that the entire bovine population within the infected area is vaccinated twice over in a short period. Obviously the two problems described earlier have to be solved simultaneously; unless these are overcome, lineage 1 could still undermine the significant advances made elsewhere in Africa. Meanwhile the ad hoc protracted use of a thermostable rinderpest vaccine, to reduce the weight of infection and save the lives of cattle, may not only fail to eradicate the virus, but may also exert a selection pressure which will lead to the emergence of milder strains, making the endemic situation harder to eliminate than ever.

**Emergency due to African lineage 2 rinderpest virus**

A severe outbreak of rinderpest occurred in 1994 and 1995 in the kudu and buffalo populations of the Tsavo National Park in southern Kenya. A similar event occurred a year later in neighbouring Nairobi and Amboseli National Parks. Serological and epidemiological evidence also indicates infection in the Meru National Park and in some wildlife populations outside the national parks in the east of Kenya. In the Tsavo outbreak, the virus exhibited a high level of virulence in buffalo and kudu; in the Nairobi outbreak, buffalo and eland were similarly affected. Conversely, in the cattle herds between the parks, overt clinical cases of rinderpest were uncommon. However, cases suggestive of the disease were seen in cattle at the time of the Nairobi Park outbreak and subsequently rinderpest was confirmed in the south, towards the border with Tanzania. These outbreaks were initially attributed to the spread of African rinderpest.
lineage 1 from southern Sudan or eastern Uganda. However, when isolates were examined by nucleotide sequencing they were shown to belong to African lineage 2 (3). This information came as a considerable surprise as no representative of lineage 2 had been unearthed in East Africa since 1962. Furthermore, while it was now recognised that lineage 2 had, at one time, been distributed across the entire continent, the last time it was isolated was in Sokoto (Nigeria) in 1983. Thus, the unexpected reappearance of this virus lineage in Kenya in 1994 could not be explained in terms of spread from another well-known focus, and therefore called for a reappraisal of the history of rinderpest in East Africa.

The two best-characterised lineage 2 viruses isolated in East Africa have completely differing clinical effects (i.e. virulence profiles) in cattle. The Kenyan virus, RGK/1, which was isolated from a sick giraffe near Garissa in northern Kenya in 1962 (10), has a high level of virulence for cattle, causing severe clinical signs and a mortality rate of 60%-70% of experimental cases. In contrast, a group of temporally and spatially related strains isolated from northern Tanzania and southern Kenya in late 1960 and early 1961, had mild effects on village cattle (16). Under controlled laboratory conditions, a number of cattle infected with RBT/1, the only surviving virus from this group, failed to develop mouth lesions and would not be clinically diagnosed as rinderpest-infected, even by experienced observers. It is clear that at least two virulence-linked sub-populations of lineage 2 rinderpest virus existed in East Africa in the early 1960s.

The historical description of rinderpest in northern Tanzania from 1917 to 1964 (4) is one of variations in virulence and of a reducing distribution in the face of veterinary control measures. From as early as 1923, the virulence of the Tanzanian virus was a noteworthy subject (mortality having fallen to 11.4% in outbreaks involving 374,000 cattle). Tabora in particular became associated with a mild form of the disease which was recorded there in 1926 and again in 1944. In contrast, outbreaks attributable to incursions of the virus from Kenya were often of a more virulent nature. In discussing the selection pressure that might favour the emergence of a mild form of the virus, Branagan and Hammond (4) point out that passage in game animals might be involved, as strains with low virulence in cattle had been isolated from wildebeest, eland and buffalo in an area around the Serengeti National Park. Thus, the focus of infection in northern Tanzania from which mild strains were isolated in 1960 and 1961 (16) was probably the product of 60 years of evolution. The contribution of cryptic foci to the persistence of rinderpest was demonstrated by the discovery of an unsuspected rinderpest focus in the Sonjo valley of Loliondo District, northern Tanzania four years after it was thought that Tanzania was free of the disease. Even after its discovery in 1965, the virus managed to remain at large until 1966 (11), after which it was believed to have been finally eliminated. The danger posed by the survival of such a virus lies in the potential outcome of the virus encountering conditions which exert a selection pressure towards greater virulence.

In Kenya it would seem that no such attenuating selection pressure was present and until the last recorded outbreaks in 1967 (1), Kenyan isolates of rinderpest could be graded as fully virulent. During the period between 1967 and 1979, rinderpest was not recorded in either Kenya or Tanzania. However, in 1980 the virus appeared in northern Tanzania under circumstances suggesting entry from Kenya (14), although no outbreaks were recorded in Kenya at that time. Unfortunately the virus involved was never isolated and the lineage is unknown. Apparently highly virulent for both cattle and game animal species, the virus ultimately spread throughout the cattle of the Masai ecosystem of northern Tanzania and affected the buffalo populations of the Tarangire and Serengeti National Parks and the Ngorongoro Conservation Area. The outbreak lasted from 1980 to 1982 but there is little evidence that the virulence of the virus changed during its course.

Thereafter, there were no recorded outbreaks of rinderpest in either Kenya or Tanzania until the Tsavo outbreak of 1994. Once confirmation was received that this virus belonged to lineage 2, the problem was not so much in dealing with the outbreak, which was in a wildlife population and ultimately self-limiting, as in understanding the implied persistence of cryptic rinderpest during the period since 1966. This somewhat surprising fact can be absorbed more easily if it is assumed that the mild form of rinderpest that persisted in Loliondo District up to 1966 was in fact more widely dispersed than had been suspected. Notably, a similar form of the virus had been detected in southern Kenya in 1961 (16). Thus, by maintaining this low profile, either in remote areas of Kenya, southern Somalia, or even Tanzania, the virus could readily pass undetected for long periods of time. Indeed, the present insight into persistent rinderpest would not have been gained without that infection of buffalo, kudu and eland with a virus that was obviously of low virulence for cattle.

 Appropriately, the virulence of the current representative of lineage 2 for cattle is not dissimilar to that of the R.Buff.T. (one of the mild Tanzanian strains from 1961) (16) which was virulent in buffalo but mild in cattle. This lack of cattle pathogenicity would account for the apparent ability of the virus to move unnoticed between the Tsavo and Nairobi National Parks, presumably by transmission among cattle. These facts also help in understanding the lack of evidence concerning the origins of the Tsavo outbreak. Additionally, it has been shown that a small number of cattle are more severely affected by this virus than others (J. Anderson and C. Dunn, personal communication). Thus, of four cattle experimentally infected with the Kenya/Eland/96 strain, three developed mild infections and recovered while one died of severe rinderpest. Clinical observations during the related outbreak in the field in northern Tanzania in early 1997
Identified within the Asian lineage to date may represent a virus. The fact that no mild strains of rinderpest have been virulence modulation is not restricted to African lineage 2 undergoing vaccination. However, as already discussed, be met before a national authority can be satisfied that which can be suggested deserve mention.

The lessons to be learnt from this emergency and the solutions appropriate selection pressure this seemingly mild virus population could begin to recover its lethal potential.

Unfortunately, the true nature of the mild strains of rinderpest was not appreciated before they apparently disappeared in the mid-1960s. With the benefit of hindsight, it is clear that the possibility of the existence of a wider distribution than was apparent should have been considered. Although the endemic area of this elusive virus must have varied from time to time, it should have been relatively simple to set up surveillance systems that would have disclosed its presence. The detection of atypical mild rinderpest in northern Kenya in 1996, linked epidemiologically to reports of similar disease in southern Somalia (J.C. Mariner, personal communication), gives some clue as to the most recent location of the virus. In addition, it is relevant to note that Gulf Co-operation Council States were notified in April 1998, through their animal health information systems, that rinderpest had been suspected in a consignment of cattle on board a ship in the Gulf; these cattle were reported to have been loaded in southern Somalia.

If investigations are to determine the current whereabouts of this extremely dangerous virus, PARC must continue to pursue the rinderpest virus vigorously, throughout an endemic area that stretches across southern Somalia, southern and eastern Kenya and northern Tanzania. Equally frightening, in view of this new-found knowledge of phylogenetic lineages, is the fact that, so far, no evidence exists to show that a virus with the capacity to disappear from sight, and which at one time was present across Africa, is not still at large in West Africa.

The lessons to be learnt from this emergency and the solutions which can be suggested deserve mention.

- A new level of understanding has been gained regarding the ability of rinderpest virus to modulate its virulence and escape detection for far longer than was imagined possible. This lesson clearly justifies the full range of internationally agreed surveillance criteria, including sero-surveillance, that have to be met before a national authority can be satisfied that rinderpest no longer exists (15). Had these criteria been applied within East Africa at an earlier stage, the presence of a cryptic focus would have been obvious, even though some segments of the bovine population might still have been undergoing vaccination. However, as already discussed, virulence modulation is not restricted to African lineage 2 virus. The fact that no mild strains of rinderpest have been identified within the Asian lineage to date may represent a fundamental difference between Asian and African strains, an absence of the appropriate selection pressure or the poor quality of virus isolation work (there is some evidence from northern Iraq, Pakistan and Afghanistan of mild rinderpest – P.L. Roeder and G.A. Kiani, personal communications). In India, rinderpest vaccination is no longer practised, which means that demonstrating the presence or absence of cryptic field strains becomes extremely simple. The obvious solution is to develop a strong sero-surveillance system capable of investigating all parts of the country. This surveillance should seek evidence of persistent rinderpest in yearling animals unprotected by either vaccine or maternal immunity.

- Notwithstanding recognition of the existence of a long-standing cryptic situation in East Africa, a clear understanding of the full endemic area regarding the host species involved and the countries involved is not possible. These considerations emphasise the immediate need for a strong, comprehensively integrated sero-surveillance system throughout East Africa. It is also important to realise that sero-surveillance can only be meaningfully pursued in unvaccinated populations, that it has to be undertaken on an on-going basis for several years and that it must simultaneously involve an examination of cattle sera from Somalia, Kenya and Tanzania.

- Only when the extent of the East African infected area is comprehensively understood will it be possible to destroy the virus with vaccine. The authors believe that immunosterilisation is a strategy that will achieve this objective rapidly and efficiently but only if the entire infected area is dealt with at one and the same time. This clearly calls for a high degree of international co-operation, together with joint decision-making and joint financing.

- It is also clear that the elimination of the East African endemic focus must be clearly demonstrated following the criteria laid down in the OIE standards for rinderpest surveillance. There must, therefore, be a pre-determined agreement to move directly from immunosterilisation to a preparatory period leading up to a declaration of provisional freedom from rinderpest. Performance indicators for rinderpest surveillance, under preparation for GREP should enable countries to assess and demonstrate the effectiveness of their systems.

- Although the solution to these problems lies in the hands of the respective national authorities, both GREP and the regional co-ordination programme of OAU/ICAR have major roles to play in supporting their efforts with advice on scientifically sound solutions to the problems encountered.

- There is an urgent need for serological evidence to demonstrate the absence of cryptic rinderpest in West Africa.

Emergency due to the Asian rinderpest virus lineage

In 1984, rinderpest virus was isolated from samples collected in the Landhi Dairy Colony, Karachi, Pakistan (5) but for the next decade Pakistan did not implement a rinderpest eradication programme. For some time, rinderpest had come
to be regarded as an exotic virus even though neighbouring, endemically infected countries, were embarking on eradication programmes. The urgent need for progress was highlighted by an FAO mission which visited the Landhi Colony in 1994. Samples collected here were submitted to the FAO World Rinderpest Reference Laboratory and were again demonstrated to contain rinderpest virus. In the same year, India, which had already commenced its European Union (EU)-assisted National Project on Rinderpest Eradication (NPRE), declared the entire north-eastern and central northern India provisionally free from rinderpest. The parameters of this emergency situation were thus becoming clear; of two large neighbouring countries, each of which had previously harboured rinderpest, one was making rapid progress towards eliminating the disease while the other lacked the requisite resources and was apparently powerless to commence.

In 1994, rinderpest virus spread from the centre of Pakistan to the north, causing a virgin population outbreak. The resulting epidemic was one of the worst attributed to rinderpest virus in many years (17), before control was achieved through national efforts supported by FAO and EU assistance. Throughout this distressing episode there were no technical communications between the veterinary authorities of neighbouring countries. Subsequently rinderpest invaded Afghanistan.

From 1994 to 1998 India has maintained a vaccine buffer zone involving all bovines in all districts along the border with Pakistan. During the same period, to ensure meaningful clinical disease surveillance, no rinderpest vaccine has been used in the 200 million bovines in central northern India found to the east of this buffer. The decision to develop this unvaccinated population embodied several lines of reasoning, including the realisation that earlier mass vaccination had eventually achieved its objective and was therefore an obsolete exercise. Another important factor was the conviction that surveillance is safer than vaccination as a means of ensuring that the disease does not re-enter the population. Last but not least, this policy was adopted in an attempt to meet OIE epidemiological standards and to be free of trade restrictions associated with a former rinderpest-endemic status. It should be noted that since 1 March 1998 the entire Indian territory has been declared provisionally free from rinderpest (19).

Meanwhile, the continuing endemic rinderpest situation in Pakistan can be seen as a threat, not only within the country and to neighbouring countries but also to a number of more remote west and central Asian countries. Molecular epidemiology reinforces this suspicion, as all rinderpest strains isolated from countries outside Africa belong to the Asian lineage. The livestock movements that have probably transmitted rinderpest are unknown but are undoubtedly illegal. In the short-term there seems little reason to expect any significant improvement in the animal health conditions under which these movements of animals take place. Therefore, the swift initiation of a programme for the eradication of rinderpest from Pakistan and Afghanistan is seen as the key issue in dealing with the Asian lineage rinderpest emergency. In addition, to provide a basis for meaningful risk assessment analyses between neighbours, a co-ordination mechanism must be developed to secure constant professional-level dialogue between the authorities of Pakistan and other interested parties.

Within Pakistan, it is clear that rinderpest can be rapidly eradicated by standard techniques provided that the recent lessons from other countries are heeded. It would appear that the primary problem is to define and implement a strategy before the situation deteriorates. The recommended strategy would in fact be very similar to that now recommended for East Africa. Although there must be a strong temptation to embark on nation-wide mass vaccination, this might well prove to be the wrong response and it should not be contemplated without establishing a strong prior necessity. Moreover, generalised vaccination could easily obscure some of the evidence needed to establish the extent of the infected area and in this respect would be more harmful than beneficial. Pakistan should commence a national rinderpest eradication programme by determining the epidemiological situation and identifying the location of foci of endemic infection, establishing the mechanisms of virus spread from village to village and examining whether or not all strains are clinically apparent. Had this been done earlier in India, progress in eradication would almost certainly have been achieved more rapidly. The process of 'chalking-out' the infected area requires a combination of nation-wide passive surveillance and a good reporting system backed by both active clinical surveillance through village searching (using participatory rural appraisal techniques) and active sero-surveillance (only possible in unvaccinated populations). These surveillance projects must be backed by a fully functional provincial diagnostic service supported in turn by a national reference service. In considering the need for these inputs, the initial priority area must be training rather than vaccination. Of course a policy management group should also be created to assess the available information and develop an appropriate action plan in liaison with GREP.

Only when the full extent of the infected area and the virus maintenance species are known should vaccination be contemplated. Here, however, it is recommended that a targeted and pulsed immunosterilisation strategy be planned and that available resources be focused on implementing short, highly penetrative, double vaccination campaigns immediately followed by seromonitoring and a rapid resumption of surveillance activities. Fund allocations should give greater priority to the short- and long-term needs for surveillance and training rather than increasing vaccine manufacturing capacity.
By maintaining unvaccinated sentinel villages within the infected area, both disease and serological surveillance could recommence as soon as the immunosterilisation programme has been completed. Should one round of immunosterilisation fail to completely eradicate the disease, a further round could be implemented as soon as a new infected area is defined. The effectiveness of short, sharp, epidemiologically relevant vaccination programmes are likely to see a speedier eradication of rinderpest from Pakistan rather than slow mass vaccination campaigns. At the same time, Veterinary Services will be strengthened more by training in epidemiology and surveillance techniques than in vaccination routines.

Strategies to prevent the spread of infection

Pan-African Rinderpest Campaign strategies

For most of the 1970s the presence of rinderpest in Africa was limited to three endemic foci, one in West Africa (Mali/Mauritania) and two in East Africa (southern Sudan and Ethiopia/Somalia), yet by the end of the decade, the disease had swept back across the sub-Saharan belt. To combat the destructive forces unleashed by the African pandemic of the early 1980s, the OAU/IBAR was asked to co-ordinate the PARC, the second attempt at rinderpest eradication in Africa. From the outset, PARC had two objectives:

- to strengthen those Veterinary Services that had been unable to prevent the spread of rinderpest in the 1980s and
- to eradicate the disease.

In the early years of the PARC, considerable emphasis was placed on implementing classic vaccination campaigns in a number of infected countries. At that time PARC perceived that rinderpest had established a single endemic area stretching across the entire continent. As the regional co-ordinating body, PARC advised that rinderpest might be eradicated more easily if spread could be reduced. Thereafter, PARC attempted to devise strategies to achieve that objective by sub-dividing the endemic area.

The method advocated for this separation process was the development of vaccine buffer zones containing populations of animals which were highly immunised against rinderpest. In West Africa it was thought that a number of the coastal states could free themselves of rinderpest more readily than their Sahelian neighbours, but that re-infection would be likely to occur almost immediately. Accordingly, a buffer zone was proposed, dividing the continent in two, along latitudes 12°-13° N between Chad and Senegal. This buffer zone was known as the 'West African Wall' and was to run along the northern border of Nigeria, through Burkina Faso and the south of Mali and end along the border between Senegal and Mauritania (21). With the express intention of preventing any repetition of the 1980 spread of rinderpest from western Sudan to Nigeria, an extremely large buffer zone was proposed in Central Africa, called the 'Central African Block'.

In East Africa where the situation appeared more uncertain, the 'East African Cordon' was proposed along the Tanzanian border with Kenya. The function of the cordon was to act as a safety net against the spread of rinderpest virus to southern Africa. It was hoped that this cordon could be extended northwards with time and, subject to the eradication of rinderpest from Ethiopia (rinderpest not being recognised in Kenya at the time), to hem the virus into southern Sudan. The disease would then be confined to this area until a Veterinary Service or NGO was able to complete the task.

While there has been no analysis of the economic pressures that drew rinderpest-infected cattle into Nigeria from 1980 to 1982, they apparently disappeared as quickly as they arose. In retrospect therefore, the 'West African Wall', which was never actually developed, was not vital to the elimination of rinderpest from West Africa. This aim was achieved in Ghana as early as 1988 through mass vaccination campaigns. Current PARC strategies for the protection of countries in West Africa are therefore more realistic, being based on the strengthening of emergency preparedness in these countries (as well as in any other countries involved). This being equally important as the other strategies employed, namely:

- the containment of rinderpest within East Africa,
- the definition and elimination of the foci of persistence, and
- compliance with the OIE Pathway.

However, the 'Central African Block' is still considered a valid concept although it has not proved possible to establish in practice. Attempts to ensure its construction are on-going but it is now clear that as currently constituted it cannot be relied on as a barrier to the westward movement of rinderpest. Until recently the concept of the 'East African Cordon' also appeared sound, even to the point that rinderpest appeared to invade Tanzania from Kenya as soon as maintenance ended in 1996. However, as discussed above, in reality it was probably totally porous and only appeared to function because lineage 2 challenges were difficult to observe.

The experience of India

Since 1990, Indian project co-ordinators have been trying to manage four different rinderpest zones in accordance with the OIE Pathway, in order to be the first previously rinderpest-infected country to gain recognised rinderpest-free status. Thirty-five years of unmonitored mass vaccination were necessary to control the endemic rinderpest situation in central northern India. In 1990, in collaboration with the EU, the Government of India launched the NPRE. One of the first successes of NPRE was to understand that the intermittent rinderpest outbreaks recorded in the late 1980s were due to the introduction of infected animals from southern India into urban dairies in the north, and were not evidence of a deeply
rooted endemic area. The rinderpest situation within India varied from endemic in the south to sporadic in the central northern region, and to rinderpest-free in the north-east and offshore islands. The division of the country into rinderpest eradication zones was considered a useful first step, and this was performed with the help of vaccine buffer zones.

By 1992, provisional freedom from rinderpest was declared in the central northern region of India (zone B). However, a condition of this declaration was that the 14 individual state Veterinary Services within this zone must cease rinderpest vaccination. The programme managers analysed the risk of the re-emergence of outbreaks of rinderpest from within the zone as low, but of outbreaks being introduced from southern India as moderately high. They therefore wanted to retain a substantial buffer zone between the infected south of India (zone C) and the uninfected north-east of India (zone A). In contrast, the individual state Veterinary Services in zone B felt that rinderpest might still be present within the zone and were reluctant to relinquish their reliance on high immunity levels among herds as a means to prevent the emergence of epidemics.

In these circumstances, the concept of buffer vaccination zones was used in two stages to support a cautious reduction in the protective effects of vaccination. In the first phase, from 1992 to 1994, each zone B state was requested to maintain a rinderpest buffer zone with a 25-km radius around its borders but to end vaccination of the remaining bovine population in the state. Thus, for 24 months, each of the 14 central northern states became a ‘rinderpest-secure’ cell protected by a buffer zone as low, but of outbreaks being introduced from southern India as moderately high. They therefore wanted to retain a substantial buffer zone between the infected south of India (zone C) and the uninfected north-east of India (zone A). In contrast, the individual state Veterinary Services in zone B felt that rinderpest might still be present within the zone and were reluctant to relinquish their reliance on high immunity levels among herds as a means to prevent the emergence of epidemics.

In 1994 a second stage was implemented. The inter-state buffer zones were abolished to give zone B a homogeneous bovine population of around 200 million animals, a growing proportion of which were rinderpest-susceptible. Meanwhile the project managers down-rated the risk of the spread of rinderpest from zone C to the point where a single inter-zonal buffer was considered sufficiently protective. Thus, a new buffer zone was created along the border between zone B and zone C. In 1998, after a two-year absence of rinderpest from zone C, this buffer was also discontinued. However, in zone B a vaccine buffer zone is still retained along the Indo-Pakistan border.

**Can buffer zones prevent the movement of rinderpest virus?**

The OIE *International Animal Health Code* permits the use of buffer zones as a means of preventing disease emergencies which could be caused by the spread of infection from one country to another, or from one part of an infected country to another. Therefore, a buffer zone should only be used when it is necessary to physically prevent infection being transferred from an infected population to an uninfected one. This takes into account the likelihood of stock movements between the two populations; in the case of rinderpest, if these movements did not take place, the buffer would not be required.

It is important to distinguish between a vaccination/surveillance buffer zone used to retain territory infected by rinderpest during an epidemic incursion, as a temporary expedient, and a passive, standing, vaccination buffer zone employed to contain the disease within an endemic focus on a semi-permanent basis. The former implies an area in which active disease surveillance and immunosterilisation proceed along a moving front. For the latter, the minimum requirement for a rinderpest buffer zone is that, were a rinderpest-infected animal to enter the zone from the infected side, that animal would no longer be excreting the virus when it crossed over into the uninfected side. This is a daunting requirement. Assuming that an animal had become infected with rinderpest the day before entering the zone, that the incubation period is ten days, that the prodromal period is ten days, that the prodromal period is four days and that the illness lasts seven days, the zone must be either so wide that it cannot be crossed by a walking bovine in less than three weeks or there must be facilities to detain incoming animals in a smaller zone for the same length of time. If there are resident livestock within the buffer zone they will obviously be at risk of developing infection by contact with the in-coming infected animals and therefore of increasing the risk that infected animals might leave the zone while still excreting the virus. Therefore, while animals within the buffer zone are customarily vaccinated, it is important to realise that doing so confers a secondary and not a primary form of security. The fact that a buffer zone of vaccinated residents has been created may or may not offer better overall security to livestock on the uninfected side. This security depends more on how animals in transit are recognised and handled than on the immune status of the buffer zone residents. Considering that cattle rarely travel alone and that transmission within a moving group (or herd) would significantly extend the infectious period, the challenge facing those attempting to control the movement of rinderpest by establishing a buffer zone of adequate dimensions is immense.

To be effective, a walk-through buffer zone has to be several hundred kilometres wide. The Central African Block is probably the only valid attempt to create a rinderpest buffer zone of this type and even in those circumstances there are serious problems in maintaining a sufficient level of immunity in the resident herds. As most other rinderpest buffer zones are considerably smaller, improved disease security depends not so much on the vaccination of the resident animals as on the ability to enforce a residency period of at least 3 weeks for livestock in transit. Effectively then, the buffer zone is transformed into a quarantine zone where incoming animals are detained while their health status is determined. Such a buffer zone requires strong administrative powers and
be kept under constant veterinary surveillance for a period of at least three weeks, possibly including serosurveillance if the in-coming animals have not been vaccinated.

The practical implications of boundary surveillance inside either a closed or open border are that strong, mobile and highly motivated veterinary surveillance forces will be needed and that these forces must be backed by strong legislative support giving the surveillance teams powers to detain and, if necessary destroy, any animal suspected of carrying rinderpest.

Surveillance zone examples

The two most important examples of situations where surveillance zones will be more appropriate than buffer zones are along the borders between:

a) India and Pakistan
b) Kenya and Tanzania.

The danger of rinderpest infecting India from Pakistan has already been discussed and it is imperative that India now maintains a disease-free status. The border between the two countries is largely fenced so a physical barrier already exists; in addition, there is a ban on the movement of livestock from Pakistan into India. The third component of the present border defence is the existence of a vaccine buffer zone in the border districts of the states of Rajasthan and Punjab and the state of Jammu and Kashmir. The actual protective value of this buffer zone is probably very small as its extent is too narrow and there is no certainty that resident bovines are highly immunised. There is little doubt that the security of India would be greatly enhanced if this vaccine buffer zone was discontinued and replaced by a zone of intensive clinical surveillance. This could be implemented by mobilising veterinary investigation patrols instructed to maintain close contact with border villages. They should look for stray animals or storm damage to the boundary fencing, and investigate any suspicious disease outbreak in any of the border villages. In addition, possible illegal animal movements reported by villagers should be investigated by teams equipped with test kits to confirm or refute the presence of rinderpest virus in any suspicious animals, as well as kits for the submission of samples to the National Morbillivirus Reference Laboratory at Mukteswar.

The border between Kenya and Tanzania is open to cross-border livestock and wildlife movement. Until 1995, efforts continued to maintain a rinderpest vaccine buffer zone in Tanzanian districts along the international border. Rinderpest was reported in Kenya in 1994, 1995 and 1996 and in Tanzania in 1997 but it is not clear in which of those years, if any, rinderpest entered Tanzania from Kenya. There is, however, serological evidence to suggest that this could have happened in 1996, or even in 1995, in which case it is clear that the buffer zone did not present an effective barrier against entry of the virus. Where open international borders exist, it is important to develop mechanisms of sharing disease

Prevention of the spread of rinderpest

Thus, the problem of how a rinderpest-free country protects itself from infection from a rinderpest-infected neighbour remains. If indiscriminate livestock movement from the infected country is permitted, the buffer zone is unlikely to function as a protective barrier. Indeed, reliance on a vaccination buffer zone may generate a false sense of security. Therefore, if at all possible, the entry of live animals from the infected area should be prohibited. In addition, a physical barrier should be erected to prevent the unauthorised movement of animals from the infected area. However, physical barriers can be readily broken or destroyed and consequently the entry of potentially infected livestock could occur. In these circumstances, recognising and detaining stray animals is an important disease security consideration. It is therefore vital to maintain a surveillance system within a surveillance zone adjacent to the physical barrier. Within this surveillance zone the resident village populations should be accurately recorded and monitored. Accordingly, rinderpest vaccine buffer zones should be replaced by systems based on physical security, supported by effective emergency preparedness. The protective elements of such a system should be:

- a ban on the entry of livestock
- the creation of a strong boundary fence
- the creation of a surveillance zone alongside the fence
- emergency preparedness planning.

If limited trade between an infected and uninfected neighbour is still desirable, despite the risk of infection, rigid security regulations should be observed. At a practical level this would mean the retention of imported animals within a veterinary quarantine station for at least three weeks, with health inspections on entry and at daily intervals thereafter. Legislation would be needed to permit the quarantine authorities to slaughter any livestock found to be diseased during the quarantine period.

In countries where it is impractical to seal the borders against the entry of livestock from an infected neighbour due to the occurrence of similar livestock-keeping communities on both sides of the border, surveillance is preferable to vaccination as a means of keeping infection out of the country. In addition, veterinary authorities need to have a complete understanding of the local pressures that will promote unusually large cross-border livestock movement (e.g. movement to escape drought or conflict, market price differentials) and be able to activate additional contingency surveillance plans at such times. If there is no way of preventing substantial numbers of livestock from crossing the border, in-coming animals should be kept under constant veterinary surveillance for a period of considerable resources for proper implementation. However, neither a large nor a small buffer zone is secure if a determined trader loads an infected animal onto a vehicle and sells it on the clean side of the zone a few hours later.
information between the Veterinary Services of both countries. In the present example this need is well understood and well catered for. Following a disease warning from a neighbouring country, clinical surveillance should be undertaken in border villages and in-coming herds should be closely monitored for several weeks. There should be no vaccination of animals of local residents and, to guard against the silent entry of mild strains, there should be serosurveillance, at least annually, of the border population. The FAO and the United Nations Development Programme (UNDP) have supported the establishment of an active surveillance system of motorcycle patrols in border villages in Tanzania. Serosurveillance in many of these villages has been complicated by emergency rinderpest vaccination undertaken in mid-1997, but should be resumed as soon as possible.

Dealing with an active rinderpest emergency situation

Any country which can predict a possible rinderpest invasion should make two major provisions to prevent its entry or re-entry or to limit and curtail the ensuing infection if re-entry occurs. Firstly the Director of Veterinary Services/Animal Husbandry Commissioner (DVS/AHC) should appoint a standing National Animal Diseases Emergency Committee (NADEC) and secondly, this Committee should commission and implement a National Rinderpest Emergency Plan. The Committee should meet to oversee development and implementation of the plan. Meetings should also be called whenever rinderpest is unusually active in an infected neighbouring country, or has been suspected or detected within the country.

The DVS/AHC is responsible for issuing warnings to the NADEC of unusual rinderpest activity in neighbouring countries. Various channels are available to the DVS/AHC for accessing this information; these include emergency alerts submitted to, and distributed by, the OIE, informed assessments of incipient transboundary events available from the FAO Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) and finally, telephone 'hot-lines', telefax or e-mail contacts which should exist between heads of neighbouring Veterinary Services or regional co-ordination units. It should be noted that in India at the time of the epidemic in northern Pakistan between 1994 and 1995, information on disease occurrence was derived from FAO reportage rather than through any form of direct communication. Furthermore, the absence of a national contingency response in India was another cause for concern.

The National Rinderpest Emergency Plan must include an analysis of resources needed (a resource plan) and a detailed description of how a threatening or actual outbreak will be dealt with (an action plan). In outlining the issues that need to be addressed, it must be assumed that responsibility for eliminating all national animal disease emergencies is vested in the DVS/AHC. The time to organise the required response is before the emergency occurs; at the time of invasion any delay will seriously compromise the effectiveness of the response. The principal issues include the following:

- the line of command to be implemented during the emergency
- the number and identity of staff to be mobilised in relation to the scale of the emergency situation
- the services from which the staff dealing with the outbreak will be drawn
- the identity of expert teams to guide disease investigation and control from an early stage
- any administrative measures needed to support changes in the normal line of command (cancellation of leave, assumption of command, etc.)
- any legal powers to be granted to the DVS/AHC for the duration of the emergency (orders banning movement of animals, closure of markets, detention of animals on the premises of the owners, destruction of infected animals, etc.)
- access to funds with which to combat the emergency
- access to surveillance and control vehicles
- access to emergency vaccine banks
- access to cold chain and vaccination equipment
- access to means of communication
- access to analysed national disease outbreak databases for predictive purposes
- access to laboratory facilities close to the site of the emergency
- access to a competent national reference laboratory recognised by the OIE or FAO
- access to police/military assistance to help enforce restrictions on the movement of animals.

In an emergency situation, it is important that the DVS/AHC can call upon fully-trained manpower. Training is not listed as one of the contingency plan issues, but should be one of the duties of the NADEC to ensure that the training needs of emergency situations are outlined, delivered and evaluated by practice during simulated emergencies.

The plans of action in an emergency situation may vary in the field according to the level which the affected country has reached on the OIE Pathway. A country or zone may only use vaccination to control an outbreak until the point at which it is accepted as being rinderpest disease-free. If the outbreak occurs after this stage, when the country is in the process of seeking infection-free status, vaccination is not allowed (or if used, only at the risk of compromising its status). The first actions should be to define a provisional infected area and halt all livestock movements within and out of the area (including
those of small ruminants). Thereafter, detailed clinical and laboratory appraisals should be undertaken to reach a detailed understanding of the actual infected area. The decision or not to vaccinate must be taken by the DVS/AHC in consultation with the NADEC; it must not be taken at a local level.

Appropriate measures should be taken to reduce the risk of further spread of infection from affected cases. If rinderpest vaccine is to be used, it is essential that the immune response in the population is uniformly high or a situation favouring virus persistence may be created. Two successive rounds of vaccination are recommended. If vaccination is inappropriate, the only way in which the spread of infection can be limited is by preventing contact between susceptible animals and animals which are already excreting the virus. This requires either slaughter or sequestration. Whichever the chosen method, it must be applied consistently until the outbreak ends and rigorously policed.

Rapid and unequivocal diagnosis is extremely important in an emergency situation. Every effort should be made to bring diagnostic facilities as close as possible to the seat of the outbreak (e.g. the use of mobile laboratories), and to establish collaboration with the FAO World Reference Laboratory.

One of the most difficult problems encountered by emergency outbreak teams is to obtain a rapid and coherent report on the situation from the front-line staff who have been taking immediate responsibility for handling the emergency response. Difficulties also arise in ascertaining who among the team of local experts may have the information needed. Therefore, one of the first actions at field level should be to create a common pool of information and to use this as part of an agreed action plan. This pool must include:

- the location of the disease
- the site of the first recorded case of the disease
- the areas to which the disease might have spread but which have not yet reported an outbreak
- markets and trading routes
- whether the index case has been recognised and if so, the origin of that case
- the possible size of the infected area
- local authority orders concerning livestock movement controls
- the number and disposition of rinderpest-susceptible livestock in the vicinity of the outbreaks
- the extent and disposition of diagnostic laboratory tools and the level of staff understanding regarding the clinical appearance of the disease
- an inventory of available vaccines and storage location
- the availability of cold chain support for distributing vaccine and the availability of vaccination materials (syringes, needles, boilers, etc.)
- detailed information on the available manpower and vehicles
- an understanding of any budgetary constraints limiting the design of the emergency response.

An early response is the key to a successful outcome.

Concluding remarks

Experience clearly indicates that to maximise its chance of success, an eradication strategy needs to be based on a sound epidemiological understanding. This is particularly important with strains of rinderpest virus which exert little or no pathological effect on livestock - the effects of these strains are certainly nothing akin to cattle plague. Over the past four years, 'mild' rinderpest associated with the African lineage 2 phenotype has attracted considerable attention, and quite rightly so. However, reduced virulence is not a characteristic unique to this phenotype. Recent observations in Afghanistan, Pakistan and Iraq suggest similar occurrences in the Asian lineage; the appearance of rinderpest during the period 1991-1992 in the Tuva Republic of Russia (18), many thousands of kilometres from the nearest known active focus of the disease, remains an enigma. Thus, cryptic foci clearly contribute to the persistence of rinderpest and other countries which are still at risk from rinderpest would be well advised to learn from the East African experience. Surveillance guidelines have been provided and performance indicators are becoming available to monitor their effectiveness. Wide-spread adoption of these guidelines is urgently required.

Eradication of rinderpest from a country is only an initial step; maintaining freedom from the disease until all risk of re-entry of the virus has been eliminated, is the next problem. It cannot be over-emphasised that effective surveillance, as a component of emergency preparedness planning, is safer than vaccination as a means of ensuring that the disease does not re-enter the population or, if it does, that it does not gain hold. Achieving a status of effective emergency preparedness through contingency planning is a relatively new concept in the field of animal health and it requires specialist skills. The development of these skills should be made a priority.

International borders to rinderpest do not provide a barrier; this, above all else, emphasises the need for enlightened regional and global co-ordination.
Peste bovine : étude de la gestion d’une urgence zoosanitaire

Résumé
Les auteurs retracent brièvement l’histoire de la peste bovine et de sa prophylaxie en Afrique et en Asie. Ils présentent la répartition actuelle du virus de la peste bovine et de ses différentes lignées phylogéniques. Les pays indemnes de peste bovine, voisins de pays infectés, sont considérés comme menacés en permanence par l’introduction transfrontalière de cette maladie ; ils sont donc continuellement confrontés à des urgences majeures. Les auteurs décrivent la nature de ces urgences par rapport aux foyers persistants de maladie due à ces trois lignées de virus. Les auteurs considèrent que les stratégies de lutte mises en œuvre dans le cadre du Programme mondial d’éradication de la peste bovine (Global Rinderpest Eradication Programme : GREP) devraient désormais privilégier les études épidémiologiques afin de définir les foyers d’infection, et diriger des campagnes de vaccination ciblées et ponctuelles au lieu d’encourager l’immunisation systématique de toute une population. L’urgence suscitée par la réapparition du virus africain de la lignée 2 en Afrique de l’Est et le problème posé par la forme bénigne de la peste bovine sont analysés en détail ; les auteurs estiment que le phénomène pourrait être plus répandu qu’on ne l’avait supposé. Ils montrent quels sont les points sur lesquels l’avenir du GREP pourrait être menacé et suggèrent quelques solutions pour écarter ces menaces. Ils évoquent également les leçons qu’il y aurait à tirer du Projet national indien pour l’éradication de la peste bovine et de la Campagne panafropoligne contre la peste bovine, par exemple l’intérêt de renforcer les systèmes de surveillance selon la méthode préconisée par l’Office international des épizooties. Ils discutent, enfin, des réponses possibles au problème posé par les foyers persistants mais cachés de peste bovine, qui est sans doute le plus grand défi posé au GREP. Les auteurs examinent, par ailleurs, l’utilité des zones tampons de vaccination et concluent qu’à moins d’être très étendues et rigoureusement maintenues, ces zones ne sauraient empêcher la dissémination du virus. Les auteurs analysent également le rôle des plans de préparation aux urgences face à la dissémination de la peste bovine et considèrent qu’une surveillance efficace, s’inscrivant dans le cadre d’une planification de la préparation aux urgences, est un moyen plus sûr que la vaccination pour empêcher la réintroduction de la maladie ou sa pénétration au sein d’une population. Le démarrage rapide d’un programme d’éradication de la peste bovine au Pakistan est considéré comme un facteur essentiel pour traiter l’urgence liée à l’existence d’un virus bovipestique de lignée asiatique. Le développement et la mise en œuvre de stratégies mettant à profit l’expérience acquise en Afrique et en Inde devraient permettre de remédier sans tarder à cette situation d’urgence.

Mots-clés
Peste bovina: un estudio de caso de gestión de emergencias zoosanitarias


Resumen

Los autores repasan brevemente la historia de la peste bovina y de la lucha contra esa enfermedad en África y Asia. Describen también la distribución actual de los tres linajes filogenéticos del virus de la peste bovina. Se considera que los países libres de la enfermedad que tienen frontera con países infectados se encuentran bajo la amenaza permanente de una penetración transfronteriza, lo que conlleva graves y continuas situaciones de emergencia. Los autores describen la naturaleza de tales emergencias en relación con los focos residuales de los tres linajes.

Los autores postulan que las estrategias de erradicación del Programa mundial de erradicación de la peste bovina (Global Rinderpest Eradication Programme: GREP) deberían privilegiar ahora el uso de estudios epidemiológicos que permitan definir focos de infección y orientar campañas de vacunación puntuales y específicas en lugar de vacunaciones generales y sistemáticas.

Los autores exploran con cierto detalle el peligro que supone la reaparición en África oriental del linaje africano 2 del virus, así como los problemas causados por la forma benigna de la enfermedad, un fenómeno quizá más extendido de lo que hasta ahora se pensaba. Evocan también diversos aspectos del GREP cuyo futuro se encuentra amenazado, y sugieren medios para descartar algunos de los peligros. Después examinan las enseñanzas que pueden extraerse del Proyecto nacional de la India para la erradicación de la peste bovina y de la Campaña panáfricana contra la peste bovina, entre ellas la importancia de reforzar los sistemas de vigilancia siguiendo el procedimiento recomendado por la Oficina Internacional de Epizootias, y la forma de abordar el problema de los focos ocultos de persistencia de peste bovina, quizás el reto de mayor envergadura al que se enfrenta ahora mismo el GREP.

Tras examinar en detalle la utilidad de las zonas tampón de vacunación, los autores concluyen que, a menos de dotarlas de una extensión considerable y de asegurar su correcto mantenimiento, es poco probable que tales zonas puedan impedir la propagación del virus.

Por último, los autores reflexionan sobre cómo la planificación de la preparación para emergencias puede ayudar a prevenir la propagación de la peste bovina, bien entendido que una vigilancia eficaz, como parte integrante de la planificación, es siempre un medio más seguro que la vacunación para garantizar que la enfermedad no penetre o se reintroduzca en una población. Los autores entienden que la clave para enfrentarse a los problemas sanitarios que plantea el linaje asiático del virus de la peste bovina reside en iniciar sin demora un programa para erradicar la peste bovina de Pakistán. La creación y aplicación de estrategias adecuadas, enriquecidas por la experiencia obtenida en África y la India, podrían dar rápida solución al problema.

Palabras clave

References


