- An international accreditation mechanism operated by the Office International des Epizooties.
- Guidelines for surveillance combined with performance indicators—the World Health Organization's pioneering work was taken as a model.[11 12]
- Molecular characterisation of viruses had a seminal effect on both epidemiological understanding and the conduct of eradication programmes. Designation of a world reference laboratory, hosted by the UK Institute for Animal Health, was invaluable.

Conclusions

Much has been learnt since the start of GREP that merits consideration when mounting control or eradication efforts for human or animal diseases. Whether other diseases will follow for eradication or be singled out for progressive control in geographically defined areas, as are foot and mouth disease and classical swine fever in Latin America, depends largely on the outcome of the global rinderpest eradication programme and the attitude of the international community towards funding such endeavours. There is no shortage of candidates, and new ones constantly arise. Medical and veterinary epidemic disease control is becoming a single continuum. The recent zoonotic Rift Valley fever, severe acute respiratory syndrome (SARS), Hendra virus or Nipah virus, and avian influenza indicate that we need to move on from separate human and veterinary scenarios.

Competing interests: None declared.

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Synergy between public health and veterinary services to deliver human and animal health interventions in rural low income settings

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Rural African communities, especially those that are nomadic, often have poor access to health care. Collaboration with other services could help improve coverage

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BMJ 2005;331:1264–7

Livestock contribute to the livelihood of at least 70% of the worlds' rural poor.[1] In arid and semi-arid ecosystems of sub-Saharan Africa, livestock holders (mobile or settled pastoralists and agro-pastoralists) use vast grazing lands and residuals of crops that otherwise could not be used productively.[2] Yet, they are marginalised from development processes and vulnerable to exclusion from health services because of their geographical, social, and cultural environment. The weak infrastructure and quality of service in both the public health and veterinary sectors are closely related to resource constraints, especially lack of qualified staff.[3 4] Therefore, professionals from the World Health Organisation and UN Food and Agriculture Organisation have suggested that public health and veterinary services should share resources.[5 6] Few experiences of joint delivery of services to pastoral communities have been documented.[7] We describe the implementation and effects of a joint project in Chad.

Delivering essential interventions

Veterinary services have a crucial role in controlling highly contagious diseases and zoonotic infections, which have implications for human health as well as that of livestock. However, in many contexts veterinary services could also contribute to the provision of essential public health interventions. This is particularly important in areas with unacceptably low health service coverage, as is often the case in rural settings of low income countries. One example of collaboration between public health and veterinary services is in providing child vaccination, one of the most cost effective health interventions, in developing countries.[8] In southern Sudan, the Expanded Programme on Immunization shared cold chain equipment with the veterinary service,[7] and the International Red Cross has implemented vaccination campaigns using veterinarians' vehicles (B Peterhans, personal

communication). Similar collaborations have been implemented during humanitarian crises such as droughts or civil wars. However, these are unfortunately not published or well documented.

Traditional healers in many pastoral societies treat animals and people. The American epidemiologist Calvin Schwabe was inspired by Sudanese Dinka pastoralist healers in the 1960s. Schwabe focused on the commonality of human and veterinary health interests. He discussed the added values to public health of "one medicine" for food and nutritional security, zoonoses, comparative medical research, epidemiology and population medicine, environmental quality, mental health, and ethics.[9]

Majok and Schwabe observed that veterinarians are the most extensively distributed, highly educated human resource in African rural areas.[5] They strongly advocated intersectoral collaboration between the health and veterinary services but also between other sectors when appropriate. Any credible and sustainable intersectoral approach must be beneficial to both sectors. Joint planning, management, and coordination of policy are essential. In addition, trans-sectoral assessments and cost-sharing schemes are needed, considering both human and animal health economics from a societal perspective.[10]

Joint human and animal vaccination services

The Swiss Tropical Institute, in close collaboration with national and international partners, has set up an interdisciplinary research and action programme to identify, test, and evaluate health interventions in nomadic pastoralist settings of Chad, Mali, and Mauritania. A combination of natural and social sciences and a transdisciplinary approach (combining scientific knowledge with the know-how of lay people) helped improve our understanding of the health priorities of the nomadic pastoralist communities (box).

Before the start of the programme, no children were fully immunised, although the communities had requested vaccination against measles and whooping cough.[16] In the same nomadic camps, compulsory vaccination campaigns had resulted in 75% of cattle and camels being vaccinated by veterinary teams arriving in the vicinity.

After national stakeholder workshops, representatives of the ministries of health and of livestock production and the nomadic communities identified joint vaccination campaigns as the priority for action. To implement and test such campaigns, both sectors assigned intervention zones.

Between 2000 and 2004, 10 vaccination campaigns for nomadic children and women were conducted among three ethnic groups (Fulani, Arabs, and Dazagada) in the areas where the communities concentrate during the dry season. With one exception, each vaccination campaign was composed of three vaccination rounds to enable full vaccination of children. The capacity of existing mobile veterinary infrastructures was extended to allow for simultaneous vaccination of people and animals in nine out of the 29 vaccination rounds. The campaigns were set up with the local health and veterinary staff to avoid parallel structures and to make use of all existing infrastructure (cold chain and transportation). The Extended Programme on Immunization provided the vaccines and consumables through the regional health administration and conducted continuous monitoring.

Vaccination of nomadic pastoralist children and women in Chari-Baguirmi, Chad

Despite logistical challenges related to the dynamic way of life of nomads and occasional shortages of materials, 103 521 livestock were vaccinated, 4022 children younger than 5 years old were fully immunised (three doses), and 6284 women received at least two doses against tetanus during the campaigns. The mean loss of children from first to third vaccination within one campaign was 68%, and efforts to reduce the drop-out rate of children must be

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Access of nomadic pastoralists to health services

The inter-relationship between pastoralists and their livestock is far reaching. Transactions of property, services, and social events are related to livestock exchange. Besides providing pastoralists with their main source of subsistence, livestock is the basis of economic wealth and social respect. An estimated 16% of the 35 million people in the Sahel region are mobile livestock breeders.[11]

Nomadic and transhumant pastoralists use mobility to manage uncertainty and risk (such as drought, diseases, raids, insect vectors).[12] This mobility and dispersion makes it difficult to get health care, as well as information and education. Nomadic pastoralists have to avoid croplands, where rural health services are typically located. Movement from place to place jeopardises treatments, especially those requiring a long follow-up such as treatment against tuberculosis. The lack of maternal health services is associated with a high pregnancy related morbidity and mortality. The access of sick women to health services depends on the network they can mobilise to receive the necessary resources and a male chaperon for treatment.[13] This may be complicated because nomadic families are periodically separated.

Studies to determine health indicators (morbidity, mortality, fertility, etc) among nomads are rare.[14 15] The good health of their animals is pivotal for nomadic pastoralists, and animal health may therefore provide a key entry point for the provision of both human and animal health understanding and services.[5]

increased. Loss to follow-up has a big effect on the costs per fully immunised child and woman because each person who is not fully immunised adds to the total costs but is not counted in the denominator. Vaccine and consumables (syringes and needles) accounted for the bulk of costs: 40% for the public health sector and 37% for the veterinary sector. Costs of transportation were mainly shared between the two sectors. The proportion of shared operational costs (after exclusion of vaccine costs that cannot be shared) was highest for the zone in which all the second vaccination rounds were conducted jointly (15%).[17] Additional cost effectiveness analyses of the campaigns are under way.

Effect on nomadic communities and service provision

Inclusion of the pastoralist communities in planning the vaccination campaigns increased their awareness that vaccination is not a governmental matter alone. Indeed, the lack of information on vaccination and specific health topics was raised by nomadic pastoralists, and they helped develop pictograms and short movies that were shown before vaccinations by trained community based facilitators. The veterinary and public health staff observed that when the two sectors were present together, pastoralist families vaccinated their livestock and children more spontaneously. This is reflected in the vaccination rates; a mean of 140 people were vaccinated a day during joint vaccination rounds compared with 100 people a day when veterinarians were absent.

An epidemiological survey in 1999 and 2000 showed that half of nomadic pastoralists had never visited a health centre.[15] A first contact with the health staff was established during the vaccination programme. Nomads appreciated the quality and the potentials of health services and started to trust the providers. The public health services were able to build on this important gateway.

After the (partial) failure of privatising veterinary services and their exclusion from rural development programmes, the Chadian veterinary service is currently searching for new ways to graft other services on to its infrastructure, building on its experiences with pastoralist groups. A contribution from the public health sector to maintain the veterinary infrastructure would make veterinary services more efficient and help all to succeed. Chadian public health and veterinary officials are now planning a common policy for vaccination of children and livestock in pastoralist populations and want to scale up the intersectoral approach to district and national level. The project assists the communities and governmental structures to build up their ownership of the approach.

Communication between human and animal health professionals

The institutional collaboration between public health and veterinary services seeks to strengthen health services for hard to reach populations by making better use of existing resources and to identify appropriate control strategies for zoonotic diseases.[18] Change is likely to be incremental and occur through taking advantage of, and grafting new ideas on to, the communities' perceived illnesses, traditional beliefs, and knowledge. Health systems and traditional institutional arrangements must be carefully examined to identify opportunities to join public health and veterinary services.

Our experiences show that the simultaneous offer of human and animal immunisation services is particularly suited to nomadic pastoralist populations in Sahelian Chad. Joint human and animal health services may also have relevance to settled pastoralist communities and for the more widespread mixed livestock-crop farmers.[5 6 19] Although these communities are better organised and more able to voice their demands than mobile groups, communities in remote rural areas often have limited access to health workers.

Shears proposes a human and animal health strategy for disease surveillance in low income countries.[19] To make best use of professionals visiting livestock breeders, veterinarians could, for example, monitor zoonotic diseases and opportunistic infections. Such combined strategies will foster communication between public health and veterinary specialists, leading to joint ideas, ethical frameworks, and leadership of human and animal health services. The inclusion of different stakeholders in the conceptual and planning phase is crucial as it increases ownership among the concerned populations and authorities.

Another emerging concept is the ecosystem approach to health, and many public health specialists recommend this as a holistic approach to health. The approach recognises that sustainable development is possible only with healthy people and ecosystems. Solutions are developed based on an alternative form of ecosystem management rather than on conventional health sector interventions.[20] The approach is complementary to the joint public health and veterinary approach, which emphasises the interdependence of human and animal health systems.[18]

For a joint approach to flourish, the curriculums of medical and veterinary students must enable and encourage communication and exchange with other disciplines. Intermittent crossover education and courses may be a way to stimulate eventual partnerships. Public health and veterinary programmes should share their knowledge (including their different approaches) more widely and explore local priorities and perceived needs. They can then develop joint implementation arrangements to improve services to poor and hard to reach communities.

Contributors and sources: This article is based on experiences of a multi-institutional working group to improve the access of Chadian nomadic pastoralists to health and veterinary services. Veterinarians contributed to the develoment of the research protocol from the beginning. All authors were involved in the design and organisation of the intervention. Other contributors to the project were Marcel Tanner, Mahamat Abdoulaye Ahmed, Abbani Abicho, Belna Djasra Mahamat, Garba Tchang, and Martin Wiese. ES, JZ, and KW prepared grant submissions for the study and all authors contributed to writing the manuscript. ES is the guarantor.

Funding: Swiss National Science Foundation (NF 3233.52202.97, NCCR North-South), Swiss Agency for Development and Cooperation (NCCR North-South), Lotteriefonds beider Basel; OPTIMUS Foundation, and Unicef.

Competing interests: None declared.

Summary points

Collaboration between public health and veterinary services could increase coverage of essential health interventions for people and livestock in remote rural areas

Such collaboration has been rare and outcomes rarely assessed

Joint vaccination campaigns for livestock and people among nomadic pastoralists of Chad were successful and highly appreciated by stakeholders

Communication between the public health and veterinary programmes must be fostered to identify further opportunities for collaboration

Ethical approval: The joint vaccination campaigns in Chad were approved by the Ministry of Health and the Ministry of Livestock Production. A review board comprising officials of the ministries, reviewed the compliance with ethical standards. Participation was voluntary and the communities were informed of the possible side effects of vaccination.

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Why shouldn't children benefit from oral rehydration solutions for calves?

When I was a veterinary student, in the early 1960s, diarrhoea was regarded entirely as an infection; antibiotics were the automatic remedy. During my final year, an exciting innovation was intravenous fluid therapy for calves with acute diarrhoea. Too expensive for widespread use, it never matched the success of similar treatment for human cholera, yet the practical problems of treating calf diarrhoea on farms were not much different from those of treating cholera in primitive surroundings. Indeed, as well as the general similarities in the pathophysiology of acute diarrhoea in any species, the then prevalent cause of calf diarrhoea, *Escherichia coli* enterotoxin, and cholera are similar.

Oral rehydration for acute diarrhoea was first suggested by remarkable clinical research by W B O'Shaughnessy reported in the *Lancet* in 1831, within months of the arrival of a terrifying new disease from Asia—cholera. Sadly his wisdom was not appreciated until the 1970s, with the arrival of the World Health Organization's oral rehydration solution—described as the greatest lifesaving advance of the century. It converted cholera from a mostly fatal disease in the absence of intravenous rehydration, into one routinely and simply treated orally. Oral rehydration goes beyond symptomatic therapy; the fundamental cause of acute diarrhoea is impairment of net enteric sodium and water absorption sufficient to overwhelm the compensatory capacity of the colon.

Veterinary oral rehydration solutions initially followed human formulations, but there are now three classes: type 1 solution (WHO formulation) corrects dehydration, hypovolaemia, and acidosis; type 2 solutions have the properties of type 1 solutions but avoid the energy deficits imposed by their low glucose content (2%), which is optimal for sodium absorption but inadequate for metabolism; and type 3 solution, which exploits the ability of glutamine to sustain villus structure and enterocyte function, and renal function, and can be helpful in conditions where reduced food intake imperils villus architecture.

Principles validated in calves may not necessarily apply to children, but we should not simply assume that they won't. Calves are pre-ruminants; they are functionally simple-stomached until they are weaned onto solid food, well beyond the age at which oral rehydration is usually needed. Unlike children, calves can be studied in the laboratory to measure directly the parameters that matter in acute diarrhoea—such as hypovolaemia, acidosis, and prerenal failure.

Paediatric research is necessarily restricted to indirect and fallible criteria such as faecal output or need for supplementary intravenous fluids; the dilemma for studies of human oral rehydration therapy is that the validity of systematic reviews and meta-analyses is undermined when the underlying data reflect crucial variables only indirectly and unreliably. It is therefore possible that the approaches currently used to treat calves, which are radically different from those used by paediatricians, could benefit children, especially those who are already cachectic before their diarrhoea. The necessary additional research should be started.

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