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Global freedom from rinderpest

The 192 member countries of the Food and Agriculture Organization of the United Nations (FAO) adopted a Conference resolution declaring global freedom from rinderpest – the first animal disease to be eradicated, following the eradication of smallpox in humans in 1980. Working with the World Organisation for Animal Health (OIE), FAO helped coordinate a large group of partner institutes, donors, national governments and regional bodies (page 2).

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Unveiling a monument to celebrate the eradication of rinderpest, Rome, Italy

AND...

Anthrax is affecting animals and humans

Factors such as the recurrence of anthrax outbreaks in many parts of the world, the international community's concern about the potential use of anthrax bacillus in bioterrorism, the persistence of anthrax outbreaks in some countries, and the emergence of penicillin-resistant virulent strains in medical practice have focused new attention on one of civilization's oldest and deadliest diseases. The FAO is working with stakeholders in endemic countries to assist the development and implementation of effective prevention and control programmes (page 12).

A review of *Escherichia coli* as an emerging food-borne pathogen

Hundreds of thousands of people are made ill by pathogenic *Escherichia coli* *(E. coli)* each year, and hundreds of them die. In recent years, there has been an increase in outbreaks of Shiga toxin-producing *E. coli* (STEC), and thousands of sporadic cases of haemorrhagic colitis (bloody diarrhoea), which sometimes develops into the potentially fatal haemolytic-uraemic syndrome (HUS). These STEC outbreaks have had a significant impact on health care systems, agricultural production and trade in many countries around the world (page 20).

E. coli *bacteria*

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Rinderpest

Resolution 4/2011 Declaration on Global Freedom from Rinderpest and on the Implementation of Follow-up Measures to Maintain World Freedom from Rinderpest


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28 June 2011, Rome – Commemorative Ceremony for the Adoption of FAO Declaration on Global Freedom from Rinderpest. FAO Conference, 37th Session, FAO Headquarters (Green Room)

The Conference

Mindful of the devastation caused by rinderpest, a viral disease of cattle, buffalo and many wildlife species that led to famines, demise of livelihoods in Africa, Asia and Europe, and loss of animal genetic resources over centuries and of the crucial importance that its global eradication is widely acknowledged and the world protected from its re-occurrence;

Acknowledging the successful collaboration of FAO with many Governments, international and regional organizations, the veterinary profession and the scientific community to achieve this ambitious goal, recalling its vision of a world free from hunger and malnutrition, where the food and agriculture sectors contribute to improving the living standards of all in an economically, socially and environmentally sustainable manner, and reiterating the global goals set out by the FAO Members to foster the achievement of this vision as formulated in the Organization's Strategic Framework 2010–19;

Recalling the establishment of the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) in 1994, in particular its Global Rinderpest Eradication Programme, including a goal for worldwide eradication by 2010;

Considering the announcement of the Director-General in October 2010 that the Organization had ended all its field operations after having obtained reliable and conclusive evidence that all countries were free from rinderpest and that the disease had been eradicated in its natural setting;

Noting the conclusions reached by the Joint FAO/OIE Committee on Global Rinderpest Eradication and the adoption of Resolution 18/2011 by the 79th General Session of May 2011 of the World Assembly of Delegates of the World Organisation for Animal Health (OIE);

Noting further the technical findings of FAO, OIE and IAEA concerning the evidence of rinderpest eradication;

Acknowledging the responsibility of Governments to reduce the number of existing rinderpest virus stocks through their safe destruction, or through their transfer to internationally-recognized reference institutions:

- **Declares** solemnly that the world has achieved freedom from rinderpest in its natural setting;
- **Expresses** its deep gratitude to all nations, organizations and individuals who contributed to the fight against rinderpest and the successful eradication of the disease;
- **Calls upon** FAO to assume its responsibility for undertaking the measures to maintain worldwide freedom from rinderpest, as recommended by the Joint FAO/OIE Committee on Global Rinderpest Eradication;
- **Encourages** FAO to take full advantage of the rinderpest eradication achievement and apply the lessons learned to prevent and control other diseases impacting food security, public health, the sustainability of agriculture systems and rural development and
- **Urges** all Members of FAO:
  a) to maintain, in accordance with the relevant provisions of OIE's Terrestrial Animal Health Code, appropriate surveillance systems for rinderpest and immediately notify the OIE and the FAO/OIE/WHO Global Early Warning System of suspect or confirmed cases of rinderpest;
  b) to put in place and update national contingency plans consistent with FAO and OIE global guidance;
  c) to destroy, under the supervision of the Veterinary Authority, rinderpest virus-containing materials or assure the storage of these materials in a biosecure facility in their country or, where applicable, assure their safe transfer to an approved laboratory in another country in agreement with the Veterinary Authority;
  d) to ensure that rinderpest occupies an appropriate place in veterinary education curricula and training programmes to maintain professional knowledge and adequate diagnostic capabilities at national levels; and
  e) to support all technical measures required to minimize the risk of rinderpest re-emergence, or its synthetic manufacture.

The Conference also took note of the statements made by the Director-General of FAO, the Deputy Director-General of the World Organisation for Animal Health, the Minister of Health of Italy, the Nobel Prize Laureate (P. Doherty) and the Assistant Director-General, Agriculture and Consumer Protection Department, as well as the statements made by the European Union and by Brazil.

References: C 2011/15; C2011/LIM/12; C 2011/I/PV/2; C 2011/I/PV/5; C2011/PV/11.

Recommendations from the Symposium on Rinderpest Eradication: Achievements and Obligations

When the Food and Agriculture Organization of the United Nations (FAO) was established in 1945, one of its objectives was to eradicate rinderpest. During the declaration of global freedom from rinderpest at the 37th FAO Conference, an important

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Rinderpest eradication plaque, FAO, Rome, Italy

Symposium on Rinderpest Eradication: Achievements and Obligations was organized (27 June 2011). Symposium participants – chief veterinary officers (CVOs), epidemiologists, laboratory technicians, rinderpest experts and disease managers – made the following recommendations:

Congratulating FAO and its international and national partners for the outstanding achievement in the global eradication of rinderpest;

Recognizing the continuing risk posed by laboratory stocks of rinderpest virus and the need to safeguard the world's cattle population against the rinderpest virus;

Noting the binding commitments to the safeguarding of pathogens, including rinderpest virus, made by the membership of FAO, the World Organisation for Animal Health (OIE) and States Parties and signatories to the Biological and Toxin Weapons Convention;

Aware:

- of the recommendations of FAO's Global Rinderpest Eradication Programme (GREP) Symposium held in Rome, Italy, in October 2010, included in *Lessons learned from the eradication of rinderpest and their possible application to other diseases*;
- that peste des petits ruminants (PPR) virus continues to increase its geographical range with severe effects on farmers' livelihoods and food security;
- that PPR, with its similarities to rinderpest, has been identified as an appropriate disease for future global control and eradication;
- that where other high-impact animal diseases are considered a regional priority, they too require concerted action to reduce their negative impact on animal health, food security, nutrition and communities' livelihoods;

The Symposium urges FAO to:

- continue to support GREP (or its future equivalent)[1] and the planned activities for implementing the post-eradication strategy;
- initiate, in collaboration with global, regional and national partners, appropriate programmes for the control and eradication of PPR within the framework of improved ruminant health;
- strengthen existing or design new programmes aimed at minimizing the effect of high-impact diseases and promoting efficiency in animal production.

[1] Such as the Global Rinderpest Prevention Programme (GRPP).

Regional workshops leading to the global declaration: concerns regarding the post-eradication era

After more than 60 years of continuous effort, at the World Food Summit in October 2010 in Rome (Italy), FAO declared that it had ceased all its field operations against rinderpest. Coinciding with this momentous announcement a GREP Symposium assimilated the lessons learned from the eradication of rinderpest in the field and began to plan how these might be applied to the control and possible eradication of other appropriate diseases. The Symposium made the following recommendations:

1. The success of the global eradication of rinderpest should be widely promoted in ways that emphasize:
   - the roles played by all stakeholders, including livestock owners;
   - the benefits that eradication has brought and will continue to bring for individuals and the economy at large;
   - lessons learned during the eradication process, and their potential application to other diseases;
   - the post-eradication strategy, including disease monitoring, sequestration of all stocks of virus, and documentation of the eradication process.
2. International and regional organizations and all stakeholders should apply the lessons learned from the eradication of rinderpest to other diseases, particularly to the progressive control and eventual eradication of PPR. FAO should play a leading role in organizing the preliminary steps necessary for initiating such global initiatives and should identify appropriate partnerships to drive and implement the necessary activities.

A veterinary technician examining blood samples from cattle under the microscope to ensure the rinderpest virus has not returned, Paduka, Sri Lanka

Between October 2010 and June 2011, GREP convened a series of meetings to celebrate the eradication of rinderpest and consolidate the strategy for rinderpest surveillance and management in the post-eradication era. Three regional workshops for CVOs, entitled "The World without Rinderpest", were held in Nairobi (Kenya), Bangkok (Thailand) and Rabat (Morocco). Each of these was immediately followed by a separate workshop, entitled "Maintaining Vigilance for Diseases caused by Morbilliviruses", for senior animal health staff responsible for field and laboratory surveillance of rinderpest. The purpose of these workshops was to consult senior decision-makers and technical staff to gather their thoughts and concerns about global, regional and national post-eradication strategies for rinderpest, and to summarize these concerns for presentation at the global symposium in June 2011 in Rome (Table 1).

Presentations at the workshops reviewed the current global situation of rinderpest, FAO's and OIE's strategic planning for rinderpest in the post-eradication era, and information about the sequestration of laboratory-held stocks of virus. The importance of both global and national emergency preparedness planning was examined, together with the availability of vaccines and diagnostics for emergency

Table 1: Participants of the World without Rinderpest workshops and Maintaining Vigilance for Diseases caused by Morbilliviruses workshops held in Bangladesh, Morocco and Kenya

Country/Territory	The World without Rinderpest workshops (No. of participants)	Maintaining Vigilance for Diseases caused by Morbilliviruses workshops (No. of participants)	Partners
Bangladesh	18	18	FAO, IAEA,[1] OIE,[2] SAARC[3]
Morocco	4	3	AMU,[4] FAO, IAEA,
Kenya	30	32	AU-IBAR,[5] FAO, IAEA, OIE, AU-PANVAC[6]

[1] Joint FAO/International Atomic Energy Agency (IAEA) Division.
[2] World Organisation for Animal Health.
[3] South Asian Association for Regional Cooperation.
[4] Arab Maghreb Union.
[5] African Union Interafrican Bureau for Animal Resources.
[6] AU Pan African Veterinary Vaccine Centre.

use. Resolution number 18, passed by the General Assembly of OIE in May 2011 in Paris (France), was presented, including its appendix of guidelines for rinderpest virus sequestration. Representatives from OIE presented the proposed new chapter on rinderpest for inclusion in the OIE Terrestrial Animal Health Code.

Workshops on morbillivirus surveillance for investigating officers reviewed the differential diagnosis and epidemiology of rinderpest and how this knowledge can be used to develop a syndrome-based surveillance system capable of detecting many important diseases, including rinderpest, should it occur. The increasingly grave global situation of PPR was also described and discussed in detail.

The regional nature of the workshops allowed AU-PANVAC and AU-IBAR to present their proposed continental strategies for emergency preparedness for rinderpest and for the control of PPR at the workshop in Nairobi. In Bangkok, presentations highlighted proposed regional and national programmes for the control and eradication of PPR, and in Rabat the host country recounted its comprehensive programme, which eradicated PPR in 2008. In Bangkok and Rabat, the OIE representatives gave presentations on VET 2011, the celebration of 250 years since the foundation of the world's first veterinary school (in Lyons, France), which coincided with the global eradication of rinderpest. At both series of workshops, representatives of the Royal Veterinary College (RVC, United Kingdom of Great Britain and Northern Ireland) and AusVet (Australia) Animal Health Services presented their methodology for risk analysis of the re-emergence of rinderpest and the results to date, and used the opportunity to interact with and gather additional information from workshop participants. These presentations and findings are reported separately as part of the overall report on risk analysis.

General discussions among participants and presenters enriched the workshops, and working group sessions on key points built consensus on the participants' main concerns.

Participants' concerns and proposed solutions

Rinderpest

Storing virus stocks

Most countries do not want to keep stocks of wild virus or vaccine seed. FAO and OIE are requested to provide guidelines for rinderpest virus destruction or, where considered appropriate, the sanctioned sequestration of viruses in appropriately biosecure facilities, and to assist with implementing these guidelines. To facilitate tracing of the origins of outbreaks, participants endorsed a suggestion that countries wishing to keep virus stocks should be sanctioned to do so only if they provide full genome sequencing data for viruses to a central database operated by FAO/OIE. *This process of virus characterization implies an additional role for FAO/OIE-recognized reference laboratories for morbilliviruses, which will require support.*

Maintaining awareness of rinderpest issues

It is more than a decade since any country experienced rinderpest, and understanding of the disease among farmers and veterinarians is diminishing rapidly. This is linked to a lack of awareness of the significant benefits that have accrued from rinderpest eradication. Countries requested support for veterinary education and communication through provision of a package of training and communication materials, together with technical and financial support if this could be made available. *Countries wished to see the FAO and OIE declaration of freedom from rinderpest used as an opportunity to promote the achievements and value of veterinary services. Countries requested FAO to provide educational materials to help educate veterinarians, veterinary faculties and other stakeholders.*

Most countries do not want to keep stocks of wild virus or vaccine seed

Emergency preparedness planning

Defining and implementing an FAO/OIE global strategic plan to manage rinderpest-related issues in the post-eradication era is considered to be critically important. A major component of this global strategic plan will be a global emergency preparedness plan, within which there will be a global contingency plan for coping with any re-emergence of the disease. These plans are urgently needed to complement and support the development of new regional and national emergency preparedness plans for rinderpest in the post-eradication era. It is necessary to provide clear guidelines and standard operating procedures for investigation of disease outbreaks suspected of being rinderpest. The success of emergency preparedness planning in preventing a return of rinderpest through accidental or malign release of virus is highly dependent on early recognition of the disease, making sustained awareness a matter of concern. A rinderpest advisory group would be needed to assist in implementing the global strategic plan. *With OIE, FAO needs to finalize the global strategy for rinderpest, including by forming the recommended rinderpest advisory group.*

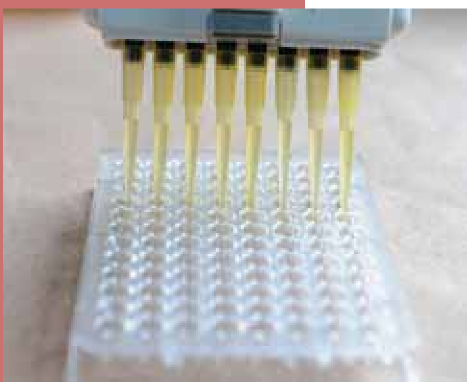
Strategic reserves of rinderpest vaccine

As with virulent rinderpest viruses, most countries also wish to destroy stocks of vaccine and virus seed lots, provided that there is assured, rapid access to vaccines in an emergency. Thus, as part of international emergency preparedness planning there is a need to maintain strategic reserves of rinderpest vaccine. For sub-Saharan Africa it is proposed that this need be met by the AU through PANVAC. For the rest of the world, other regional vaccine banks will have to be considered, to support emergency procedures if the use of vaccine becomes necessary. *FAO and partners are urged to finalize preparations without delay.*

Diagnostic preparedness

With some exceptions, there was general agreement that the need for assured laboratory confirmation of rinderpest outbreaks would best be met by one or perhaps two global morbillivirus reference laboratories supporting a small network of regional reference laboratories. Global morbillivirus reference laboratories are required to maintain expertise and provide regional reference laboratories with diagnostic reagents and kits, as well as to provide scientific capacity in the unlikely event of a re-emergence of the virus in the field. Each regional reference laboratory would provide diagnostic capacity to the countries within its region. Some countries wished to retain national capacity to help screen suspected rinderpest outbreaks before transporting samples to reference laboratories for examination. A robust and affordable test would be very useful for such primary diagnosis, and could be supplied to countries by reference laboratories, if the laboratories received support for this. Countries also stressed that in the event of an outbreak the affected country would need rapid access to both virus detection tests and antibody assays, to control the disease and demonstrate its absence for regaining freedom status. The existing processes put in place by FAO to facilitate appropriate packaging and transit conditions for materials potentially containing rinderpest virus need to be strengthened and promoted. *FAO and OIE were requested to define the requirements for and recognize and support the functioning of appropriate global and regional laboratories*.

A batch of fluid samples being processed for testing at the Animal Virus Laboratory, Polgola, Sri Lanka



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Regaining freedom after an outbreak

The proposed new chapter for rinderpest in the OIE Terrestrial Animal Health Code gives two options for regaining the status of rinderpest freedom after an outbreak. Both of these require the slaughter of infected and/or vaccinated livestock. If national freedom is not regained within six months of the occurrence of an outbreak, the status of global rinderpest freedom will be lost. There was general concern about these provisions because in many countries it is neither socially acceptable nor affordable to slaughter cattle. If an outbreak occurs in one of these countries, it is therefore inevitable that global rinderpest freedom will be lost. *OIE and FAO are requested to explore other possibilities for regaining freedom in a timely manner without jeopardizing global freedom. It is essential that all countries comprehensively review, and if necessary comment on, the proposed rinderpest chapter when it is submitted to them.*

The status of official veterinary services

Many countries are concerned that the work done by veterinary services is undervalued. *These countries would like to see international organizations, including FAO, OIE and the AU, advocating at the highest levels of government for the strengthening of veterinary services, to improve management of the serious diseases and pests of livestock that currently affect and threaten the livelihoods of their people.*

Peste des petits ruminants

Participants from all six workshops repeatedly and virtually unanimously voiced their concern about the alarming and growing global impact of PPR. This disease exerts a major negative economic impact on farm households that are economically dependent on small ruminants. There is growing appreciation that PPR is the most serious and escalating disease constraint to the livelihoods of the poorest farming families and to food security in the regions participating in the workshops. International funding for PPR control provides assistance to some national control programmes, especially in Africa. However, although they provide welcome temporary respite from the impact of the disease, such short-term vaccination projects usually fail to contribute significantly to the overall required goal of progressive control. Many of the factors that made rinderpest suitable for eradication also apply to PPR, and workshop participants considered that a coordinated global eradication effort, built on the lessons learned from rinderpest eradication, warrants significant investment. *FAO was asked to work with international and regional partners to initiate a PPR control strategy without delay, before expertise gained during rinderpest eradication is lost.*

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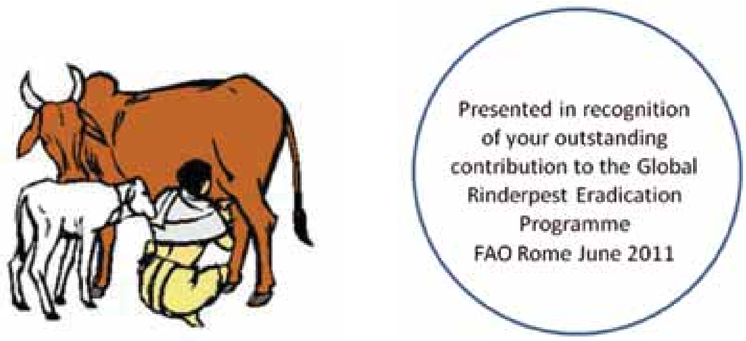
Awards for significant contributions towards the eradication of rinderpest

During the 37th FAO Conference, member countries adopted the resolution for the global freedom of rinderpest. Individuals, institutions and donors contributed significantly to this major veterinary professional achievement, in some cases by making

Figure 1: Recognition medal



seminal contributions to epidemiological understanding and developing diagnostic tools, vaccines and surveillance methodology; and in others by developing and promoting the concepts of rinderpest eradication, implementing control/eradication programmes, and supporting international coordination.

Award winners

Post-humous medals were awarded to Thomas Barrett (United Kingdom of Great Britain and Northern Ireland); W.G. Beaton (United Kingdom); Yves Cheneau (France); J.T. Edwards (United Kingdom); Titus Lwebandiza (United Republic of Tanzania); I.M. MacFarlane (United Kingdom); Junji Nakamura (Japan); Walter Plowright (United Kingdom); Alain Provost (France); Gordon Scott (United Kingdom); Henri Lepissier (France); and Roland Geiger (Germany).

Medals were also awarded to John Anderson (United Kingdom); Pg Atang (Cameroon); S.P. Anbumani (India); Berhanu Admassu (Ethiopia); John Crowther (United Kingdom); Manzoor Hussein (Pakistan); Joseph Domenech (France); Andrew James (United Kingdom); Martyn Jeggo (United Kingdom); Gholam Ali Kiani (Islamic Republic of Iran); Richard Kock (United Kingdom); Tim Leyland (United Kingdom); Jeff Mariner (United States of America); Walter Masiga (Kenya); Sheikh Masood (Pakistan); J.N. Mollel (United Republic of Tanzania); Otto Möller (Denmark); D.R. Nawathe (Nigeria); Felix Njeumi (Cameroon); S.T. Pandya (India); Yoshiro Ozawa (Japan); Rafaqat Raja (Pakistan); M. Rajasekhar (India); Leslie Rowe (United Kingdom); Mark Rweyemamu (United Republic of Tanzania); Daouda Sylla (Mali); William Taylor (United Kingdom); Nick Taylor (United Kingdom); Emily Twinamisko (Uganda); Lindsay Tyler (United Kingdom); Gijs van't Klooster (Netherlands); Henry Wamwayi (Kenya); Bouna Diop (Senegal); Bernard Vallat (France); Amadou Samba Sidibe (Mali); Solomon Haile Mariam (Ethiopia); René Bessin (Burkina Faso); Karamoko Wague (Mali); and Datsun Kariuki (Kenya).

Institutional partners were OIE; IAEA; International Cooperation Centre of Agricultural Research for Development (CIRAD); European Union/European Commission; AU-IBAR; PANVAC; Muguga (Kenya); Mukteswar (India); Institute for Animal Health (IAH) Pirbright; United States Agency for International Development (USAID); Department for International Development (DFID); Swedish International Development Cooperation Agency (SIDA); Italian Cooperation; Republic of Ireland; and Japanese International Cooperation Agency (JICA).

Recommendations of the GREP workshop on Biosafety, Sequestration and Risk Analysis for Laboratories holding Rinderpest Virus (Debre Zeit, Ethiopia, 4 to 7 July 2011)

Workshop participants agreed that it is essential to sequester rinderpest virus without delay, that relevant lessons learned from smallpox eradication be applied to rinderpest, and that the global emergency preparedness plan be put in place as soon as possible. All future research on rinderpest virus should be carried out under the aegis of the proposed new FAO/OIE rinderpest advisory body. The workshop noted that:

- the African countries present would sequester their viruses at AU-PANVAC;
- the European countries present are considering progressively transferring their virus collections to the FAO and OIE-designated World Reference Laboratory for Rinderpest at Pirbright, United Kingdom of Great Britain and Northern Ireland;
- the other countries present would destroy their viruses, transfer them to suitable FAO and OIE-approved laboratory facilities, or seek to obtain FAO and OIE recognition of their own laboratory facilities as suitable for maintaining stocks of live virus, including vaccine, vaccine seed, virulent strains, infected tissues and other materials; some countries offered to host repositories of vaccine, vaccine seed and virulent virus;
- by the end of 2012, all biosafety level (BSL) 1 and BSL2 laboratories holding rinderpest virus or specimens containing rinderpest virus and its component (ribonucleic acid [RNA] or antibody) should destroy or relocate these materials to designated laboratories, and decontaminate their premises and equipment using accepted protocols;
- FAO, the Joint FAO/IAEA Division and OIE should pursue the workshop objectives, particularly sequestration and risk reduction, with all the countries that still hold stocks of rinderpest virus;
- by the end of 2014, the number of repositories of virus should be reduced to a maximum of six;
- there should be periodic review of progress towards further reduction of risk;
- countries that have not already done so should complete and submit their FAO/OIE questionnaires for identifying the risk of rinderpest re-emergence.

Participants attending the GREP workshop, Debre Zeit, Ethiopia

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The meeting also recommended that as a priority, FAO and partners should finalize the post-eradication strategy for rinderpest. This should:

- establish the proposed FAO and OIE rinderpest advisory committee, without delay;
- develop methods for outbreak response and control in the post-eradication era;
- finalize criteria for the selection of rinderpest virus repositories;
- identify suitable banks of rinderpest vaccine with clearly understood mechanisms for rapid emergency access, and assist hosting institutions in ensuring long-term technical and financial viability of these vaccine banks;
- prepare guidelines for written agreements between virus donor and virus recipient countries (Material Transfer Agreements, letters of agreement, letters of understanding, etc.) on research, ownership, safe transportation of virus, and destruction and decontamination of rinderpest virus.

Anthrax

An ancient threat still killing animals and affecting humans

Introduction

Anthrax is a zoonotic disease primarily seen in domestic herbivorous animals and occurring in humans when they are infected from an animal source. The disease in both humans and animals has featured in records since ancient times and was described in the early literature of the Greeks, Romans, Egyptians and Hindus. It has been suggested that the fifth and sixth plagues that struck ancient Egypt, as described in the Bible, may be among the earliest descriptions of anthrax (Fasanella *et al.,* 2010). Some of the literature suggests that the probable origin of anthrax is therefore in Mesopotamia or northern Africa, but other evidence indicates the diverse fauna of sub-Saharan Africa as the origin, from which anthrax spread to the rest of Africa and subsequently, via movement of humans and their domestic animals, into Eurasia, North and South America and Australia (Hugh-Jones and Vos, 2002). This ancient threat still occurs regularly in both animals and humans in many parts of the world, despite the availability of preventive tools and the well-established knowledge of how to control anthrax effectively in livestock.

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A typical household with cattle in Sirajganj (Bangladesh) where anthrax is endemic (CMC-AH mission report)

A surge in cases of anthrax in both animals and humans has been noted over the past few years in several countries around the world. It is not clear whether there is a global increase in the number of outbreaks, or whether better reporting of the disease in humans and more efficient disease tracking through electronic early warning systems – the FAO Global Animal Disease Information System (EMPRES-i), the Program for Monitoring Emerging Diseases (ProMED-mail), the Center for Infectious Disease Research and Policy (CIDRAP), etc. – are responsible for the rise in the number of reported cases worldwide.

The recurrence of anthrax outbreaks in many parts of the world, the international community's concern about the potential use of anthrax bacillus in bioterrorism, the persistence of anthrax outbreaks because of poor-quality locally produced vaccines in some countries, and the emergence of penicillin-resistant virulent strains in medical practice are all factors that have focused new attention on one of civilization's oldest and deadliest diseases. The Food and Agriculture Organization of the United Nations (FAO) is working with stakeholders in endemic countries to assist in the development and implementation of effective prevention and control programmes. This paper outlines some aspects of concern for anthrax control.

Anthrax has global geographic distribution

There is a general worldwide decrease in the number of reported anthrax outbreaks in livestock – and thus of human cases – as a result of successful national control programmes. However anthrax still occurs naturally in most countries around the world and continues to cause significant losses in domestic and wild animal populations, with implications for human health. It is widely recognized that anthrax in livestock is still underreported, particularly in communities that do not have adequate veterinary services. The disease remains endemic in sub-Saharan Africa, Latin America, the Near East and parts of Asia, and is endemic in the Russian Federation, eastern Europe and most republics of central Asia (*Anthrax summary facts*, no date; Golsteyn-Thomas and Gale, 2010). Sporadic cases are reported from southern European countries and certain regions of North America and Australia (Golsteyn-Thomas and Gale, 2010). Specific areas of some countries are known to favour the survival of anthrax bacterium spores in the soil, and are thus the location of somewhat predictable recurrent outbreaks.

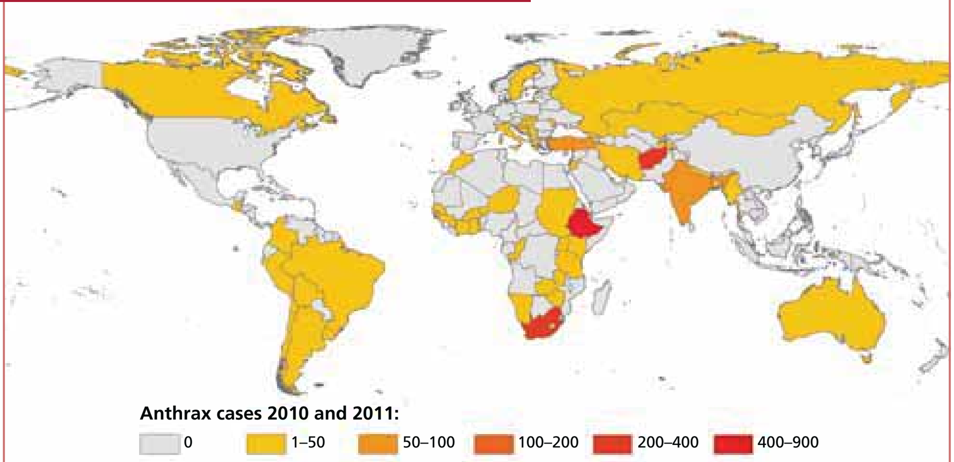
Figure 1 shows the worldwide distribution of anthrax outbreaks based on the numbers of cases reported to the World Organisation for Animal Health (OIE) in 2010 and 2011.

Countries with poor socio-economic conditions are the most affected

Anthrax incidence is linked to countries' socio-economic conditions and capacity to address animal diseases effectively. Countries with poor socio-economic conditions and weak veterinary and public health services are more likely to suffer anthrax outbreaks. Recurring anthrax outbreaks have been noted in countries and regions where it is difficult to implement control programmes and sustain vaccination campaigns because of political unrest, civil conflict and natural disasters.

Human anthrax is linked to rural poverty, which results in livestock owners slaughtering moribund animals and selling the meat to villagers at lower prices, to recover

Figure 1: Anthrax outbreaks, 2010 and 2011



Source: OIE.

at least part of their financial losses. This practice is considered to be the main risk factor for human anthrax among poor rural communities in some endemic countries in Asia and Africa.

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Cutaneaous anthrax lesions in humans

From animals to people

Anthrax can spread from animals to people, but not easily. Human cases associated with an animal outbreak are rare if proper precautions are taken when handling and moving affected animals and carcasses. Anthrax is not easily transmitted from person to person. When infected, humans can develop cutaneous, inhalational (or pulmonary) or gastrointestinal anthrax. Pulmonary or inhalation anthrax is highly fatal but rare. It normally affects people working with wool or leather from diseased animals. Gastrointestinal anthrax is contracted from eating poorly cooked meat of infected animals. This form is not as dangerous as pulmonary anthrax, but it can kill.

Cutaneous anthrax accounts for at least 95 percent of all natural infections. It is a generally non-fatal skin infection that strikes people handling infected animals or animal products. In many countries where anthrax is endemic, the cutaneous form is associated with slaughtering moribund animals and handling contaminated meat and animal by-products. As already mentioned, this practice is considered to be the main risk factor for human anthrax occurrence among rural communities in many countries in Asia and Africa.

Anthrax and wildlife

Anthrax can also involve wildlife in the infection cycle. Anthrax may be perpetuated in nature by wildlife reservoirs, and then spill over into the livestock population. Although the worldwide incidence of the disease in wildlife is unknown, anthrax remains enzootic in many national parks and wildlife reserves where susceptible species are present, putting surrounding livestock at persistent risk. The disease is well recognized in African wildlife, with periodic major outbreaks in national parks in many countries of the region (Hugh-Jones and Vos, 2002). Areas of high risk to wildlife also include wildlife conservation areas in North America (Hugh-Jones and Vos, 2002), South and Central America, and southern and eastern Europe (*Anthrax summary facts*, no date).

Control of anthrax – particularly in large wildlife reserves – is challenging because of practical difficulties encountered in vaccinating free-living wild animals. In the opinion of many wildlife managers and experts, anthrax is an integral part of the ecosystem and can be considered a natural regulatory agent in free-ranging wildlife areas. It tends to strike when populations of certain wildlife species become too

The infectious cycle of anthrax

Anthrax is caused by infection with the spore-forming bacterium *Bacillus anthracis* the spores of which can survive in the environment for many years. When the carcass of an infected animal is opened, these bacteria quickly form spores that contaminate the environment. Certain environmental conditions appear to favour the survival of the organism, resulting in "anthrax areas" where the soil remains heavily contaminated with viable spores. Warm humid weather and soils rich in organic matter are often linked to outbreaks in livestock; in known anthrax areas, outbreaks are therefore to some extent predictable when these conditions and other predisposing factors are met.

Anthrax is primarily a disease of grazing mammals, but all warm-blooded species can contract it. Livestock are most commonly infected by ingesting the spores from contaminated pastures, feed or soil while grazing (Golsteyn-Thomas and Gale, 2010). Pigs are frequently infected by eating the carcasses of animals that died of anthrax. Anthrax outbreaks in wildlife are attributed to blowflies that feed off the body fluids from opened carcasses infected with anthrax, and contaminate vegetation, which is then eaten by browsing animals. Biting flies are also suspected of transmitting anthrax among wild animals and livestock. Wild carnivores and scavenging vultures can disperse contaminated meat and spores over considerable distances (Turnbull, 2006).

The disease is rapidly fatal owing to severe septicaemia, and unexpected sudden death is characteristic of anthrax in animals. Bleeding from the nose, mouth and anus is common, but not invariable. Anthrax is a zoonotic disease that can be transmitted from animals to humans when human activity results in ingestion, inhalation or accidental inoculation of the organism from an infected animal source.

dense and exceed what the ecosystem can maintain, over a period of years. In small national parks, particularly those where livestock and game live side by side, anthrax can present a persistent risk to surrounding livestock and the local human population, and should therefore be controlled.

Effective anthrax control should be able to prevent and limit the impact of an outbreak

Surveillance, livestock vaccination and proper disposal of livestock carcasses are the most efficient ways of preventing and controlling anthrax infection in domestic herds, and also limit its transmission to humans.

An important step in the implementation of anthrax control is the acquisition of data or information about the disease. Field data related to the characteristics of the pathogen, its ecology and determinants of its natural occurrence are very use-

Anthrax vaccination in animals

As a preventive tool, vaccines can be deployed strategically to prevent animals from dying of anthrax in endemic areas. The Sterne vaccine is among the most commonly used and is one of the best. It is a live vaccine produced from the toxigenic, non-encapsulated *Bacillus anthracis* strain 34F2. The Sterne vaccine has been used safely in many species of livestock and produces a high degree of immunity. A single vaccination produces immunity for eight to ten months, provided that animals receive a full dose and are not under antibiotic therapy. Annual vaccination of susceptible animals is sufficient to control outbreaks of anthrax in defined localities. It is important that the vaccine is produced in accordance with the OIE standards described in the *Manual of standards for diagnostic tests and vaccines.*

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A goat being vaccinated against the anthrax virus

ful initial tools for livestock producers and veterinary services dealing with anthrax disease outbreaks. Surveillance can be used to predict areas where natural livestock cases of anthrax are likely to occur. These areas should have an effective mandatory reporting system in place so that all unexpected livestock deaths during the anthrax period are reported to the veterinary authorities for immediate investigation. Field veterinarians should have the ability to make diagnosis on-site or have good liaison with laboratory services to ensure diagnosis without delay.

Because anthrax is almost invariably fatal in domestic animals, a preventive strategy should be adopted involving regular vaccination of all susceptible animals (cattle, sheep and goats) in areas known to be at high risk. Vaccines can be deployed strategically in endemic areas and should be administered at least a month prior to the established anthrax outbreak period. This maximizes the likelihood that animals will develop protective immunity against the bacterium before the highest-risk period for infection. The interruption of livestock vaccination programmes in enzootic areas is a risk factor for both livestock and wildlife.

Managing anthrax outbreaks

When an outbreak occurs, several immediate actions can be used to curb mortalities and limit the spread of anthrax infection:

- Vaccinate all susceptible animals in affected premises and surrounding households: Based on the degree of vaccine potency and the severity of the outbreak, more than one booster shot can be administered in the course of an outbreak.
- Restrict/trace the movement of livestock and animal by-products from infected premises: Particular attention should be given to monitoring the distribution of skins and hides from infected animals.
- Use antibiotics to treat affected animals and – if necessary – exposed livestock, to stop any incubating infections: Anthrax is very responsive to antibiotic treatment if this is administered early in the course of the infection.
- Ensure the safe disposal of infected carcasses, followed by disinfection and decontamination of associated ground and all contaminated equipment and tools.
- Carry out epidemiological investigation to identify promptly the source of infection and the extent of the outbreak area.
- Carry out intensive surveillance and monitoring in areas surrounding infected premises, for early detection of anthrax cases.

General guidance on control of anthrax can be found in:

- **WHO.** 1998. *Guidelines for the surveillance and control of anthrax in humans and animals*, 3rd edition. Geneva.
- **OIE.** 2007. *Terrestrial Animal Health Code*, Appendix 3.6.6. Paris.
- **WHO/OIE/FAO.** 2008. *Anthrax in humans and animals*, 4th edition. Geneva, WHO.

Appropriate and safe disposal of dead animals, and subsequent disinfection and decontamination of all surfaces that can harbour anthrax spores are key steps in limiting the spread of anthrax and contamination of the environment. The ideal method of disposal for an anthrax carcass is burning. Where this is not possible, burial is the best alternative. Unlike burial, burning has the advantage of destroying anthrax spores, which reduces the number of spores available in the environment, therefore reducing the chance of spores resurfacing years later. In impoverished, protein-depleted communities, burial has the additional disadvantage that buried carcasses can be exhumed for consumption. Carcass disposal must be included in regulations for the control of anthrax.

Awareness among community members is key to anthrax control

Given the important zoonotic implications of anthrax, villagers and community farmers who are at risk must be aware of the hazards of anthrax. Coordinated efforts are needed at the community level to avoid the slaughter and eating of sick animals and to promote proper disposal practices.

Slaughtering sick animals and eating/handling meat from infected animals is a socio-cultural practice driven by motivation, usually monetary, to salvage the farmer's livelihood. This issue needs to be addressed with effective community approaches and solutions to persuade community residents not to slaughter diseased animals and eat/handle their meat. Community members must be educated about using personal protective equipment when slaughtering animals and handling meat and skins. Increasing rural households' awareness can be effective, but should be complemented by other measures, such as financial incentives for reporting and slaughtering affected animals, and close follow-up of suspected anthrax reports by local public health and veterinary services.

Anthrax control requires inter-sectoral coordination

Control of the disease requires effective coordination between the veterinary and public health authorities, particularly at the field level, through structured information exchange, joint case investigations and better coordination of awareness raising and implementation activities.

Anthrax provides a suitable platform for development of the One Health approach

Anthrax provides a good platform for the One Health approach

The control of anthrax outbreaks in animals brings very significant benefits for human health and poverty alleviation. To break the infectious cycle, avoid contamination of the environment and reduce the risk for human health, several aspects of anthrax control require investigation and further guidance, particularly communities' attitudes to basic control principles, and the capacity of the animal health services to deliver adequate vaccine to susceptible livestock and to manage anthrax outbreaks. Anthrax provides a good platform for the One Health approach, which can be operationalized through locally adapted approaches for improved surveillance, increased community awareness, effective delivery of vaccination campaigns, and coordinated and synergetic inter-sectoral collaboration. FAO is working in this direction by developing the One Health agenda and implementing it through the comprehensive and integrated control of zoonotic diseases that have impacts on public health and human livelihoods.

Conclusion

Although the true worldwide incidence of anthrax is unknown, official reports show that the disease is enzootic in many countries, and sporadic outbreaks are common. Experience shows that countries with inadequate veterinary and public health facilities and areas where it is difficult to implement control programmes are the most affected.

The persistence of anthrax outbreaks in livestock and the disease's incidence in people suggest that improved control measures are urgently needed to protect both human and animal health. Vaccinating livestock and properly disposing of animal carcasses are the most effective measures for controlling anthrax in livestock and limiting its transmission to humans.

Effective implementation of these measures implies the use of quality-assured vaccines, the establishment of an effective surveillance system and the enforcement of regulations pertaining to anthrax control.

Although significant progress has been achieved in understanding the disease, further research is required at both the national and regional levels, to improve understanding of the disease's ecology under natural conditions, so that potential risk factors can be identified and the areas with greater probability of anthrax occurrence can be defined.

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Escherichia coli

A review of *Escherichia coli* as an emerging food-borne pathogen

Why is it important?

Hundreds of thousands of people are made ill by *Escherichia coli (E. coli*) each year, and hundreds of them die. In recent years, there has been an increase in outbreaks of Shiga toxin-producing *E. coli* (STEC), and thousands of sporadic cases of haemorrhagic colitis (bloody diarrhoea), some of which develop into the potentially fatal haemolytic-uraemic syndrome (HUS). These STEC outbreaks have had a significant impact on health care systems, agricultural production and trade in many countries around the world.

E. coli *bacteria*

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What is *E. coli*?

E. coli is a bacterium that is commonly found in the gastrointestinal tract of humans and warm-blooded animals. Because of its high prevalence in the gastrointestinal tract and in faeces, *E. coli* is used as the preferred indicator of faecal contamination when assessing the safety of food and water. Most *E. coli* are harmless commensal organisms when contained in their natural intestinal habitat.

Different strains of *E. coli* are serious human gastrointestinal pathogens, and some are also pathogenic for young food production animals. Pathogenic *E. coli* are distinguished from other *E. coli* by their ability to cause illness through genetically controlled mechanisms such as toxin production, adhesion and invasion of host cells, interference with cell metabolism and tissue destruction.

E. coli have the ability to exchange genetic material via mobile genetic elements such as plasmids and bacteriophages, as an adaptation response to new and stressful environments. These genetic elements are believed to contribute to the emergence of pathogenic types with enhanced virulence, environmental survival and persistence in food systems.

Pathogenic *E. coli* types and symptoms in humans

Pathogenic *E. coli* are assigned to six groups or pathotypes, based on common mechanisms of pathogenicity and clinical syndromes: Shiga-toxigenic *E. coli* (STEC) or verotoxigenic *E. coli* (VTEC); enterohaemorrhagic *E. coli* (EHEC); enterotoxigenic *E. coli* (ETEC); enteroinvasive *E. coli* (EIEC); enteropathogenic *E. coli* (EPEC); enteroaggregative *E. coli* (EAggEC or EAEC); and diffusively adherent *E. coli* (DAEC).

Characteristics of the pathotypes are not exclusive and may be shared by more than one group. In general, the incubation period in human cases of *E. coli* disease ranges from three to eight days, with the appearance of a variety of gastrointestinal symptoms, ranging from mild to severe and bloody diarrhoea, mostly without fever.

Infected individuals and animals (with or without disease symptoms) can shed up to 10^6 to 10^9 colony-forming units (cfu) per gram of faeces.

The following are the main characteristics and distinctions among the six pathotypes:

- *STEC or VTEC* produce symptoms that range from mild to severe and bloody diarrhoea. STEC produce cytotoxins called verotoxins (VT) or Shiga toxins (Stx) (owing to their similarity to *Shigella dysenteriae* toxin). Up to 10 percent of cases can develop life-threatening HUS, particularly in young and elderly patients.
- *EHEC* are a subset of STEC typically associated with bloody diarrhoea and HUS. EHEC and EPEC produce intestinal epithelial cell changes called attaching and effacing lesions. STEC/EHEC are asymptomatically carried by healthy animals such as cattle, sheep, goats and wildlife.
- *ETEC* commonly cause watery diarrhoea among infants and travellers to areas of the world with poor sanitation and hygiene. ETEC attach to the small intestine via colonization factor antigens and produce enterotoxins that are similar to *Vibrio cholerae* toxin and are either plasmid-mediated heat-stable toxins (ST) or chromosomally mediated heat-labile toxins (LT). These enterotoxins and their respective variants cause disruption of the sodium chloride balance in the intestine, resulting in profuse watery diarrhoea.
- *EIEC* penetrate and spread among intestinal cells causing extensive cell destruction resulting in mild to bloody diarrhoea similar to dysentery.
- *EPEC* cause profuse watery and sometimes bloody diarrhoea, particularly in infants in developing countries. EPEC adhere to the intestinal epithelium causing disruption of the cellular function. The pathology is associated with production of attaching and effacing lesions similar to those from EHEC. EPEC are distinct from STEC as they do not produce Stx.
- *EAggEC or EAEC* cause both acute and persistent watery and mucoid diarrhoea in young children. EAggEC attach to tissue culture cells in a distinctive aggregative pattern. A plasmid encoded enteroaggregative heat-stable toxin (EAST1) may contribute to diarrhoeal symptoms.
- *DAEC* are less well defined and cause diarrhoea in older children. DAEC are distinguished from EPEC and EAggEC by their diffuse adherence to tissue culture cells.

Cattle and wildlife are recognized as the primary natural reservoir of STEC

Ruminant animals, mainly cattle and wildlife, are recognized as the primary natural reservoir of STEC and, particularly, EHEC O157:H7. Pigs and poultry are not considered to be major sources of STEC for human infection in Europe.

Serotyping using antisera to somatic (O), flagella (H) and capsular (K) antigens is commonly used to distinguish *E. coli* strains, and there are now hundreds of antigenic types. Some pathotypes belong to certain serotypes, although this is not always exclusive. There are pathotype/serotype combinations more commonly associated with food-borne disease, such as EHEC belonging to the O157:H7 serotype. As not all strains are known to present a public health risk, it is important to distinguish pathogenic types based on pathotype as well as serotype.

E. coli and food contamination

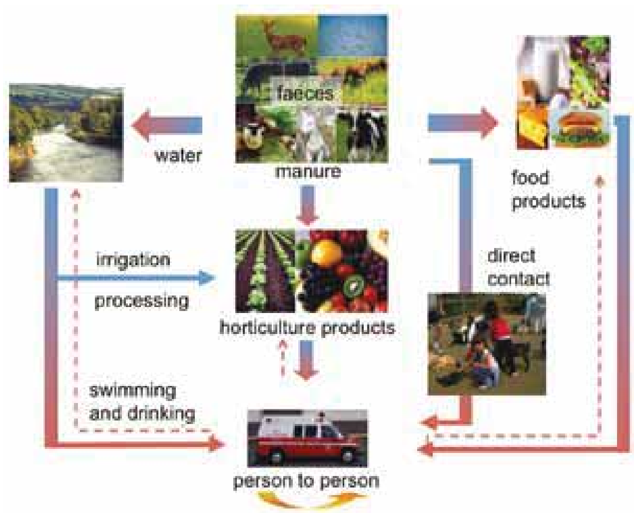
Humans can acquire an infection with pathogenic strains through consumption of food and water directly contaminated with faeces or contaminated as a result of cross-contamination from another food source. In addition there is possible contamination from direct human contact during food preparation. The epidemiology of food-borne pathogenic *E. coli* varies throughout the world. In communities with poor sanitation and hygiene, ETEC, EIEC and EPEC are prevalent. However, food-borne pathogenic *E. coli* have also emerged in communities with better developed sanitation and hygiene systems.

Food may also be contaminated and/or cross-contaminated during growth and harvest (horticulture products), collection (milk) or animal slaughter and carcase dressing (meat). Further contamination can occur during post-harvest handling, transport, processing and preparation.

Fresh meat and raw milk are considered common vehicles for *E. coli*, particularly EHEC O157:H7. Contamination of meat usually occurs during animal slaughter and carcase dressing as a result of poor hygiene practices and inadequate abattoir hygiene standards. Of particular importance are stages such as hide removal, evisceration and handling after dressing, which if not properly controlled are likely to result in contamination of meat by animal faeces.

Fresh vegetables can be contaminated with *E. coli* from animal and human faeces that may enter crop agro-ecosystems through inadequately composted manure, the use of untreated waste- and grey water for irrigation, contaminated seeds, wildlife and insect pests, and nematodes. Contaminated fresh produce that is eaten raw has become an emerging source of human *E. coli* infection. *E. coli* may survive in contaminated soil for up to 20 months. They can also survive for long periods on crop leaves and roots. Younger leaves tend to provide a better habitat than older ones, and leaves with higher levels of nitrogen or damaged leaves and fruits are able to support faster multiplication and prolonged survival of *E. coli*.

Figure 1: STEC transmission



Source: FAO.

Detection of pathogenic *E. coli* in foods

The wide diversity of *E. coli* pathotypes presents challenges for their detection. No single method can be used to detect all types, so methods target specific pathogenicity markers and serotypes. Detection of O157 EHEC has proved the easiest owing to their specific phenotype, virulence traits and serotype. Because even small numbers present in a food may constitute a health risk, enrichment is required to improve sensitivity to detection. Although genetic or immunological detection methods can be used to screen enriched samples, isolation and characterization of the bacterium are required for confirmation.

For the purposes of surveillance, outbreak investigation or assessment of health risk, pathogenic *E. coli* strains are usually typed according to a hierarchy of phenotype, pathotype, serotype, phagetype and DNA-based fingerprints (e.g., pulsed field gel electrophoresis).

The *E. coli* O104:H4 outbreak of 2011

On 26 May 2011, Germany reported what became the largest national outbreak of EHEC infections with the highest numbers of affected people developing HUS caused by Shiga-toxigenic *E. coli* infections. The outbreak was centred in northern Germany and peaked around 21 to 23 May 2011. It was officially considered over on 26 July 2011. During these two months, a total of 4 321 cases comprising 3 469 EHEC cases and 852 HUS cases were reported to the Robert Koch Institute (RKI) in Germany. In total 50 patients died. According to the European Centre for Disease Prevention and Control (ECDC), 76 EHEC cases, of which 49 developed HUS, including one patient who died (as of 22 July 2011) were reported across other European Union countries. All were linked to the German outbreak. Most of the patients who developed HUS were adults (89 percent, median age of 43 years) and women were overrepresented (68 percent).

Germany reported what became the largest national outbreak of EHEC infections

All patients were infected with *E. coli* serotype O104:H4. This rare serotype was previously reported in few STEC and HUS cases, but never in foodstuffs. It was genetically characterized at the National Reference Laboratory for Salmonella and other Enteric Bacteria at RKI and found to possess characteristics of two types of pathogenic *E. coli* – EHEC and EAggEC. The organism was also resistant to many antimicrobials, and the combination of virulence factors suggested that the strain was more likely to be of human rather than animal origin.

The outcome of the epidemiological investigations in Germany suggested that the consumption of several types of sprouts was associated with the outbreak. The original source of the contamination was apparently traced to dry bean seeds used for sprouting.

On Friday 24 June, a cluster of 15 cases of HUS or bloody diarrhoea due to *E. coli* O104:H4 was identified in the Bordeaux area of France. The microbiological characteristics of the isolated strain of *E. coli* O104:H4 from three of the French HUS patients were similar to those of the isolated strain in the German outbreak, including the antibiotic resistance profile. A joint rapid risk assessment by the European Food Safety Authority and ECDC suggested that the consumption of fenugreek sprouts was the possible source of both the German and the French *E. coli* O104:H4 outbreaks.

Control of pathogenic *E. coli* in food and water

As the key points of control tend to vary with the specific pathotype implicated in an outbreak, knowledge of local food-borne disease epidemiology is essential in establishing an appropriate and effective control programme. This requires multidisciplinary approaches that address the interactions among humans, animals, plants and their ecosystems.

Control points along the food chain that will ensure the greatest reduction of risk to public health should be identified, and risk mitigation steps should be taken in accordance with recognized codes of good practice and relevant recommendations from veterinary and public health services. At the pre-harvest or pre-slaughter stage, such steps include minimizing pathogenic *E. coli* colonization of livestock – particularly ruminant – herds and prevention of manure contamination of crops. At the post-harvest or post-slaughter stage, they include slaughterhouse/milking shed hygiene and the application of good hygiene practices during carcase dressing, handling and packing of produce or meat.

Some *E. coli* strains can elicit stress responses that enhance their growth and persistence

Some *E. coli* strains can elicit stress responses that enhance their growth and persistence; for example, STEC may tolerate acid conditions in fruit juice and fermented meat and dairy products. *E. coli* are destroyed by thorough cooking, so any controlled heat treatment can be an effective means of elimination. The main challenges are therefore to prevent contamination or cross-contamination of foods that are to be eaten raw or with minimal processing, and to prevent post-process contamination of food.

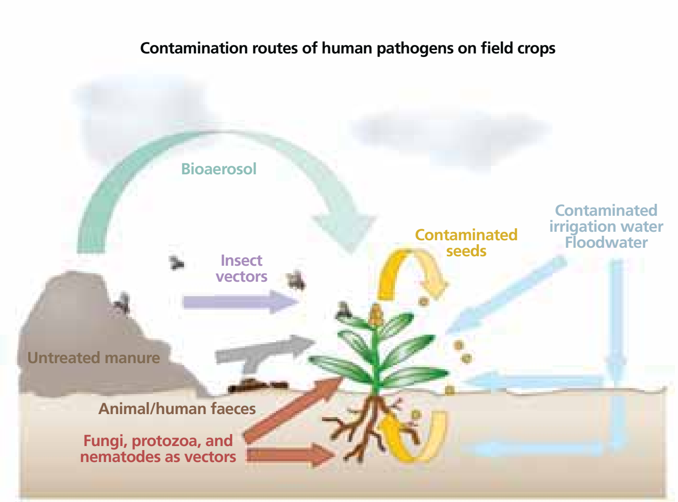
Pre-harvest interventions in farm animal production

Strategies that reduce pathogen shedding in live animals can reduce pathogen populations in food animals before they enter the food chain. For example, abruptly switching cattle from a high-grain ration to a high-quality hay-based diet has been shown to reduce generic *E. coli* and *E. coli* O157:H7 populations. The feeding of probiotic *Lactobacillus acidophilus* bacteria has also been shown to be effective and has been adopted for the pre-slaughter control of *E. coli* O157:H7 in cattle. Further research is needed to elucidate the mechanism (e.g., competitive exclusion, physical removal, forage quality, tannins, lignin, other phenolics) by which forage feeding affects the microbial ecology of the bovine intestinal tract, including the ecology of *E. coli* and *E. coli* O157:H7 populations, so that economically viable and practical dietary interventions can be implemented. Current areas of investigation include feed and water hygiene, dietary supplements and vaccination (a vaccine against *E. coli* O157:H7 is commercially available). Research should also be aimed at improving understanding of the factors that cause individual animals to shed high numbers of pathogenic *E. coli* (so-called "super shedders") and at identifying such animals and their farm holdings of origin. This would allow more risk-based controls to be applied to limit the risks of contamination from such animals or holdings.

Pre-harvest strategies in fresh produce and sprout production

Appropriate on-farm manure storage and handling practices that minimize runoffs from farms are important. Crop management can also reduce some of the factors

Figure 2: Contamination routes of human pathogens on field crops



Source: Brandl, 2006.

associated with *E. coli* populations and could reduce the risks of epidemics in humans. It is generally possible to reduce the survival and growth of *E. coli* populations in crops by adopting good agricultural practices (FAO, 2011b). These include reducing the use of nitrogenous fertilizer, applying only treated or well-processed manure with a higher carbon-to-nitrogen ratio, applying compost, ensuring that seeds are not contaminated before planting, encouraging better animal and human hygiene in the field, and irrigating with clean water. While intended to reduce risks from *E. coli*, these practices also support the sustainable intensification of crop production.

Low levels of pathogenic *E. coli* grow prolifically during the production of sprouted seeds, so it is necessary to establish control to minimize initial seed contamination and limit subsequent growth. Guidance is available in the document CAC/RCP 53-2003 Annex for Sprout Production in FAO and WHO, 2007. This can be downloaded from the Web site[1] or obtained on request from the Secretariat of the Codex Alimentarius Commission.[2]

Food processing and preparation

Effective prevention of post-harvest contamination and cross-contamination can be achieved by applying practices based on the principles of good hygiene and manufacturing practices and Hazard Analysis Critical Control Point (HACCP)-based approaches. For the meat sector, the FAO (FAO and *Fondation Internationale Carrefour*, 2004) manual, *Good practices for the meat industry,* outlines these principles. FAO is also involved in projects to strengthen veterinary public health systems and services

[1] www.codexalimentarius.net/download/standards/10200/CXP_053e.pdf
[2] codex@fao.org.

through veterinary supervision and inspection of animal slaughter establishments and practices, meat inspection and slaughterhouse hygiene.

Food handlers should follow the Codex Alimentarius Commission (CAC, 2001) *General Principles of Food Hygiene*, and the WHO (2006) guide, *Five keys to safer food*. Improved consumer awareness and education are also essential.

Conclusions

A wide variety of pathogenic *E. coli* strains causing human food-borne diseases can be found in the gastrointestinal tract of animals and in the environment. Some animals or animal species can be asymptomatic carriers. *E. coli* stains are known for their propensity to exchange genetic elements and adapt to changes in their environment. Sometimes this leads to the emergence of strains with increased pathogenicity and survival capabilities.

The most effective way of preventing *E. coli* contamination of food and water is through the implementation of good hygiene and good practices at the primary production level and along the stages of the food supply chain, such as post-harvest/ post-slaughter and any subsequent handling and preparation stage.

It is also necessary to strengthen systems for epidemiological surveillance of STEC, including non-O157 *E. coli*.

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Avian influenza

H5N1 highly pathogenic avian influenza outbreak dynamics and drivers in Indonesian poultry, 2008 to 2010

Background

H5N1 highly pathogenic avian influenza (HPAI) was first reported in poultry in Indonesia in 2004 and outbreaks have subsequently continued to affect domestic poultry populations and humans in many parts of the country. By early August 2011, 178 human cases had been reported, of which 146 were fatal. In early 2008, the Indonesian Government implemented a revised participatory disease surveillance response (PDSR) programme to allow rapid identification and response to H5N1 HPAI outbreaks. Through this programme, data were collected from a combination of random and targeted active surveillance, passive surveillance based on events reported to the government, and follow-up visits to villages where a potential or actual outbreak had previously occurred. During visits, villages were assigned one of five HPAI status indicators: infected, suspect(14), suspect(60), controlled, or apparently free. Infected status was assigned to villages where an HPAI-compatible event had occurred within the previous 60 days and an Anigen® rapid test at the time of the visit was positive. A village was defined as suspect(14) or suspect(60) when there were no positive rapid tests at the time of the visit although an HPAI-compatible event had occurred within the previous 14 or 60 days, respectively. A village received controlled status if follow-up investigations found no HPAI-compatible events for 14 days after implementation of control measures. Apparently free villages were those where no HPAI-compatible event was present at the time of the visit and none had been reported over the previous 60 days.

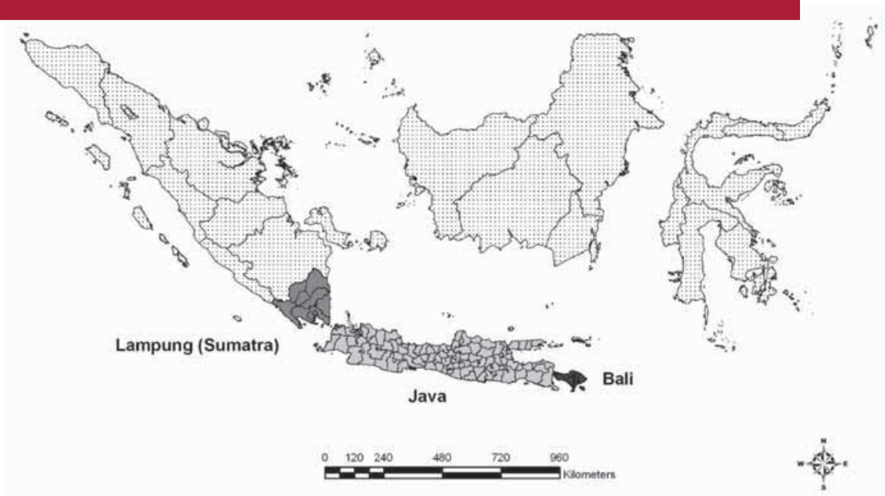
The spatial-temporal dynamics of H5N1 HPAI outbreaks in Indonesia was examined using ecological approaches to identify potential drivers of outbreak maintenance and spread

Data collected by the PDSR programme between April 2008 and September 2010 for Java, Bali and Lampung Province of Sumatra (Figure 1) provided the opportunity to examine the spatial-temporal dynamics of outbreaks in Indonesia, using ecological approaches to identify potential drivers of outbreak maintenance and spread. Although the PDSR data were gathered at the village level, the analysis was conducted at the district level for nine 90-day rolling periods, with data for the five HPAI outbreak status indicators being summarized at the district level. During each 90-day period, if an outbreak was recorded in a village anywhere within a district, it was defined as the presence of HPAI in that district for that period. For the other outbreak status indicators, the number of each reported outcome type was counted for each district and time period and the results were used as covariates (not outcome variables). These covariates included the numbers of villages reported controlled, suspect(14) and disease-free in each district for each 90-day period.

The study set out to determine: i) the probability of a district becoming infected after a period of freedom (90 days), referred to as the "colonization probability";[1]

[1] Colonization probability refers to the probability of HPAI infection in a district where there was no infection in the previous 90-day period. It could be interpreted as being the probability of new outbreaks in a district.

Figure 1: Indonesian provinces with PDSR activities, and the study area for this research (shaded)



Source: PDSR, Directorate General of Livestock and Animal Health Services (DGLAHS), Indonesia.

ii) the probability of an outbreak persisting in a district, referred to as the "persistence probability";[2] iii) how a district's HPAI status in a previous period influenced the occurrence of outbreaks (colonization and persistence) in that district; and iv) the effect of risk factors such as human and poultry population densities on the probability of outbreaks (colonization and persistence) at a district.

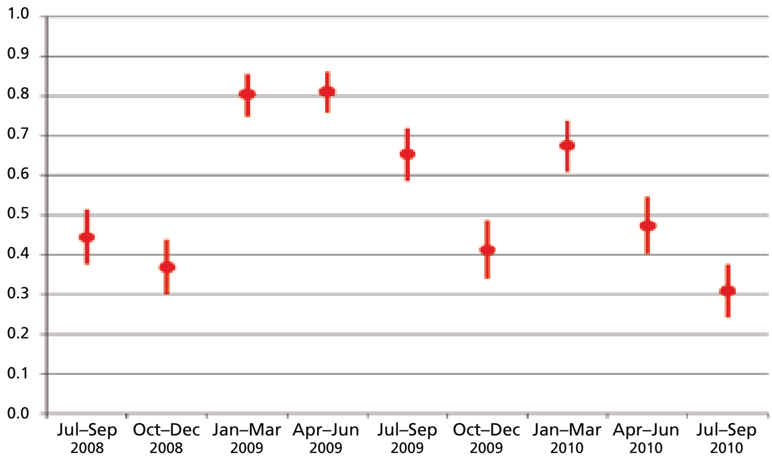
Spatial and temporal patterns of outbreaks

The data available suggested that there were strong temporal and spatial differences in outbreak probabilities across the areas examined. For all districts in the study area, the average outbreak probability over time followed a distinct seasonal pattern (Figure 2). The probabilities of outbreaks increased during the early months of the year (January to March) and declined for the July to September and October to December periods, in both 2009 and 2010. This seasonality in H5N1 HPAI outbreak dynamics has been reported previously for several Asian countries. The risk factors for seasonality were shown to differ among locations.

Over the 30-month study period, the average outbreak probabilities by district (Figure 3) ranged from 0.17 to 0.60 in Bali and East Java Provinces, with a gradient of increased outbreaks towards the west. In Central Java and Yogyakarta Provinces outbreak probabilities were noticeably higher, usually ranging from 0.50 to 0.92. Western districts of Java had moderate outbreak probabilities, which appeared to be more heterogeneous than in the rest of Java, ranging from less than 0.10 to more than 0.80. All districts in Lampung Province of Sumatra showed outbreak probabili-

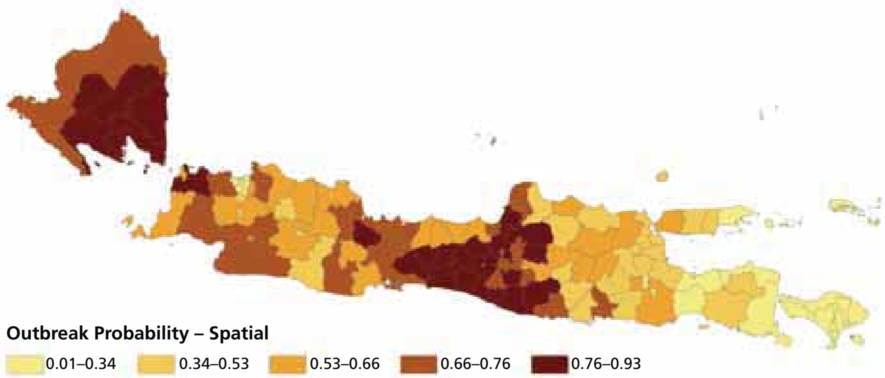
[2] Persistence probability refers to the probability of HPAI infection being maintained in a district from the previous to the current 90-day period. It could be interpreted as being the probability of HPAI maintenance.

Figure 2: Outbreak probabilities for 90-day periods, averaged across all districts in the study area, July 2008 to September 2010



Source: PDSR, Directorate General of Livestock and Animal Health Services (DGLAHS), Indonesia.

Figure 3: Spatial distribution of outbreak probabilities in districts across the study area, averaged across 90-day periods



Source: PDSR, Directorate General of Livestock and Animal Health Services (DGLAHS), Indonesia.

ties of more than 0.70, with several exceeding 0.80, suggesting that levels of virus circulation were nearly constantly high in these areas, mainly because of the movement of poultry and products through poultry market chains.

Determinants of disease outbreaks

The analysis showed that the occurrence of outbreaks in each study district was affected by poultry and human densities and the number of villages in the district assigned to controlled status during a previous period. The occurrence of new outbreaks (colonization probability) was higher in districts with relatively low poultry densities, while outbreak persistence was favoured by high poultry densities. In addition, the occurrence of new outbreaks dropped as poultry density increased, while persistence probability remained relatively high at all but the highest densities. The observed relationship between poultry density and new outbreaks (colonization probability) suggests that districts with relatively low poultry densities that had not reported outbreaks in a 90-day period were susceptible to new outbreak incursions. The drop in colonization probability at higher poultry densities possibly indicates that as poultry density increases, the virus is more likely to persist year-round, rather than to colonize seasonally.

The relationship between outbreak persistence and poultry density was non-linear; however the poultry density at which disease persistence was highest was almost double the density that maximized new outbreak probability. This pattern suggests that high probability of incursion of H5N1 HPAI into a previously unaffected district can occur at relatively low poultry densities within a district; however, a much higher poultry density is required to sustain a high persistence probability across a 90-day period. This suggests that at lower densities there are too few susceptible hosts to maintain the transmission chain between 90-day periods, and that control efforts are more likely to be successful where poultry densities are lower. The study also shows that virus survival in the environment appears to be an important factor in the epidemiology of the disease in the study area. Taken together, the patterns of colonization and persistence of H5N1 HPAI in relation to poultry density support the view that H5N1 is a seasonal disease in Indonesia, with year-round persistence more likely in areas with sufficient poultry density to support continuously a basic reproductive number greater than one, regardless of the time of year.

The occurrence of outbreaks was affected by poultry and human densities and the number of villages in the district assigned to controlled status during a previous period

The effect of human density on outbreak colonization probability was linear, meaning that as density increased the chance of new outbreaks within any 90-day period increased. This may reflect greater movement of live poultry between market networks and local markets within a given area, through facilities such as live-bird markets and collector yards. New outbreaks were maximized at moderate human density (6 250/km^2) and relatively low poultry density (fewer than 2 000/km^2). Although this is a relatively low human density compared with districts with large urban populations, such as Jakarta (14 493/km^2), it is higher than the density in most of the rural districts considered.

In a district, the more villages assigned to controlled status in a previous period the greater the probability of outbreak persistence (i.e., the continuous presence of outbreaks over time). This indicated that districts that experience large numbers of outbreaks, and hence have large numbers of villages with controlled status reported in the surveillance database, continue to experience relatively large numbers of outbreaks into the future. Such districts are likely foci of the endemicity of HPAI in Indonesia, and so should be targeted for enhanced disease control activities. PDSR activities do not include surveillance in the commercial sector, so it is not possible to give an indication of the impact of disease on this part of the poultry population; only village poultry are under surveillance.

Conclusions

In general, H5N1 HPAI outbreaks reported in poultry in Java, Bali and Lampung Province of Sumatra between 2008 and 2010 demonstrated marked seasonality, with increased outbreaks during the early months of the year (January to March). The spatial distribution of outbreaks varied across the study area, with highest probabilities in Lampung, Central Java and Yogyakarta Provinces, implying endemic disease in these areas. Districts with relatively low poultry densities were likely to have new outbreak incursions after a period of freedom, while those with high poultry densities were likely to have continuous outbreaks over time. An increase in the number of villages reported with controlled status in a previous period increased the possibility of repeated outbreaks.

Acknowledgements

Much of this report was extracted from the original publication by Farnsworth *et al.* (2011), with some important differences, including an attempt to simplify the technical language, to highlight the practical implications of analysis presented by Farnsworth *et al.* This report demonstrates the value of the disease data collection and analysis that long-term surveillance of HPAI in Indonesian village poultry makes possible. The findings will support the development of technical approaches to refining surveillance and disease control, and provide policy-makers with insights into the mechanisms of HPAI persistence in poultry in Indonesia.

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Eastern Africa selects a regional laboratory for highly pathogenic avian influenza and Newcastle disease

The Eastern Africa Regional Laboratory Network (EARLN) for Highly Pathogenic Avian Influenza and other Transboundary Animal Diseases was launched in June 2008 at the FAO regional workshop in Debre Zeit, Ethiopia. Its members are national veterinary laboratories of 12 eastern African countries: Burundi, the Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Kenya, South Sudan, Rwanda, Somalia, the Sudan, the United Republic of Tanzania and Uganda. The overall technical and operational capacity of each national laboratory member of EARLN was reviewed during the regional workshop, along with their specific abilities and capacities to carry out highly pathogenic avian influenza (HPAI) diagnosis and differential diagnosis. Workshop participants also determined the need to designate a regional laboratory for avian influenza (AI) and Newcastle disease (ND), and the minimum requirements for such a laboratory. Subsequent network meetings held in Kigali, Rwanda (July 2009) and Dar es Salam, United Republic of Tanzania (July 2010) provided additional opportunities to discuss and define the specific roles and modalities for selecting the regional laboratory, and it was concluded that a clear picture of the technical and operational level of each laboratory member of EARLN was required, through detailed assessments of each national laboratory facility.

The Food and Agriculture Organization of the United Nations (FAO) requested the World Organisation for Animal Health (OIE)/FAO Reference Laboratory for Avian Influenza and Newcastle Disease at the *Istituto Zooprofilattico Sperimentale delle Venezie* (IZSVe), Padova, Italy to carry out a series of independent assessments of central veterinary laboratories (CVLs) in the region. These assessments took place between June 2008 and August 2010, and their findings were presented and discussed during a meeting of East African chief veterinary officers (CVOs) and heads of CVLs, organized in Zanzibar, United Republic of Tanzania from 24 to 26 August 2010 by the Emergency Centre for Transboundary Animal Disease Operations (ECTAD) Unit for Eastern Africa. The meeting was attended by the CVOs of ten countries and representatives of OIE, the African Union Interafrican Bureau for Animal Resources (AU-IBAR), IZSVe, the Southern African Centre for Infectious Disease Surveillance (SACIDS), the United States Agency for International Development's Emergency Pandemic Threats (USAID/EPT) RESPOND programme and the FAO regional office for Africa (Accra, Ghana). Based on the assessment findings, criteria for selecting the regional laboratory for eastern Africa were agreed. These are outlined in the box on the next page.

ELISA testing in the serology unit

Histological examinations

Based on these criteria, the CVOs at the meeting short-listed the CVLs of Ethiopia, Kenya, the Sudan and the United Republic of Tanzania as candidates. The CVOs of these countries were then asked to confirm their commitment to hosting the regional laboratory by formally submitting applications to ECTAD in Nairobi (Kenya). These applications had to provide evidence that the CVL could serve as the regional laboratory. An EARLN interim secretariat (IS) consisting of FAO-ECTAD, AU-IBAR, OIE, two representatives from EARLN Member States (one for livestock and the other for wildlife), and the regional economic communities – the East African Community (EAC) and the Intergovernmental Authority on Development (IGAD) – was mandated to deliberate on the applications and review the dossiers submitted. The CVOs agreed on the following terms of reference or roles for the regional laboratory:

- assist in building the capacity of other laboratories in the region by providing training on AI/ND diagnostic techniques and organizing technical and coordination meetings;
- assist in the procurement (or production) and/or maintenance of stocks of AI/ND reagents, such as reference antigens and antisera, for emergency release to the region;
- contribute to the preparation, harmonization or review of technical reference documents, such as manuals and standard operating procedures, for use within the region;
- receive samples for AI diagnosis, perform required tests and report the results in a timely manner;

Criteria for selecting eastern Africa's regional laboratory for HPAI and ND

1. A statement of the government's commitment to supporting the role and responsibilities of the regional laboratory, issued by a high-level government member.
2. A strategic location within the region, making the laboratory easily accessible to eastern African countries (for the sending of samples, communications, scientific visits, training, etc.).
3. An organizational set-up that includes:
   - institutional and technical management arrangements;
   - commitment to and effective implementation of a quality management system, following the technical and management requirements set out in International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 17025: 2005 standard guidelines with the ultimate objective of eventual accreditation for AI diagnostics;
   - willingness to provide AI confirmatory services to other countries;
   - willingness, experience and means for submitting infectious agents to OIE/FAO reference laboratories;
   - evidence of activities and training capabilities for AI/ND and other transboundary animal disease (TAD) diagnostic procedures;
   - experienced and qualified personnel capable of undertaking AI virology and molecular diagnostics;
   - adequate functional equipment;
   - reliable electricity supply and water services, with back-up;
   - functional incinerators;
   - a proper waste disposal system;
   - laboratory conditions of at least biosaftey level (BSL) 2, with plans to improve to at least BSL2+;
   - animal housing facilities;
   - sufficient laboratory rooms dedicated to AI/ND diagnosis;
   - good local and international networking with laboratories, research institutes and universities;
   - good level of funding – from government, own funds or potential funding agencies;
   - participation in inter-laboratory proficiency testing for AI/ND;
   - experience of international collaboration for receiving and submitting samples and providing training in AI/ND diagnosis;
   - experience of hosting trainees from other countries or receiving and processing samples from other countries;
   - capability or potential ability to produce diagnostic reagents for AI/ND (e.g., facilities for research and development, and demonstrated experience in this field);
   - experience of handling AI virus (e.g., numbers of samples handled and tests conducted over the past three years);
   - capability of maintaining a repository of animal pathogens.

- lead the standardization of HPAI diagnostic techniques in the region, such as through missions to assist in addressing laboratory-related testing issues;
- assist in the organization and implementation of regional proficiency testing;
- facilitate international submission of AI samples to world reference centres;
- assist in the evaluation of new diagnosis-related technologies and disseminate new knowledge to member countries.

Following the Zanzibar meeting, all four short-listed countries submitted their application dossiers to the ECTAD unit. These were reviewed at a meeting of the IS on 9 and 10 May 2011, in Nairobi, which was attended by representatives of FAO-ECTAD, OIE, AU-

IBAR, EAC, the Veterinary Service of Ethiopia, the Wildlife Service of the United Republic of Tanzania and a representative of Kenya's CVO. The IS decided to select one regional laboratory, in the understanding that network members may decide to designate a second regional laboratory at a future date, should the need arise. The IS reached consensus on the methodology to be used for reviewing the dossiers and ranking the four laboratories. At the end of the process, the National Animal Health Diagnostic and Investigation Centre (NAHDIC) of Ethiopia was ranked first. Accordingly, the IS meeting recommended the designation of NAHDIC, Sebeta, Ethiopia as the eastern Africa regional laboratory for AI and ND.

The newly designated regional laboratory needs additional support to be able to fulfil its new responsibilities. Such support should include the provision of reagents, laboratory materials, equipment and capacity building. This laboratory is considered a priority for twinning arrangements with an OIE/FAO reference laboratory for AI and ND.

Key information about NAHDIC

The National Animal Health Diagnostic and Investigation Centre (NAHDIC) is the national referral veterinary laboratory of Ethiopia. It was established in 1995 in Sebeta and was initially named the National Animal Health Research Centre, changing its name in October 2007. This name change brought a broadening of responsibilities and duties from the centre's primary focus on research. NAHDIC now:

1. generates internationally acceptable laboratory diagnostic results to support the export trade of livestock and livestock products;
2. coordinates and performs national surveillance and diagnosis of livestock diseases of economic and public health importance, whose occurrence can lead to lengthy export bans for livestock and livestock products;
3. builds capacity in all Ethiopia's regional veterinary laboratories, to help improve the national veterinary service so it can address the problems facing poor farming and pastoral communities;
4. undertakes a regulatory role for the control and eradication of animal trypanosomosis and tsetse fly;
5. coordinates the control and eradication of hide and skin diseases in Ethiopia, contributing to increased income generation from the animal hides sector;
6. contributes to the expansion of high-quality veterinary education at all the veterinary faculties in Ethiopia, by hosting 12 to 15 graduate students (M.Sc., DVM, B.Sc., and Ph.D.) a year for their dissertation research;
7. runs and coordinates national and international research projects such as vaccine trials for peste des petits ruminants and capripoxes, and modelling of disease dissemination.

NAHDIC has 121 staff members excluding its satellite laboratory for trypanosomosis control. Most of its activities support the generation of foreign income from exports of livestock and livestock products. The South African National Accreditation Service (SANAS) has recommended the centre for accreditation under ISO 17025 for five TADs: brucellosis (Rose bengal plate test), Rift Valley fever (enzyme linked immunosorbent assay [ELISA]), peste des petits ruminants (ELISA), foot-and-mouth disease (ELISA), and ND virus and AI (molecular diagnosis). In November 2009, it established a national laboratory network with 15 regional laboratories, and it participates in proficiency tests for Rift Valley fever, foot-and-mouth disease, peste des petits ruminants, brucellosis, HPAI and ND virus. NAHDIC has applied for OIE laboratory twinning projects, as a means of improving its diagnostic capacity and compliance with OIE standards.

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Four-way linking of epidemiological and virological information on human and animal influenza

Preface

In recent decades there has been an unprecedented increase in the numbers of new and highly threatening viral diseases of humans and animals. One example has been the rapid spread of highly pathogenic avian influenza (HPAI) H5N1 viruses among poultry populations, and the subsequent threat to humans, especially in Asia, Europe and Africa. In the scientific community, discussions continue about the best control strategies for such pandemics, but it is clear that successful management and containment of HPAI depend on the ability of the animal and human health sectors to work together before, during and after epidemics. Efficient epidemiological and virological information management systems are necessary for effective collaboration and timely response by the public health (PH) and animal health (AH) sectors. Such systems need to manage the variety of data required to assess the public health risk of influenza at the human-animal interface, at the national, regional and global levels, so that actions by the different actors can be harmonized. Unfortunately, coordination between PH and AH sectors has so far fallen short of the basic requirements for efficient control of HPAI.

The concept

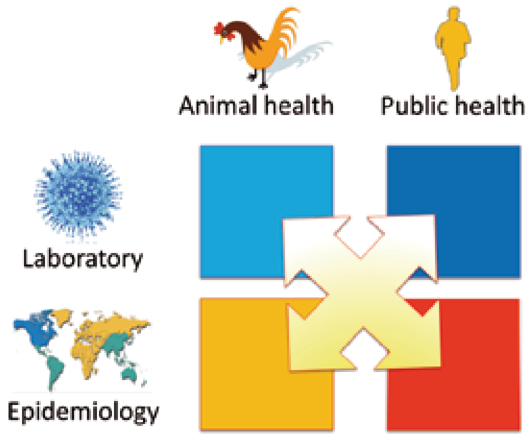
The four-way linking framework is a collaborative effort among WHO, FAO, OIE, OFFLU and GLEWS

The four-way[3] linking framework is a collaborative effort among the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (OIE), the OIE/FAO network of expertise on animal influenza (OFFLU) and the Global Early Warning and Response System for Major Animal Diseases, including Zoonoses (GLEWS) to improve national, regional and global qualitative risk assessments for animal and zoonotic influenza. This framework seeks to establish a national-level mechanism for routine, integrated and qualitative assessments of virological and epidemiological influenza data from humans and animals. Decision-makers can use the information from the risk assessments to develop and implement new scientifically based measures for prioritizing and managing the risks identified and for evaluating the effects of measures already in place.

To ensure the availability of appropriate information for conducting such assessments it is necessary that systems be in place for collecting relevant epidemiological and virological information on influenza from both animals and humans, and for establishing linkages within this information according to where and when events took place, which samples and isolates belong to which human cases or animal outbreaks, and which humans were associated with which animals and when. This linked information can be examined and assessed by experts in different fields to: i) improve understanding of the overall situation, including the animal and public health risks from influenza; and ii) identify gaps in information availability or national systems.

[3] Four-way linking focal points: Filip Claes (FAO), Gwenaelle Dauphin (FAO), Liz Mumford (WHO), Kate Glynn (OIE).

Figure 1: Four-way linking of epidemiological and virological information on influenza in animals and humans



The national process for collecting relevant information and assessing risks is expected to be iterative within the four-way linking framework; gaps in the available information, and areas where national systems need strengthening would be identified during risk assessments, and used to suggest areas for improvement. Subsequently, improved information would allow better assessments, which in turn would suggest additional refinements to national systems. It is envisioned that the four-way linking framework could therefore act as a national platform for the alignment of internationally mandated capacity building and other national-level projects and activities designed to improve the systems.

The framework will be tested in three pilot countries and is expected to improve the linkage between national-level information about human influenza epidemiology and virology and about animal influenza epidemiology and virology (including sequence analysis). Regular risk assessments will also increase awareness and understanding of the process among the technical staff involved and among the stakeholders and decision-makers receiving the information. At the global level, the project aims to develop a standard mechanism for joint qualitative risk assessment of linked data for zoonotic influenza. Country-level implementation will be in partnership with human and animal health institutes and the respective ministries.

Assessment missions

WHO, FAO and OIE carried out joint assessment missions in two pilot countries – Egypt and Viet Nam – to identify key partners, national initiatives and current efforts, and existing operational tools and systems for epidemiological and virological surveillance of influenza in both the PH and AH sectors. The team assessed the existing systems for data collection, data traceability, data exchange and reporting of influenza within the PH and AH sectors, and identified major gaps in and constraints to these systems.

Observations in the pilot countries found positive trends, but also revealed opportunities and challenges for working towards more efficient information management. The following are some of the important issues to emerge:

- Increased veterinary capacity for surveillance and investigation is required.
- Human cases and positive poultry cases should be investigated by combined PH-AH teams, but cooperation between the two sectors is sometimes incomplete.
- Data sharing between sectors is incomplete, and there is no organization or output that combines intelligence from all aspects. Concerns over intellectual property and perceived lack of organizational support are the main barriers to data sharing.
- More analysis of epidemiological data for both sectors is necessary. At the moment, data are often compiled without analysis and interpretation.
- It is difficult to obtain exposure information for human cases, as late reporting generally makes it impossible to obtain real-time follow-up on the level of disease in the related poultry population. It is also difficult to obtain exposure information from poultry outbreaks where no human cases are reported.
- Translating surveillance outcomes into policy decisions is difficult.

Participants and facilitators of the four-way linking workshop in Ain Sokhna, Egypt, 26 to 28 September 2011

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National workshops

National-level workshops will help address and improve collaboration among the sectors in pilot countries. The first four-way linking workshop was held in Ain Sokhna, Egypt from 26 to 28 September 2011 with participation from the four main sectors involved in control of HPAI in Egypt – public health epidemiology (Ministry of Public Health, Epidemiology Unit), public health virology (Central Public Health Laboratories [CPHL]), animal health epidemiology (General Organisation for Veterinary Services [GOVS]) and animal health virology (Central Laboratory for Quality Control of Poultry Production [CLQP]) – and academia (two professors). Through didactic presentations, group work, plenary discussions and scenario-based training, the workshop addressed principles and applications of (joint) risk assessment; communication and data sharing among laboratory staff and epidemiologists; and the benefits of joint AH-PH outbreak investigations. The workshop identified gaps in daily work at the animal-human interface, and possible solutions to these gaps, leading to concrete proposals for improving mechanisms and communications among the four sectors. The outcome of the process will inform policy- and decision-makers for HPAI control. The national workshop in Viet Nam will be held in February 2012.

In conclusion, there is a definite need to build mechanisms for enabling and supporting data sharing, improving joint work on case investigations, and improving and harmonizing surveillance systems. The four-way linking platform can be instrumental in bringing together stakeholders from the animal and human health sectors, to facilitate virological and epidemiological information sharing. To improve the cooperation and data sharing between PH and AH, formal agreements that allow direct contacts between the two sectors are necessary.

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OFFLU Avian Influenza Vaccine Efficacy project in Egypt

Highly pathogenic avian influenza (HPAI) subtype H5N1 is currently endemic in Egypt, with the first outbreaks reported in February 2006. In efforts to control the disease, vaccination of commercial flocks was introduced at the end of March 2006, and mass vaccination of household poultry was conducted from May 2007 until 2009. As in other countries applying vaccination against HPAI, these vaccination efforts met with variable success, and to increase understanding of how to improve the use of vaccination as part of an overall control strategy, the Food and Agriculture Organization of the United Nations (FAO) – in close collaboration with national agencies – implemented a three-year (2008 to 2011) World Organisation for Animal Health (OIE)/FAO network of expertise on animal influenza (OFFLU) technical project entitled Vaccine Efficacy for the Control of Avian Influenza (AI) in Egypt (OSRO/EGY/801/USA). The project aimed to promote the appropriate use of efficacious poultry vaccines as part of a comprehensive strategy to combat HPAI through understanding the characteristics and epidemiology of circulating A/H5N1 viruses; determining the efficacy of available AI poultry vaccines; and supporting the development of sustainable national systems to monitor viral evolution and ensure vaccine efficacy.

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Poultry vaccination in Egypt

National partners included laboratories with national diagnostic responsibilities (Central Laboratory for Quality of Poultry Production – CLQP) and those responsible for veterinary vaccine quality (Central Laboratory for Evaluation of Veterinary Biologics – CLEVB). International partners were recognized leaders in influenza research: the Southeast Poultry Research Laboratory (SEPRL) of the United States Department of Agriculture (USDA) (which is the OIE Collaborating Centre in Research on Emerging Avian Diseases) was responsible for laboratory capacity building activities for CLQP, conducting of and training in laboratory challenge trials, and evaluation of procedures for registration and licensing of poultry vaccines for AI; and the Erasmus Medical Centre undertook virus relationship analysis using antigenic cartography.

The project also benefited from concurrent work conducted by the *Istituto Zooprofilattico Sperimentale delle Venezie* (IZSVe, Italy) and the *Friedrich-Loeffler-Institut* (FLI, Germany), which are OIE/FAO reference centres for avian/animal influenza and Newcastle disease. Technical collaboration between IZSVe and the public and private sectors in Egypt (particularly universities and vaccine manufacturers), and the OIE twinning project between FLI and CLQP, entitled Promotion of Rapid Molecular Diagnosis and Characterization of Avian influenza and Newcastle Disease Viruses, contributed data and shared information that enabled the OFFLU project to develop an even broader perspective on the Egyptian H5N1 situation. The project was funded through the United States Agency for International Development (USAID), which had funded a similar project implemented by FAO in Indonesia. Lessons learned from these projects and other FAO national programmes in affected countries contribute to the understanding and control of HPAI.

Characteristics and epidemiology of circulating A/H5N1 viruses

Genetic analysis was conducted on isolates from 2008 to 2010

To improve understanding of the evolution of the H5N1 HPAI virus in Egypt and assess the impact of AI vaccines used in poultry, biologic and genetic characterization and analysis of H5N1 HPAI viruses were conducted at both national and international reference laboratories. Between 2006 and 2008, a total of 1 592 cases of H5 AI were detected using real-time reverse transcription polymerase chain reaction (RT-PCR) (confirmation of N1 was conducted on a subset of samples), and 586 cases were confirmed during 2009/2010. A total of 540 virus isolates were obtained, predominantly from household poultry: 157 from 2006 to 2008; 160 from 2009; and 223 from 2010. Genetic analysis was conducted on isolates from 2008 to 2010; SEPRL conducted sequencing of 27 isolates and supported the laboratory staff at CLQP in completing 170 H5 genes and 71 N1 genes. The data from the majority of the genes sequenced by CLQP and SEPRL have been submitted to public databases such as Genbank. Phylogenetic analysis of the Egyptian viruses indicated two major groupings – "classical" and "variant". The classical viruses prevailed in household poultry, most of which is unvaccinated; these viruses belong to clade 2.2.1, according to the updated World Health Organization (WHO) unified nomenclature for H5N1,[4] and demonstrated few mutations compared with the initial introduced virus from 2006. The variant viruses were predominantly detected in the commercial sector, where vaccination is routinely applied, and appeared in late 2007 (Arafa *et al.,* submitted). These variants belong to a newly designated 2.2.1.1 clade and demonstrated a higher mutation rate (Cattoli *et al.,* 2011) than classical viruses. It is to be noted that these variant viruses have not been associated with human infections, apart from one human case in 2009 (109 human cases were reported by WHO between 2008 and 2 November 2011).[5] While these findings have improved the epidemiological understanding of the HPAI situation in Egypt (Arafa *et al.,* 2010; submitted), they also highlight the need to include representative sampling from all poultry production sectors to ensure a more complete understanding of the situation, especially in efforts to monitor vaccine efficacy.

Antigenic cartography (Smith *et al.,* 2004) quantifies the antigenic differences between the haemagglutinin (HA) proteins of tested viruses based on haemagglutination inhibition (HI) assay data. The data are displayed in a map format to enable visualization of the antigenic distances between the viruses. This method was applied

[4] www.who.int/csr/disease/avian_influenza/guidelines/nomenclature/en/

[5] www.who.int/influenza/human_animal_interface/en_gip_20111102cumulativenumberh5n1casesupdated.pdf

to aid the selection of candidate challenge and vaccine strains for further *in vivo* testing.[6] Reference strains for reagent production were selected from the Egyptian strains, based on the year of isolation and biological characterization, and shared among the partners. Technical staff from CLPQ were trained in assay techniques, data management and analysis of the cartography results, and participated in reagent production with SEPRL, using a harmonized protocol.

Challenge tests

Trials to determine vaccine efficacy through challenge testing against both classical and variant strains were conducted at both SEPRL and CLQP, and benefited from additional information from trials conducted separately at FLI (Grund *et al.,* 2011) and IZSVe (Terregino *et al.,* 2010). In laboratory trials, birds were inoculated using either commercially available inactivated vaccines or experimental inactivated vaccines generated from classical or variant Egyptian strains. The level of protection and the extent of virus shedding after challenge were then evaluated.

All trials under the OFFLU project – and those carried out by FLI, IZSVe, CLQP and the Veterinary and Agrochemical Research Centre (VAR – Belgium) (Rauw *et al.,* 2011), where a classical sub-lineage Egyptian virus was used for challenge – demonstrated 100 percent clinical protection under laboratory conditions, regardless of the vaccine strain used. For trials using challenge viruses from the variant sub-lineage, protection afforded from vaccination was highly variable (ranging from nearly 80 percent to complete vaccine failure of 0 percent protection in a few cases), as was the level of virus shedding post-challenge. However, the data also suggest that vaccines with sufficient antigen content to produce high titres in the bird could be protective even against viruses with large antigenic and genetic differences (e.g., variants). This highlights the importance of the antigenic content of commercial vaccines in stimulating the appropriate immune response.

Vaccines could be protective even against viruses with large antigenic and genetic differences

Laboratory capacity building

Laboratory capacity building activities and technology transfer under this project aimed to support the rapid and accurate diagnosis of H5N1 HPAI in government veterinary laboratories and to ensure the sustainability of ongoing surveillance and monitoring activities.

Laboratory staff at CLQP and CLEVB received training on-site and abroad (at SEPRL) on genetic sequencing for H5N1 HPAI and phylogenetic analysis; antigenic characterization and production of standardized reagents; safety, potency, purity testing, and challenge testing of H5 AI vaccines; and laboratory biosafety and biosecurity. Recommendations were provided, related to the CLQP and CLEVB facilities: protocols for pathogen characterization, vaccine potency and efficacy determination; and virus surveillance.

[6] Antigenic cartography data should not be regarded as the only criterion for predicting vaccine efficacy.

Recommendations and perspectives

Project partners contributed their expertise through joint data analysis and technical review of strategies and policies, developed recommendations and indicated necessary actions. These outcomes were delivered at two meetings (January 2009 in Cairo, Egypt, and June 2011 in Rome, Italy), which engaged other national stakeholders. Project activities helped strengthen national laboratory capacity, improve biosafety procedures in national partner laboratories, and support ongoing virus detection and characterization through the provision of laboratory equipment, reagents and other consumables. Support to the development of a new laboratory information management system made it possible to monitor and respond to disease outbreaks and analyse epidemiologic data in conjunction with laboratory data. The outcome of biologic, genetic and antigenic analyses of Egyptian viruses contributed to understanding of these viruses and identification of potential candidate vaccine strains for use in poultry.

CLQP should continue the surveillance and characterization of influenza viruses, to develop a complete understanding of the epidemiology of H5N1 HPAI in Egypt and ensure sound disease control planning and informed decision-making. The data generated by such surveillance and characterization are used to validate diagnostic tests and enable early detection of emerging viruses with specific mutations that have major phenotypic implications. Collection and integration of data on vaccine efficacy and effectiveness at both the laboratory and the field levels (e.g., post-vaccination monitoring, vaccination data analysis) are still needed in Egypt. Given the country's current socio-economic situation, external funding may be required in the short term to continue this important work.

There is also need for increased cooperation between government and industry, to improve the virus data and epidemiologic information regarding commercial poultry. The engagement of other stakeholders – such as private laboratories, Egyptian universities and other institutions conducting laboratory analysis in the country, including New Medical Research Unit 3 (NAMRU3) – should be encouraged to allow the sharing of data and information that can contribute to disease control efforts. The integration of epidemiological information with virus characterization data could also contribute to better early risk assessments, leading to appropriate response actions in both the animal and the human sectors and to a more effective national AI control programme. The national animal health sector should play an active and leading role in improving these linkages, in line with the four-way linking framework proposed by FAO and WHO.[1]

Although this study shows that most AI poultry vaccines currently used in Egypt appear to confer acceptable levels of protection when applied appropriately, the

[1] A four-way linking workshop was conducted in Egypt from 26 to 28 September 2011 (see article on page 36).

proper handling and application of vaccines in the field are critical if vaccination is to be an effective part of a comprehensive control programme. Based on field data, the actual coverage of vaccination campaigns appears to be low, suggesting that application of AI vaccination in Egypt needs to be improved. Vaccination of day-old chicks (DOCs) with an effective vaccine (if and when available) may significantly decrease the virus load and subsequent circulation along the poultry value chain. The application of DOC vaccines at both traditional and modern hatcheries represents an efficient intervention that could have a significant impact on the control of H5N1 HPAI. FAO encourages the ongoing efforts of pharmaceutical companies to develop vaccines for use in DOCs.

FAO continues to emphasize that biosecurity remains one of the most important and critical tools in the fight against H5N1 HPAI; as a supportive measure to reduce virus load in the poultry population and the environment, vaccination should be applied as part of a comprehensive control programme. When a nation opts to apply AI vaccination, a clear plan for ongoing surveillance and post-vaccination monitoring must be in place (FAO, 2011). This project contributed to the development of enhanced capacity to undertake laboratory-based activities in support of field investigations and surveillance in Egypt, but inputs for implementing the recently revised HPAI surveillance programme based on the value chain and covering all sectors of poultry production are still required.

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OFFLU contribution to the World Health Organization Consultation on the Composition of Influenza Vaccines for the Southern Hemisphere 2012 (26 to 28 September 2011, Geneva, Switzerland)

Every six months, a team of specialists reviews all human influenza virus activity and virus characterization, including of the zoonotic influenzas A/H5N1 and A/H9N2. The team also describes the current status of development of new A/H5N1 and A/H9N2 candidate vaccine viruses. This process is managed by the World Health Organization (WHO) and aims to provide national authorities and vaccine companies with guidance on the selection of candidate viruses for use in vaccine development. Since 2010, the World Organisation for Animal Health/Food and Agriculture Organization on the United Nations (OIE/FAO) network of expertise on animal influenza (OFFLU) has been officially involved in this consultation process, for an initial period of three years. FAO gathers genetic and antigenic data on animal viruses from laboratory networks and publicly available sources, and epidemiological data are compiled from animal health databases – the FAO Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases Global Animal Disease Information System (EMPRES-i), and the OIE World Animal Health Information Database (WAHID).

At the last consultancy meeting (September 2011), OFFLU provided a summary of the available epidemiological and molecular data for highly pathogenic avian influenza (HPAI) H5N1 and avian influenza H9N2 for the period 1 February to 20 September 2011. For H5, OFFLU shared new and previously unreported sequences from Bangladesh, Egypt, India, Indonesia, Israel, Lao People's Democratic Republic, Myanmar and Viet Nam, representing clades 1, 2.1.3, 2.2, 2.2.1, 2.3.2, 2.3.4. The report included 245 H5 sequences (120 non-public and 12 public-domain sequences from 2011, and 113 non-public for 2009 to 2011). For H9, OFFLU contributed 20 pre-2011 sequences (most from 2009) and one 2011 sequence from Bangladesh. The very satisfactory and increasing level of information sharing between countries and OFFLU is to be acknowledged.

The outcomes of this consultancy process are published on the WHO Web site under Antigenic and genetic characteristics of zoonotic influenza viruses and development of candidate vaccine viruses for pandemic preparedness.[7]

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[7] www.who.int/influenza/resources/documents/characteristics_virus_vaccines/en/

CLASSICAL SWINE FEVER

Overview of classical swine fever: learning from regional disease control strategies

Introduction

Classical swine fever (CSF) is considered to be one of the most important diseases of swine, affecting modern swine production systems as well as the livelihoods of small-scale pig holders. CSF has high economic and socio-economic impacts on production systems in Asia, Latin America and Europe. In the European Union (EU), CSF is among the diseases that have caused major socio-economic damage in recent decades. In 1993 and 1994, EUR 10.7 million was spent on outbreaks in Belgium and EUR 21.4 million in Germany, with a further EUR 130 million being spent for market support in 1994. In 1997, an epizootic outbreak centred in the Netherlands resulted in the compulsory slaughter and disposal of more than 10 million pigs, with costs estimated at more than EUR 1 billion. An estimation of the overall economic losses comes to several times these amounts.

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French white pigs cross-bred with local Beninese variety for better meat and natural resistance to disease

Successful eradication of CSF has been achieved in many countries, including in North America, Australasia and parts of northern Europe, and many of these countries have maintained freedom in the absence of vaccination, i.e., with a fully susceptible swine population. Regional control programmes in South and Central America have demonstrated success in the progressive control and elimination of CSF in the past decade, with industry and the public sector sharing common objectives for disease control and eradication.

In developing countries, the economic impact of CSF has consequences for livelihoods in family production systems. Rough estimates for Latin America indicate that between 1997 and 2001 losses due to pig mortality were approximately USD 30 million in Mexico, based on official disease reports. In Chile, between 1983 and 1997, direct losses to morbidity and mortality were estimated at USD 2.5 million (FAO, 2003). This figures does not include the costs of vaccination or other control measures, so the real impact of CSF has been much higher. In addition, underreporting is believed to be high, particularly among small-scale pig holders, owing to the absence of appropriate compensation schemes. In Haiti, the estimated net benefits for a ten-year CSF vaccination programme ranged from USD 16.4 million to USD 32.0 million after the costs of the programme were deducted. Cost-benefit analysis indicates that there are very strong economic arguments in favour of an intensive, national CSF control programme in this country, where smallholders account for almost 90 percent of the pig population (FAO, 1997). Studies of smallholders in Honduras (McCauley, 1997) indicated that mortality attributable to CSF was 13.5 percent of total mortality on a pig holding, and the case fatality rate was between 40 and 70 percent. The same author concluded that control of CSF could reduce total mortality on a small-scale pig holding by 21 percent.

The progressive control and eradication of CSF in Latin America and Europe are examples of the successful use of such tools as vaccination, effective disease surveillance systems and rapid reporting from farmers, good capacities at laboratories, early diagnosis, rapid elimination of infected herds, and control of animal movement. In some countries where CSF has been eradicated, including Chile, innovative follow-up schemes such as insurance policies were set up during the last phase of the programme, to cope with potential losses from any resurgence of the disease. However, despite intensive efforts at the national and regional levels in Central and South America, the complete eradication of CSF from some regions has proved to be elusive; CSF is still endemic in many countries, and spill-over is observed from these areas to free areas around the world. This phenomenon is most likely due to persistence of the virus in domestic pig populations in endemic settings, while wild boar and wild pig populations play a role in CSF transmission in some regions, such as in parts of Europe and the Balkans.

Dynamics of CSF

CSF occurs under natural conditions in domestic pigs and wild boars (*Sus scrofa*). Infected pigs can transmit CSF virus to other pigs by direct contact. Swill-feeding plays a major role in the introduction and spread of CSF virus into new areas. For example, outbreaks in Europe in 1997 were caused by virus strains originating in Asia and introduced via the illegal feeding of swill to pigs in Germany.

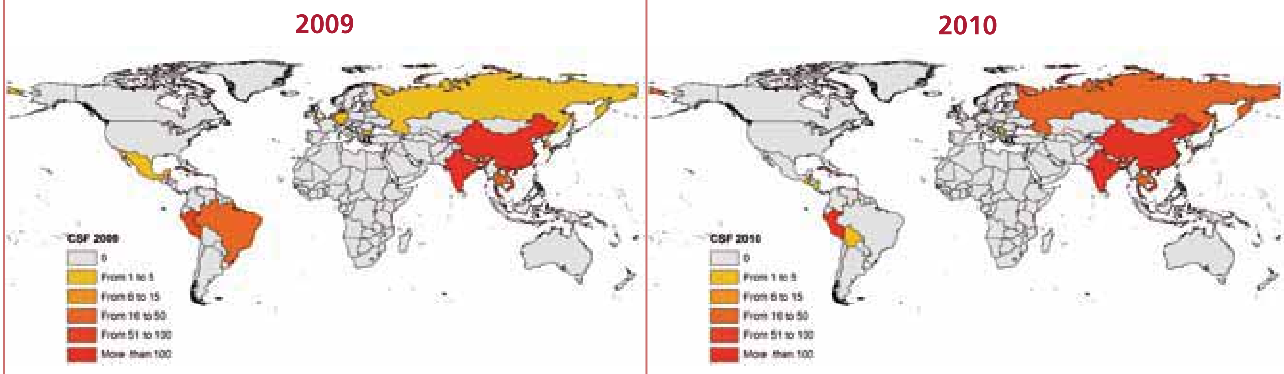
CSF remains widespread in several regions; in others, CSF status is unknown owing to lack of surveillance (Figure 1). CSF is widespread in Andean countries, the Caribbean, Asia and Eastern Europe. For example, in their reporting to the World Organisation for Animal Health (OIE) for 2010, 59 countries reported occurrences of the disease; 73 countries reported disease absence for 2010 – of these 12 had reported CSF in the previous two years (2008 to 2009); and 24 countries reported new cases of CSF.

However, the true incidence of CSF is underestimated in some endemic regions due to the weakness of the veterinary services and shortage of resources for CSF surveillance, diagnosis and control activities.

In Latin America, for example, epidemiological and ecological characteristics of the regional distribution of CSF include continuing trends in the demand for pork and pork products, and increased investments in swine, which have low production costs so can compete advantageously in international markets.The cost price of pork in Brazil is 25 percent lower than it is in Western Europe and 10 percent lower than in Canada and the United States of America. Feeding of swill in family production systems is another factor that supports CSF transmission and spread in endemic settings. Family production systems, which are predominant in developing countries, constitute a favourable environment for disease transmission and virus maintenance and perpetuation. The main challenge is the difficulties veterinary services face in implementing appropriate CSF control and eradication measures in backyard systems (Vargas Terán, Calcagno and Lubroth, 2004).

A young girl on a family farm feeding the pig, chickens and turkeys in Santa Maria de Fantasma in Nicaragua

Figure 1: Reported CSF outbreaks, 2009 to 2010



Source: OIE World Animal Health Information System (WAHID).

In general, CSF prevention and control is based on the application of biosecurity measures and prophylactic vaccination. However, in some countries where CSF is still endemic, progress towards control and eradication is very slow and is strongly influenced by economic and social factors. In these endemic settings, the role of backyard pigs in the epidemiology of CSF seems to be crucial but is not fully understood. There is therefore a strong need for increasing knowledge about CSF and intervention strategies in these systems. Although large-scale commercial farms have successfully controlled and eradicated CSF in countries with a high proportion of family production systems, there are still substantial challenges to addressing CSF eradication and keeping commercial and integrated systems free in the presence of family production systems, where disease transmission can be sustained. CSF persists in endemic areas because of such factors as lack of capacity among veterinary services, absence of robust diagnostic capacity and effective surveillance, lack of quality control and registration of vaccines and vaccinations, lack of adequate compensation schemes to encourage early reporting by farmers and private veterinarians, and lack of a regional strategy for CSF elimination. In endemic areas, CSF seriously affects small production units, livelihoods and food security, particularly in rural communities; CSF therefore not only has implications for international trade, but is also a food security threat.

CSF is still present in some countries in the Andean and Amazon regions, but progress has been achieved in parts of Brazil and Colombia. Uruguay, Chile, south Brazil and Argentina are free of CSF, and an intensive control programme is being developed for areas of the Andean region where CSF is still endemic. Central America has made important advances in the eradication of CSF, with only sporadic outbreak occurrence. Mexico was declared free of CSF in 2009, while three Caribbean countries are still considered CSF endemic – the Dominican Republic, Haiti and Cuba.

Some countries in the EU have reported CSF in wild boars: Germany, France, Slovakia, Hungary, Bulgaria and Romania. The disease has also been reported in countries of Eastern Europe.

Many countries in Asia report regular outbreaks of CSF to OIE. CSF is considered to be endemic in China, which has almost half of the world's total pig population, and southeast Asia. Most CSF control in endemic countries is carried out by the private sector, with few initiatives promoted by official veterinary services. In Africa, the CSF situation is uncertain, with South Africa and Madagascar reporting outbreaks; further surveillance efforts are needed to differentiate between areas where there is no circulation of the virus and those where the disease could be circulating without being reported.

CSF control: experience from regional approaches

Based on experience from regional strategies for CSF control in the Americas, common strategies can help to harmonize control efforts, both technically and financially. Common strategies support the coordination of CSF control in endemic countries and the progressive increase in zones and countries that are free from the disease. Inspired by regional experience in the control and eradication of foot-and-mouth disease (FMD) and New World screwworm (Vargas-Terán, Calcagno and Lubroth, 2004), a plan for tackling CSF has been developed. The plan includes a control phase, followed by an eradication phase and a final disease-free phase.

However, although CSF has been eradicated in some regions, new approaches to its control may be needed in remaining infected regions where it persists. There are no official reports of the disease in Africa, except for in South Africa and Madagascar, where African swine fever (ASF) is also reported. This lack of reporting from African countries indicates that more CSF surveillance efforts should be implemented and differential diagnosis with ASF carried out routinely.

One challenge for CSF is that the virus can be maintained in domestic pig and wild boar (*Sus scrofa*) populations, creating the risk of transmission between species. In countries with significant wild boar populations, increased efforts are being made to improve the prevention of and response to CSF cases in wildlife, together with other measures to decrease the risks of transmission between domestic pigs and wild boars. In some wild boar populations in Europe, the CSF virus is maintained because dense populations and high fertility result in large numbers of susceptible offspring, which can maintain virus circulation.

The OIE Terrestrial Animal Health Code (Chapter 15.2) establishes the conditions and requirements for declaring disease freedom in a country, in domestic pig and/or wild boar populations. Controlling and eradicating CSF is particularly challenging in developing countries that are affected by both CSF and ASF. The two diseases have very similar clinical signs, and surveillance based on clinical signs cannot differentiate between them. In the Russian Federation, Eastern Europe and parts of Africa – where differential diagnosis is inaccurate and based solely on clinical signs and laboratory testing is not routine for every suspected outbreak – the incidence of CSF disease is under- or overestimated. A new OIE procedure for official recognition of disease freedom is expected to be in operation in 2013.

Vaccination against classical swine fever in pigs

Advantages for CSF control and eradication

Some characteristics of CSF make it a very interesting target for effective control and eradication at the regional level:

- In all countries where CSF occurs, the public and private sectors have included it as a priority livestock disease for control and eradication.
- CSF virus is genetically stable and has not incurred significant changes and mutations. This stability supports the wide use of live attenuated vaccines for CSF as a very safe way of providing excellent immune protection, when vaccination schemes are correctly applied. Vaccination is a tool for controlling CSF in endemic areas, and can also be used as a response measure in an emergency situation.
- CSF control in family production systems brings benefits for the food security and increased quality of food for rural and urban populations.
- Global pork production increased from 24.7 million tonnes in 1961 to 86.6 million tonnes in 2002, with the global trade of pig meat increasing by 9.9 percent a year since 1992. This expansion of the pig industry represents serious challenges for biosecurity and swine health and for ensuring the quality of pork products, food safety and the effective control of swine diseases. Most CSF control in Western Europe, the Americas and Asia is in emerging economies where there is rapid expansion of the pig industry accompanied by a continuing important presence of and contribution from small-scale pig holders.
- Following the request of member countries, OIE has resolved to include CSF in the diseases with official recognition status. This procedure is planned to be implemented in 2013. Official recognition of CSF-free status will encourage countries to embark on the progressive control and eradication of CSF and creates strong incentives for the Food and Agriculture Organization of the United Nations (FAO) to expand its technical assistance to regional strategies and national control/eradication programmes.
- Regions such as Latin America have positive experience of the progressive control and eradication of CSF in different production systems. CSF control is well advanced along the progressive control pathway in countries where economic and social factors have been addressed, including the establishment of good public-private partnerships. For example, the Continental Eradication Plan for the Americas is committed to declaring freedom from CSF in the Americas by 2020. However, in other regions and countries, such as China and Africa, the CSF situation remains uncertain, so more surveillance and research are needed to support control and eradication. In Europe, CSF has been eliminated from domestic pig populations, but remains a challenge because of the difficulty of controlling the disease in wild boars.
- Lessons learned from the emergence of highly virulent swine diseases – such as porcine reproductive and respiratory syndrome (PRRS) in southeast Asia and China since 2007, or porcine teschovirus in Haiti in 2009 – clearly show that control of pig pathogens represents a major challenge that calls for a more balanced approach to swine disease control, particularly in China, which contains almost half of the world's 1 billion swine population (450 million pigs) (FAOSTAT, 2009).

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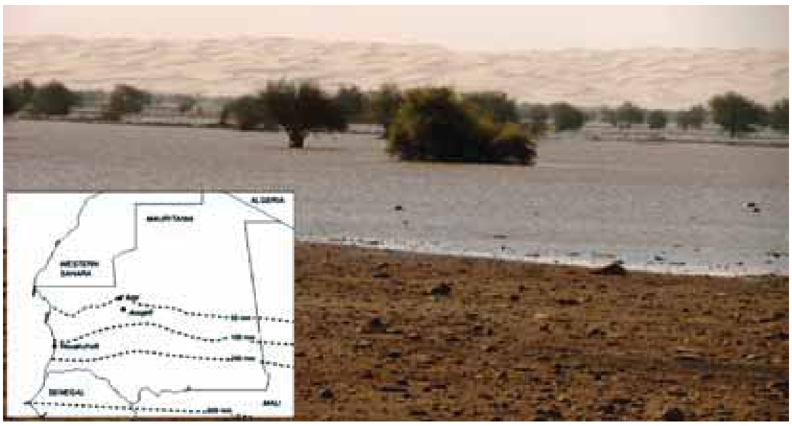
Rift valley fever

A severe and unexpected outbreak of Rift Valley fever in northern Mauritania affects small ruminants, camels and humans

From late September to the beginning of October 2010, unprecedented rainfall created large ponds of water in the oases of the Saharan region of Adrar, northern Mauritania. Such rains had not been observed since 1956 (locally known as the "year of the fever"). This climatic event promoted an exceptional growth of vegetation, attracting shepherds and pastoralists from remote areas, including south and southeastern regions of the country where Rift Valley fever (RVF) is endemic. It also favoured the extreme multiplication of several mosquito species, mainly from the genera *Culex* and *Anopheles,* some of them known to be competent vectors for important arboviruses, including RVF virus.

A few weeks after these rains, severe outbreaks of malaria and RVF were reported in several oases (*Graret*) of the Adrar region. The first potential case in livestock was a sick dromedary camel, observed during the last week of October 2010 in the Aoujeft area, with symptoms suggesting pasteurellosis. The herder slaughtered the animal before it died of the disease, the meat was shared among the family. Within a few days, several people died with intestinal and haemorrhagic symptoms. The health authorities requested testing for several pathogens, including Congo-Crimea haemorrhagic fever and RVF, and results showed positive for the latter. While it is improbable that these people became infected through the consumption of meat – the virus is rapidly destroyed by post-mortem changes in meat – and possible that they succumbed to other causes (e.g., food poisoning), it is now obvious that the virus was circulating intensively in this area at the time.

Figure 1: One of the main outbreak foci



Note: Flooding at Lefrass oasis (30 km north of Atar) persisted for about ten weeks, enabling mosquito populations to develop. The insert shows the locations of Atar and Aoujeft and the average isohyets for 1965 to 2002.
Source: FAO, Land and Water Development Division.

Two weeks after this likely index case, additional camel cases, abortion storms in small ruminants and human fatalities (with haemorrhagic fever, icterus and nervous symptoms) were reported on a massive scale. At the end of December 2010, a total of 63 human cases, including 13 deaths, were officially reported, but the real numbers were probably much higher because of underreporting due to the remoteness of the affected area. Of 14 initial camel samples, seven tested positive in reverse transcription polymerase chain reaction (RT-PCR) at the *Centre National d'Elevage et de Recherches Vétérinaires* (CNERV – National Livestock and Veterinary Research Centre), and the virus was isolated from four of these. First serological results indicated an IgM/IgG prevalence reaching 33 percent in camels, and 44 percent in small ruminants. Sero-prevalence in camels was as high as 43 percent in Adrar, and reached 54 percent in the eastern Inchiri area two weeks after the index case in the camel was observed.

During this outbreak, two clinical forms were observed in camels: a per-acute form with sudden death in less than 24 hours; and an acute form with fever, ataxia, oedema at the base of the neck, respiratory difficulty, icterus, severe conjunctivitis with ocular discharge and blindness, haemorrhages of the gums and tongue, foot lesions, nervous symptoms, and abortions (Figure 2). When haemorrhagic signs developed, the outcome was usually death within a few days.

Figure 2: Observed clinical symptoms of RVF in camels during field investigation in the Adrar region

A Conjunctivitis and ocular discharge, haemorrhages of the gums, and oedema of the trough.

B Haemorrhages of gums and tongue.

C Oedema at the base of the neck.

D Foot lesions (cracks in the sole), with secondary myasis.

E Dead camel, with evidence of abortion, convulsions, and arching of the neck.

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Education and awareness raising

To cope with this outbreak, veterinary and public health authorities took appropriate control measures, including restrictions of livestock movement, reallocation of locust control teams for mass insecticide spraying, and risk communication and public awareness campaigns for the population at risk. Following a request from the Chief Veterinary Officer, a Food and Agriculture Organization of the United Nations (FAO) Crisis Management Centre (CMC) mission was deployed early in January, with experts in the epidemiology of vector-borne diseases, diseases of camels, and diagnosis and strengthening of laboratory capacities. In close collaboration with the *Réseau Mauritanien d'Épidémio-surveillance des Maladies Animales* (REMEMA – Mauritanian Network for the Epidemio-surveillance of Animal Diseases, involving the Ministry of Rural Development and the Ministry of Health), the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), a United Nations Central Emergency Response Fund project was obtained to support the country's response plan. Activities included provision of materials and reagents for sample collection and diagnostic testing; training of field staff; improvement of communication tools; supply of individual protective materials for populations at risk, including slaughterhouse workers; and communication material for public awareness campaigns. Further livestock surveillance at the national level revealed high sero-prevalence rates – of 32 percent in camels (n = 1 081) and 4 percent in small ruminants (n = 1 193) – and wide distribution of the disease. The outbreak ended within a few months, but a key remaining issue is assessing the virus's capacity to survive in such an arid environment, so continuous monitoring for virus circulation in sentinel herds is essential.

The non-governmental organization SOS Abbere conducted education courses at schools in Ouadane. Educating schoolchildren is an efficient way of reaching remote settlements and disseminating key messages

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Foot-and-mouth disease

Foot-and-mouth disease in Mongolia in 2010: FAO response

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In late 2010, an outbreak of foot-and-mouth disease (FMD) involving both livestock and gazelles occurred in the rangelands of eastern Mongolia. The response to this outbreak included mass vaccination, the culling of affected livestock and the selective culling of clinically ill gazelles in some affected areas. Because gazelles were extensively involved in the outbreak, it was assumed that they introduced the FMD to cattle, and the initial outbreak investigation did not thoroughly evaluate other potential sources of FMD spread, including the cross-border movement of cattle or possible introduction of the virus via transported fomites such as contaminated trucks, equipment or clothing. In October 2010, the Food and Agriculture Organization of the United Nations (FAO) Crisis Management Centre – Animal Health (CMC-AH) conducted a mission to Mongolia to provide technical assistance in aspects of the epidemiological investigation and ongoing outbreak control. Along with the harsh winter weather, which decreased both animal and human movement, the response interventions appeared to control the outbreak and no further cases had been reported by October 2011.

During the outbreak, the Mongolian Government requested FAO's assistance in preparing for future potential FMD outbreaks by providing needed capacity development for disease management and vaccination supplies. Support to the development of a surveillance strategy and approach was also requested, to develop an understanding of the role of gazelles in the 2010 outbreaks. An emergency Technical Cooperation Programme (TCP) project entitled "Emergency Support to Smallholders of Ruminants affected by the Foot-and-Mouth Disease Outbreaks in 2010" was approved in March 2011.

Under this TCP project, supplies such as temperature-controlled storage boxes for vaccines, personal protective equipment, necropsy kits, specimen collection kits and decontamination kits were procured and delivered to Mongolia in time for the 2011 pre-winter vaccination campaign. In August 2011, FAO's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) Wildlife Health and Ecology Unit led a two-day stakeholders' workshop attended by more than 60 people, including government officers, livestock owners, herders, market and industry professionals and wildlife experts. The goal of the workshop was to review the 2010 FMD outbreak response and share perspectives on issues that required further cooperation and refinement, thus ensuring that future FMD outbreaks will be rapidly detected and controlled, with minimal impacts on the livelihoods and food security of livestock herders and local communities. This diverse group of stakeholders identified the risk factors for FMD spread and developed recommendations. The workshop was followed by the first of two national training courses on the epidemiology and prevention of FMD, which was attended by 26 government veterinarians

Yaks in Mongolia

who are now in the field conducting targeted FMD vaccination campaigns. The training also included details of the FMD progressive control pathway (PCP) and evaluated where Mongolia should focus its efforts to move through PCP stages towards FMD freedom.

Further TCP activities will include gazelle surveillance, such as capture and sampling, to measure the extent of exposure to FMD and to determine whether there could be an FMD reservoir. Historical analysis will be undertaken to evaluate where gazelle and livestock ranges overlap and the potential for FMD transmission between these species. When combined with FMD outbreak maps, this analysis will help to clarify the role of gazelles in the epidemiology of FMD in Mongolia, as well as helping to identify management steps that can be taken to minimize disease impacts and spread.

FAO and the EMPRES Wildlife Health and Ecology Unit anticipate that this TCP support will ensure that the Mongolian Government is better prepared to address outbreaks of FMD or other livestock and wildlife diseases that may occur in the future.

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Role of wildlife in foot-and-mouth disease dynamics in Thrace Region in 2011 and beyond

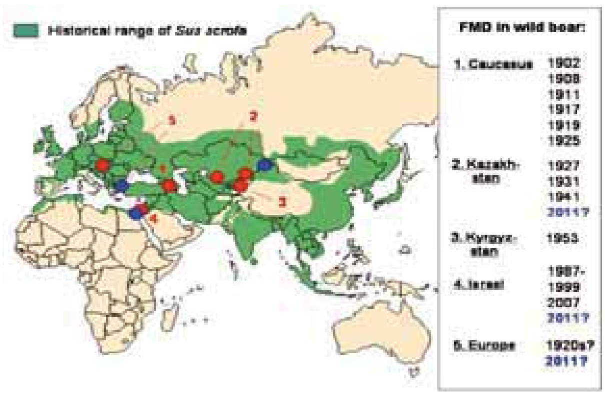
Historical notes and background

Wild boar (*Sus scrofa*), ancestor of the domestic pig, is fully susceptible to all diseases of swine, including foot-and-mouth disease (FMD). Specifically clinical FMD (or less frequently laboratory-confirmed disease) has been reported from a number of locations across the historical range of the species (Figure 1). There is little doubt that these occasionally observed (and reported) cases represent just a tiny proportion of such events on the global scale. Marek and Hutÿra (1931, cited in Sludskiy, 1956) mention a widespread epidemic in *S. scrofa* in a European country at the beginning of the twentieth century. In the countries of the Former USSR, clinical disease in wild boar was most often observed in the Caucasus (1902 to 1925), but also occasionally in southern Kazakhstan (1927 to 1941) and, in 1953, in Kyrgyzstan (Sludskiy, 1956; Danilkin, 2002), until the country-wide vaccination of livestock and control efforts finally eradicated FMD from the Former USSR in the 1980s.

FMD lesions in cattle in Kosti, Bulgaria

Donaldson and Shimshony (1988) speculated that two independent FMD virus (FMDV) introductions into Israel in 1985 might have been due to air-borne spread of the virus emitted by infected wild boars from across the border in Jordan. Following these incidents, a total of 740 boar sera were sampled in Israel between 1987 and 1999, of which 108 (14.6 percent) were found positive in serum neutralization (SN) tests (ProMED-mail, 2007). Virus was also found in two out of 73 animals (2.8 percent) in 1992. It was reported that as many as 85.7 percent of wild boars (18 out of 21 sampled) from three locations along Israel's northern and northeastern frontiers were positive in the non-structural protein (NSP) enzyme linked immunosorbent assay (ELISA) for FMD (ProMED-mail, 2007). In July 2011, wild boars were again implicated as potential virus

Figure 1: Anecdotal and documented historical observations of FMD in different parts of the wild boar historical occurrence range



Source: Oliver *et al.,* 1993; downloaded from: www.ultimateungulate.com/artiodactyla/sus_scrofa.html.

disseminators in northern Israel (ProMED-mail, 2011). Similarly, following unexplained mortality in wild boars, an FMD type O outbreak in eastern Kazakhstan in September 2011 was attributed to possible migration of the species from China (A. Tanraev, personal communication). All these anecdotal or surveillance observations were made in areas with concurrent FMD outbreaks in livestock (often involving domestic pigs) and were usually considered to be the result of transmission from domestic animals rather than stand-alone epidemics in wild boars (Sludskiy, 1956; Goreglyad, 1971; Danilkin, 2002), which is the case in a large majority of FMD detections in wildlife in general (Thomson, Vosloo and Bastos, 2003).

Late in 2010, type O FMD virus was detected in a wild boar shot in southeast Bulgaria (Figure 3). The VP1 genotyping of the FMD virus isolate performed at the European Union (EU) Reference Laboratory for FMD, Institute for Animal Health Pirbright (United Kingdom of Great Britain and Northern Ireland) confirmed its close genetic relationship with recent isolates from the Asian part of Turkey (Valdazo-Gonzales *et al.,* 2011). On 5 January 2011, Bulgaria notified this case. Prior to 2011, the last outbreak of FMD in Bulgaria was in 1996, and since then the country had been free of the disease. Further investigation of the epidemiological situation in this area – where 14 FMD outbreaks in livestock (Figure 3) were reported to the World Organisation for Animal Health (OIE) in 2011 – from January to April 2011, coupled with molecular data on Bulgarian isolates, showed that the virus was possibly amplified in an unidentified reservoir (supposedly wild boars), from which it was independently introduced into livestock in different locations of the area at least four times (based on the available epidemiological and genetic evidence). Simultaneous intensive surveillance in livestock on the Turkish side of the border did not reveal circulation of FMD virus (Khomenko and Honhold, 2010) and found only limited and localized occurrence in Bulgaria. The Bulgarian Ministry of Agriculture, the Turkish veterinary authorities and international organizations therefore raised concerns regarding:

- the possibility that transboundary spread of FMDV from Turkish Thrace, which has disease-free status with vaccination, was facilitated by infected wild boars and/or other FMD-susceptible wildlife species;
- the suspicion that local wild boar or other wild ungulate populations may represent a silent epidemiological reservoir of FMDV that is separate from livestock (which has 100 percent cover from vaccination in the Turkish part of Thrace);
- the actual and future risk of FMDV introduction into EU Member States, and the chances of persistence in European populations of wild ungulates if this occurs.

For these reasons, serological surveillance in wild boars and other ungulate species, such as roe deer (*Capreolus capreolus)* and red deer (*Cervus elaphus*), was initiated to find out what actually happened in the population of wildlife inhabiting the Turkish-Bulgarian cross-border area and what the immediate and long-term implications of this unique epidemiological situation were likely to be. Short- and long-term surveillance plans were developed by both Bulgaria and Turkey, the latter with assistance from the FAO Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) Wildlife Health and Ecology Unit (see next section).

FMD surveillance in susceptible wildlife in Southeast Bulgaria and Turkish Thrace.

Both Bulgaria and Turkey adopted statistically similar approaches to surveillance. The sample size of 59 head per sampling unit (see following) was set to achieve 95 percent confidence for detection of FMD antibodies, with an expected FMD antibody (Ab) prevalence of 5 percent. Another assumption was that as a highly contagious disease, once FMDV is introduced to a wild boar herd (family group) it is likely eventually to infect all herd members. Assuming that hunters can kill all the animals in a group (which is not usually the case), with this sample size a minimum of 12 average-sized herds of wild boars (e.g., quasi-epidemiological units) would be sampled. Thus, the infection would be detectable if it had affected about a quarter of the herds in a sampling unit (with herd sero-prevalence of approximately 25 percent at 95 percent confidence). Other FMD-susceptible species (red deer, roe deer, unowned stray livestock) were targeted, with a sample size of 35 head (10 percent sero-prevalence at 95 percent confidence).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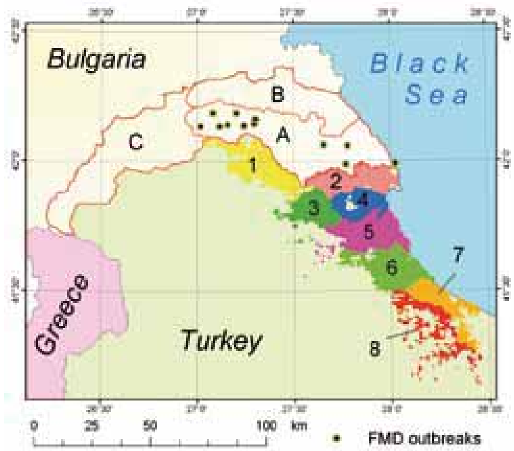
Interview with a local veterinarian, Azdavay, Turkey

In Bulgaria, a defined infected area (area A) has been established, based on the results of epidemiological considerations and the geographical distribution of the disease in January 2011 and in March and April 2011. This 20-km-wide region along the Turkish border in southeast Bulgaria covers about 1 240 km^2. Two risk areas (areas B and C) cover about 2 160 km^2 adjacent to area A in the north and west, along the Turkish border (~ 240 km). Together these form a cordon sanitaire to control the possible spread of FMD. The estimated wild boar population was about 1 500 animals in area A and about 3 000 in the risk areas B and C. The sampling frame developed for serological and virological monitoring generally followed European Food Safety Agency (EFSA) recommendations for classical swine fever surveillance, with some adaptations. The animals were either hunted (in Bulgaria and Turkey) or trapped (only in Bulgaria). From each animal, blood samples for serological and virological tests, and tissue samples (pharyngeal area, skin with lesions, lymph nodes and vesicular fluids where available) were collected. In Turkey the NSP ELISA kit PrioCHECK FMD NS (Prionics Lelystad B.V.) was used for initial testing; positive samples were re-tested with another commercially available NSP ELISA kit (Svonovir FMD 3ABC-Ab Ruminant, Svanova Biotech AB).

In Turkey the whole forested area extending from the border with Bulgaria to Istanbul was defined as the area at risk of FMD persistence in wildlife and was divided into patches based on the map of catchment areas (originally produced with ArcInfo 9.3 based on 90-m resolution digital elevation model [DEM]), which were grouped following the relief into eight larger sampling units averaging 342 km^2 of forested area each (and ranging from 232 to 438 km^2). Catchment areas were selected because they were easier for hunters to locate on the ground and because particularly high ridges are likely to serve as ecological barriers for the movement of wild boars. In the absence of official wild boar population estimates, numbers were calculated based on the total forested area, the average home range for a wild boar group (4 km^2) and the average group size (five head) (Danilkin, 2002). This gave a total of 3 500 to 7 000 head (depending on the season), with between a few hundred and 1 000 wild boars estimated to occur in each sampling unit.

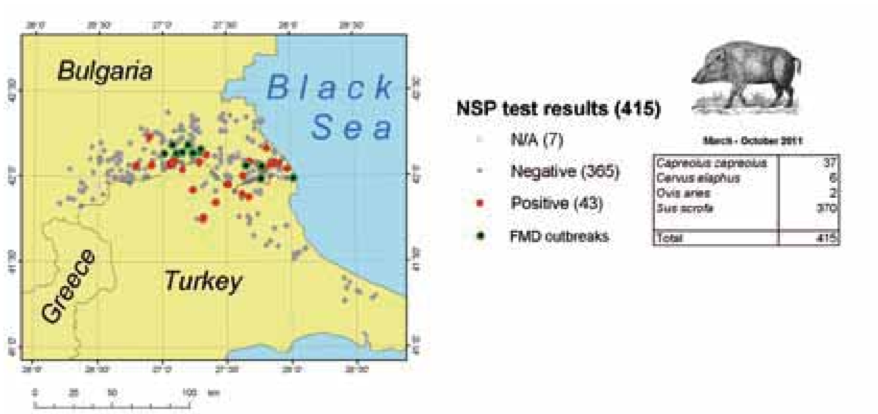
Owing to the foreseen logistical difficulties for hunting wild boars in July and August 2011, sampling units 1 and 2, which are in immediate proximity to FMD-affected locations in Bulgaria, were given priority. Several hunting teams led by professional veterinarians were established to hunt wild boars in July and August. A specially

Figure 2: Locations of the three sampling areas within the cordon sanitaire in Bulgaria



Note: Infected area A – South Tsarevo, Malko Tarnovo and South Sredets Municipalities; risk area B – North Tsarevo, Primorsko, Sozopol and Central Sredets Municipalities; and risk area C parts of Bolyarovo, Elhovo, Topolovgrad and Svilengrad Municipalities. In Turkey there were eight sampling units, of which units 1 and 2 were given highest priority.

Figure 3: Sample collection locations and results of serological tests



Note: 11 samples from wild boars collected in Demirkoy District, Kirklareli Province, Turkey in February 2011 are not shown, but are included in Table 1.

designed sample collection protocol was followed in the field. Geographical coordinates, a full-size photograph of each animal killed and close-up photographs of its feet, snout and tongue were taken, and its age, sex and any other relevant information (e.g., size of its group) were recorded. In addition to standard blood and tissue samples, pharyngeal lymph nodes were also collected to attempt virus isolation. In sampling units with lower priority (units 3 to 8) in Turkey, wild boar populations were to be tentatively surveyed with a maximum target sample size of ten.

Between February and 20 October 2011, a total of 426 individuals from four susceptible wild species were tested serologically and virologically for FMD in Bulgaria (total n = 321, wild boars = 280) and Turkey (n = 98, all wild boars). No virus was detected. Average sero-prevalence of 11.6 percent was found in all the wild boars sampled. Adult and juvenile (born in 2011) animals (n = 361) had the same sero-prevalence (12.2 percent), while among animals of undefined age (n = 28) there was one positive sample. In adult roe deer (n = 33) sero-prevalence was 9.1 percent. Sample sizes for other species (red deer and mouflon [*Ovis musimon*]) were too small (n = 6 and 2, respectively) to draw any conclusions. On average, sero-prevalence in wild boar in Turkey (27.6 percent) was significantly higher (four times) than in Bulgaria (6.5 percent), including when the prevalences in adults and juveniles were compared separately (2.6 and 14.8 times higher in Turkey, respectively, Table 1). Most positive detections seem to be clustered in the cross-border area near FMD outbreaks in livestock, although some were found further from the border in Turkish Thrace (Figure 3). This should be taken into account, as differences between countries might be influenced by spatial bias in sample distribution. No positive animals were reported from sampling units other than 1 and 2 (Figures 2 and 3), but sample sizes in the districts of Vize, Saray, Catalca and Gaziosmanpas (east of 27° 30' E) were too small to exclude the possibility of failure to detect past or current infection.

The age distribution of sero-positive juvenile animals suggests that although some of them might have had maternal antibodies at the time of testing, others could have been challenged with FMDV either during the period of their maternal immunity (probably similar in length to the three months of domestic piglets) or after. This seems particularly likely for several juveniles aged seven to nine months shot in Bulgaria in October. Surveillance efforts are continuing in the area, and further testing of juvenile animals and analysis based on a more comprehensive data set will help improve understanding of the timeframe and spatial extent of this FMD epidemic in wildlife. However, it is already clear that FMDV introduced into wild ungulate populations somewhere in Thrace Region, probably as early as the Kurban Bayram period (16 November in 2010), resulted in a fairly extensive and long-lasting (at least six to eight months) epidemic involving at least two abundant species (wild boar and roe deer), but probably also some unowned stray domestic animals in the Strandzha area of Bulgaria. These preliminary results should be treated with caution and need to be properly evaluated to avoid possible biases and artefacts of sample distribution and size.

EU-FMD/FAO wild boar surveillance project in Anatolian Turkey

in addition to this study, the EU-FMD Secretariat and the EMPRES Wildlife Health and Ecology Unit have developed a study project proposal and submitted it to the European Commission for funding. The proposed project aims at exploring further the epidemiological role of wild boars in Anatolian Turkey, where FMD is endemic in some areas. Prior to developing the project proposal, an EU-FMD/FAO mission visited Anatolia in July and August 2011 to evaluate the feasibility of such a study. The mission visited the Turkish Ministry of Environment and Forestry and the General Directorate for Protection and Control (GDPC) in Ankara, and the Provincial Directorates of Environment and Forestry (EFD) and Agricultural (AD) in Gumushane, Kastamonu, Samsun

Table 1: Results of serological surveillance for FMD in wildlife in Turkey and Bulgaria, by species, February to 20 October 2011

Country	Species	Age group	No. sampled	Number NSP-positive	Prevalence (%)	95% confidence interval +/-
Turkey	*Sus scrofa*	Adult	46	11	23.9	12.3
		Juvenile	52	16	30.8	12.5
		All	98	27	27.6	8.8
Bulgaria	*S. scrofa*	Adult	167	15	9	4.3
		Juvenile	96	2	2.1	2.9
		?	17	1		
		All	280	18	6.4	2.9
	Capreolus capreolus	Adult	33	3	9.1	9.8
	Cervus elaphus	Adult	2	0		
	Ovis musimon	Adult	2	0		

and Rize. These provinces were selected based on the occurrence and frequency of FMD outbreaks, livestock husbandry systems and the availability of wild boar habitats (broad-leaved or mixed forests, Figure 4). Modalities, logistics, legal aspects and practical options for project implementation on the ground were discussed with EFD and AD staff. The project's aims, objectives and details were explained to district-level government and private veterinarians, who were invited to participate in the project.

Leaders of local hunting communities were interviewed regarding wild boar population trends, wild boars' movement/seasonal migration patterns, crop damage, estimated annual hunting bags, methods and timing of hunts, historically known cases of mortality and disease, number of licensed hunters available for organized hunts, normal frequency of hunts, etc. Most respondents agreed that wild boar numbers had been increasing recently, reportedly because of warmer winters, a general decline in grey wolf (*Canis lupus*) numbers (related to an overall decline in sheep breeding) and a decrease in hunting pressure due to hunting restrictions. A respondent in Azdavay (Kastamonu Province) reported regular migration of local wild boars to the Black Sea coast (70 to 80 km away) in August and September, to feed on chestnuts. No historical accounts of mortality or disease were reported. Crop damage (on both private garden plots and larger croplands) by wild boars was commonly reported everywhere in late summer. At the moment, driven wild boar hunts are forbidden (permits have to be requested from EFD). Individual chase hunting with dogs takes place from October to January (when snow cover facilitates this type of hunting). Both registered hunters and EFD authorities admitted that up to 80 to 90 percent of the people who hunt wild boars are poachers. The enforcement of legislation in this part of Turkey is weak to non-existent, particularly in remote mountain villages.

In summary, the mission drew the following conclusions:

Figure 4: Provinces and districts visited/selected for project implementation

Note: Provinces (in yellow) and districts (red dots) visited/selected for project implementation (Gumushane Province: Central, Kelkit and Siran Districts; Kastamonu Province: Central, Tosya and Azdavay Districts; Samsun Province: Central, Carsamba, Asarcik and Kavak Districts; Rize Province: Findikli, Kalkandere and Camlihemsin Districts).

- A sample collection strategy can be based only on animals harvested under licensed hunts, of which commercial hunts organized by safari companies are the best option.
- A sample size of 60 animals would be feasible in three of the four provinces visited (not in Rize). The total target sample size was set at 210 samples.
- Collaboration between local hunting clubs and veterinarians for the collection of samples would be feasible with proper organization, particularly with official endorsement and support from the local AD and EFD.

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EMPRES-i

Launch of the new EMPRES-i public interface: an integrated tool for global animal disease surveillance, early warning and disease control

The Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) Global Animal Disease Information System (EMPRES-i) is a specialized Web-based application first publicly released in 2009 to support veterinary services and related organizations by providing access to regional and global disease information to facilitate analysis. Timely and reliable disease information enhances early warning and response to transboundary animal diseases (TADs), including emergent zoonoses, and supports their progressive control and eradication.

The Food and Agriculture Organization of the United Nations (FAO) EMPRES operates in collaboration with the Global Early Warning and Response System for Major Animal Diseases, including Zoonoses (GLEWS), an initiative of FAO, the World Organisation for Animal Health (OIE) and the World Health Organization (WHO) for sharing information on priority diseases. With the aim of increasing awareness of animal or zoonotic disease events worldwide, FAO EMPRES/GLEWS receives information from officers in the field and screens information available from other official and unofficial sources.[1] Official and unofficial sources are also used to verify incoming information, including in-country assistance projects and personal contacts with non-governmental organizations (NGOs) and other institutions. Such a wide breadth of information gathering ensures a constant high level of awareness regarding the presence or emergence of TADs and zoonoses globally. This detailed information on animal disease events is fed into the EMPRES-i database and presented to the public as confirmed or denied, in a structured and summarized format. Disease information is analysed daily and, once threats have been identified, early warning messages are created and disseminated.

EMPRES-i is under continuous development, and an upgraded version was released in November 2011.[2] Among several new features, public users can now log into the *My EMPRES-i* section to set up personal data and customize views of disease events

[1] FAO EMPRES/GLEWS daily screens information on animal disease events from FAO member countries, regional projects, field missions, partner NGOs, cooperating institutions, government ministries of agriculture and health, FAO in-country representations and other United Nations parties, public domains, the media and Web-based health surveillance systems.

[2] http://empres-i.fao.org

of interest by selecting disease, period or geographical area and personal preferences for country or region in the Directory and Laboratory sections. An online user's manual provides a comprehensive introduction to using EMPRES-i and can be consulted when questions arise. Questions not covered by the manual can be sent directly to EMPRES-i.[3]

Information on animal disease events worldwide can easily be accessed in EMPRES-i and retrieved according to criteria defined by the user under the Disease Event tab, such as disease, date, species and location. Animal disease events can then be represented by time or location on graphs, and geographically on maps. In the upgraded EMPRES-i *Map*, views can be enriched by adding optional layers, such as livestock population, human demographic data, biophysical layers and animal health status. These layers are created and maintained by the Global Livestock Production and Health Atlas (GLiPHA), which is FAO's user-friendly, highly interactive electronic atlas using the Key Indicator Data System (KIDS). Maps, graphs and data can be exported into different formats (csv, excel, pdf, jpeg) and may be used for further analysis by users.

In addition to providing updated information on global animal disease distribution and threats at the national, regional and global levels, through its Library, Directory and Laboratory sections EMPRES-i also offers access to publications, manuals and other resources related to animal health, such as contact details of chief veterinary officers (CVOs) and FAO/OIE reference laboratories. The *Library* hosts FAO technical material such as books, bulletins, reports, newsletters, manuals and guidelines related to the current situation, epidemiology, diagnosis or control of TADs, which can be searched using different criteria (document type, topic, language, date or free text). The *Directory* provides contact information on CVOs in every country. EMPRES-i users can search for CVO details using different criteria (location, disease, category or free text). The *Laboratory* section provides contact information on FAO/OIE reference laboratories and regional laboratory networks. EMPRES-i users can search the information using different criteria (location, disease, laboratory name and free text).

Information on animal disease events worldwide can easily be accessed in EMPRES-i

Development of the EMPRES-i system is continuing, and new features are being added, including a module for collecting information on animal disease surveillance activities implemented through FAO projects and joint projects with national, regional and international partners. A genetic module is also being designed to integrate genetic data from influenza virus sequences stored in open databases, such as Openflu used for H5N1 highly pathogenic avian influenza (HPAI) viruses. The plan is to include data from the Pirbright FAO/OIE World Reference Laboratory for Foot-and-Mouth Disease (FMD) on sequences available for FMD virus. Currently, a mobile application prototype for smart phones is being developed, for use in reporting disease data information to EMPRES-i directly from field activities.

EMPRES/GLEWS promotes data sharing and inter-operability to integrate data and information for analysis. Through specific official agreements with key partners, further integration is being developed with the databases of other systems, such as the

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University of California at Davis FMD BIOPORTAL, the Swiss Institute of Bioinformatics (SIB) and FAO reference centres. Additional plans include integrating agricultural economic data from FAO's statistical database, FAOSTAT, such as trade volumes and price indices.

EMPRES-i was conceived in response to a growing demand for global animal health information systems, and provides a platform for disease information gathering and sharing on the national, regional and global scales. The database is password-protected and different access levels safeguard the sensitivity and/or confidentiality that may apply to disease information. The new interface and features of EMPRES-i enable personalization, improve the usability of EMPRES-i and enhance access to and analysis of animal disease information worldwide. On request, EMPRES-i modules have been customized for use by other groups in FAO dealing with public health and food safety threats.

EMPRES-i can be accessed at http://empres-i.fao.org/empres-i/home.

Workshops

EMPRES Wildlife Health and Ecology Unit rolls out One Health training workshop in Africa: Wildlife Investigation in Livestock Disease and Public Health workshop in Rwanda

As part of the One Health approach promoted and led by the Food and Agriculture Organization of the United Nations' (FAO's) Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) Wildlife Health and Ecology Unit, and with support from the African Union Interafrican Bureau for Animal Resources (AU-IBAR), the United States Agency for International Development (USAID) RESPOND programme and the Royal Veterinary College of London (RVC), FAO has rolled out a comprehensive interactive training workshop integrating wildlife and environmental health within the context of agriculture, food security and public health. This Wildlife Investigation in Livestock Disease and Public Health (WILD) workshop consists of a range of cross-sectoral activities, including lectures, problem-solving group exercises and field-based studies, which require different disciplines to work together to address and find solutions to ecology and development issues involving wildlife, livestock and people. WILD workshops have already been held successfully in Bangkok (Thailand) and Beijing (China), as part of the broader Field Epidemiology Training Programme for Veterinarians (FETPV), and in Johannesburg (South Africa), as a follow-up to wildlife capture and surveillance training implemented by AU-IBAR and FAO.

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Discussion with local pastoralists during a village visit

The most recent WILD workshop was held in Rwanda (July 2011) and attended by 24 professionals, including veterinarians, public health practitioners and wildlife experts from 11 eastern and southern African countries. The participants were high-level ministry employees responsible for developing national programmes and policy and well-positioned to integrate a One Health approach into national decision-making.

The 11-day interactive workshop was conducted in Akegera National Park (NP), which in 1997 had two-thirds of its land de-gazetted and made available for settlement by returning refugees. Akegera NP contains thriving populations of large African plains mammals, but is under increasing pressure from the growing agricultural communities along its borders. Human-wildlife conflict, particularly involving elephants and hippopotamuses, is a major issue in this region.

At the start of the training workshop, participants' knowledge of wildlife disease and One Health issues was tested for evaluation purposes. The first topics addressed in the workshop were environmental ecology, environmental health and the drivers of emerging diseases. Field surveys were conducted within and outside Akegera NP to count the biodiversity of species, including plants, insects and vertebrates, and to evaluate soil fertility, erosion and water quality. Participants stated that direct comparisons of the ecosystems within and outside the protected park, and of areas settled recently versus historically, were "eye-opening" and increased their understanding of the impact of agriculture and human activity on the environment.

The next topics covered were wildlife ecology and health issues. These workshop activities included a visit to Akegera NP to observe encroachment into border regions. Evidence of illegal cattle grazing, fuelwood collection and wildlife poaching were all observed. Participants visited a village bordering the park to discuss villagers' interactions with wildlife. It was reported that livestock and crop losses due to wildlife were common and that occasional human deaths occurred from hippopotamus attacks. Villagers complained that they were not compensated for these losses and saw no benefits from living adjacent to the park.

Further training concentrated on the development of integrated surveillance plans and risk analysis/mapping. Exercises focused on diseases emerging from the harvesting, processing and marketing of wildlife and their products. Field activities included designing a wildlife health monitoring programme, selecting appropriate monitoring sites, and a demonstration of capturing and sampling birds and mammals. A local village was visited for a survey of the health and agriculture problems considered most important in the region.

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Fieldwork on bird ecology

Next the workshop covered integrated disease outbreak and response planning and the prevention and control of important zoonotic diseases. A visit to a local health clinic facilitated discussion of common health problems in the region. Undiagnosed febrile illness, usually treated as malaria, was reported as the most common ailment. The clinicians stated that apart from rabies, zoonotic diseases were not an issue in their region, but – as already observed – many cases of illness go undiagnosed.

The workshop then addressed communication skills, and practical examples of integrated One Health responses in the African context were discussed. Table-top exercises included examining complex disease outbreak scenarios in villages where both human and animal cases were reported.

Towards the end of the workshop, park managers came to discuss the challenges to managing wildlife and the park area. A large village bordering the park was visited, and participants observed the various ways in which people around the park derived a living, including from agriculture, trade and tourism, and the economic performance of each strategy.

On the final day of the WILD workshop, without assistance from the facilitators, the participants developed recommendations for the managers of Akegera NP (see the box on the next page). The final product was an excellent demonstration of park management through a One Health approach. Scores from a post-workshop test demonstrated that participants had greatly improved their knowledge, particularly regarding public health.

Evaluations almost unanimously gave this workshop an excellent rating, saying that it was a unique and effective approach to learning about the connectivity among wildlife, the park habitat and local communities and about the importance of these relationships. The field exercises and visits to villages were reported to be the most valuable learning experiences. Following the positive reception of this workshop, two more regional WILD workshops will take place in central and western Africa, and workshops are being developed for eastern and southern Asia.

Recommendations for the management of Akegera National Park developed by workshop participants

- Develop a clear national policy for wildlife veterinary practices, detailing the detection and management of emerging and re-emerging diseases.
- Encourage family planning practices to control population growth, so that the increased demand for land and other resources can be met.
- Review water quality, access, availability and consumption in light of changes in the microclimate resulting from climate change and land clearing for agriculture.
- Prioritize fencing according to community needs and monitor environmental impacts on Akagera National Park, to mitigate human-wildlife conflict.
- Review alternative measures for resolving human-wildlife conflict, and community-based natural resource management approaches for managing buffer zones around national parks.
- Establish community-based natural resources management for the park, including a comprehensive awareness and benefits programme that enables communities to appreciate the value of wildlife.
- Consider community empowerment through the provision of small income-generating schemes to address the socio-economic constraints currently faced by communities.
- Increase support to research aimed at controlling zoonotic disease at the human-livestock-wildlife interface.
- Focus more attention on wildlife, particularly at the interface, to address human-wildlife conflict.
- Encourage communities to communicate through their local leaders and participate in the notification, reporting and management of emerging and re-emerging infectious disease outbreaks.
- Establish official national and sub-national multidisciplinary teams to address the One Ecosystem health approach in Rwanda.
- Encourage the Government of Rwanda to conduct an environmental impact assessment and environmental audits around Akagera National Park and other parks, to address the adverse effects of changes in land use.
- Establish an intensive biodiversity monitoring programme to develop an inventory and continuous monitoring of Akagera National Park's flora and fauna resources.
- Enforce a revenue sharing/compensation policy for communities living around the conservation areas.

Contributor: Tracy McCracken (FAO)

Rift Valley Fever Vaccine Development, Progress and Constraints workshop

The Rift Valley Fever Vaccine Development, Progress and Constraints workshop was organized by the Animal Health Service (AGAH) of the Food and Agriculture Organization of the United Nations (FAO) and the Central Veterinary Institute of Wageningen University and Research Centre (CVI-WUR, Netherlands), under the umbrella of the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs). The workshop was supported by the Netherlands Ministry of Economic Affairs, Agriculture and Innovation, and the United States Centers for Disease Control and Prevention (CDC), with participation of the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) and the World Organisation for Animal Health (OIE). It took place from 19 to 21 January 2011 at FAO Headquarters, in Rome (Italy), and was attended by 34 leading scientists in Rift Valley fever virus (RVFV) vaccine development, representatives of international organizations, and policy-makers. Stakeholders from industry were represented by the International Federation for Animal Health (IFAH). The workshop's main objective was to gain consensus on desired characteristics of novel veterinary RVFV vaccines and to discuss how to establish incentives to make sure that these novel vaccines come to market.

Participants of the workshop on Rift Valley Fever Vaccine Development, Progress and Constraints

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Historically, two vaccines have been available for the control of RVFV in livestock. The first is based on the live attenuated Smithburn virus. Although this vaccine is inexpensive and provides lasting immunity after a single dose, its residual virulence renders it unsuitable for application in newborn and gestating livestock. The second vaccine is a safe alternative, based on inactivated whole virus. However, for optimal immunity, this vaccine requires a booster and annual re-vaccination, making it a less attractive measure. The drawbacks of these classical vaccines explain the need for a new generation of novel vaccines that must be cost-effective, provide swift and long-lasting immunity after a single dose, and be safe to apply, regardless of the physiological state of the animal. The possibility of needle-free delivery would be advantageous, to reduce the risk of spreading virus when viraemic animals might be present in the target population. Novel vaccines that allow the differentiation of infected from vaccinated animals (DIVA) using an appropriate discriminatory assay would be beneficial.

One of the candidate live attenuated vaccines discussed during the workshop is the MP-12 virus. This virus was produced by growing a virulent isolate of RVFV in the presence of the mutagen component, resulting in mutations on each of the three genome segments. Recent results suggest that the MP-12 vaccine is highly immunogenic in both humans and livestock and does not cause serious adverse reactions. A recombinant MP-12 virus that carries a large deletion on one of the segments was produced, opening the possibility for DIVA.

The Clone-13 vaccine virus is another well-known example of a live attenuated Rift Valley fever (RVF) vaccine. This virus is a natural non-virulent isolate of RVFV. A single vaccination provides full protection and has no undesirable effect, including on gestating animals. The Clone-13 vaccine virus was recently registered in South Africa and is currently used in the field.

A further live attenuated vaccine based on a recombinant RVFV has been developed with attenuating mutations on two genome segments, so it does not express the non-structural NSs and NSm proteins. This vaccine virus is completely avirulent in a laboratory rat challenge model, can provide solid protection against the virulent virus, and could be accompanied with a DIVA enzyme linked immunosorbent assay (ELISA).

Alternative vaccines discussed during the workshop are based on the structural glycoproteins Gn and Gc. These proteins are presented by vaccine vectors and are produced *in vivo* from plasmid deoxyribonucleic acid (as DNA vaccines) or administered in the form of virus-like particles (VLPs). Vector vaccines discussed during the workshop are based on capripox viruses, Newcastle disease virus or modified vaccinia virus Ankara. Multivalent vaccines that are currently being evaluated make use of capripox viruses as vaccine vectors and provide joint protection against sheep pox virus, goat pox virus and lumpy skin disease virus. These candidates are under evaluation. Apart from the high safety profile of these vaccines, an additional advantage is the potential application of DIVA with commercially available nucleocapsid protein-based ELISAs.

Tremendous progress has been made in the development of novel vaccines for RVFV control

The development of vaccines based on VLPs aims to combine efficacy and safety. VLPs closely resemble the structure of the complete virus and are therefore highly immunogenic. Their high safety profile renders VLP-based vaccines suitable for application in both livestock and humans. Several studies have demonstrated that VLP-based vaccines can protect mice from a lethal dose of RVFV, even without adjuvant. These first results, together with recently established improved production methods, suggest that this approach holds promise for the future.

In conclusion, the workshop showed that tremendous progress has been made in the development of novel vaccines for RVFV control. At the end of the workshop, the participants drafted 11 recommendations to guide and facilitate the development of RVFV vaccines, the norms and standards for them, and the establishment of vaccine stockpiles for rapid deployment. These recommendations, the proceedings of the workshop and other meeting documents can be accessed from the Internet.[4]

Acknowledgements to Dr Jeroen Kortekaas and Dr Rob J.M. Moormann from the Central Veterinary Institute of Wageningen University (Netherlands) for their scientific support in the organization of this workshop.

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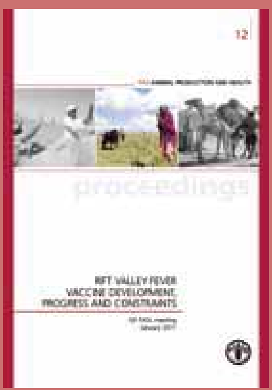
[4] www.fao.org/ag/againfo/programmes/en/empres/rvf_2011.html

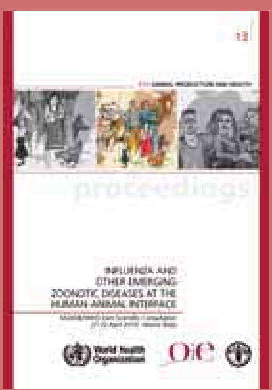
News

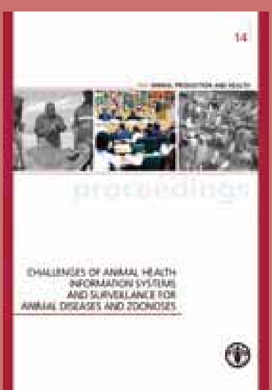
Meetings and publications

Meetings and events

- Global Agenda of Action in Support of Sustainable Livestock Sector Development, Phuket, Thailand, 1 to 4 December 2011
- Joint FAO-ICAR-FEPALE Workshop on animal identification and recording systems for traceability and livestock development in countries of Latin America and the Caribbean, Santiago, Chile, 5 to 7 December 2011
- WHO-OIE-FAO Reference Laboratory and Collaboration meeting, Sapporo, Japan, 5 to 6 December 2011
- Global South-South Development Expo, FAO Rome, Italy, 5 to 9 December 2011 (www.southsouthexpo.org/)
- International FMD Conference, New Delhi, India, 30 January to 1 February 2012
- Scientific Developments and Technical Challenges in the Progressive Control of Foot-and-Mouth Disease (FMD) in South Asia, New Delhi, India, 13 to 15 February 2012 (www.fao.org/ag/againfo/programmes/en/empres/fmd_india_12.html)
- One Health – One Planet – One Future Risks and Opportunities, Davos, Switzerland, 19 to 23 February 2012 (www.grforum.org/pages_new.php/onehealth/1013/1/938/)
- Annual Regional ECTAD Meeting, Bangkok, Thailand (tentative location), 20 to 24 February 2012 (tentative dates)
- International Conference on Emerging Infectious Diseases (ICEID 2012) Atlanta, Georgia, United States of America, 12 to 14 March 2012 (www.iceid.org/)
- 15th International Congress on Infectious Diseases (ICID) Bangkok, Thailand, 13 to 16 June 2012 (www.isid.org/icid/index.shtml)
- FAO/OIE International Conference on FMD Control, Bangkok, Thailand, 27 to 29 June 2012 (www.fao.org/ag/againfo/commissions/docs/fao_oie_fmd_conference2012/2011_fao_oie_fmd_conference_announcement.pdf)
- 13th International Society for Veterinary Epidemiology and Economics (ISVEE) Conference 2012, Building Bridges – Crossing Borders Maastricht, Netherlands, 20 to 24 August 2012 (http://isvee13.org/)







FAO Animal Production and Health publications

- **FAO Animal Production and Health Proceedings No. 12:** *Rift Valley fever vaccine development, progress and constraints, GF-TADs Meeting January 2011* (available at: www.fao.org/docrep/014/i2310e/i2310e00.pdf).
- **FAO Animal Production and Health Proceedings No. 13:** *Influenza and other emerging zoonotic diseases at the human-animal interface, FAO/OIE/WHO Joint Scientific Consultation 27 to 29 April 2010, Verona, Italy* (available at: www.fao.org/docrep/014/i1963e/i1963e00.pdf).
- **FAO Animal Production and Health Proceedings No. 14:** *Challenges of animal health information systems and surveillance for animal diseases and*

zoonoses. Proceedings of the international workshop organized by FAO, 23 to 26 November 2010, Rome, Italy (available at: www.fao.org/docrep/014/i2415e/i2415e00.pdf).

New staff

Samia Metwally joined the Animal Health Service (AGAH) on 30 May 2011 as an Animal Health Officer (virologist). She is sincerely interested in gaining global perspectives on transboundary animal diseases (TADs) and becoming fully engaged in disease control and support to capacity building for developing countries. Samia came to FAO from the Plum Island Animal Disease Center, United States Department of Agriculture (USDA) Animal and Plant Inspection Service (APHIS), where she served as the head of the diagnostic laboratory for TADs for ten years. She was the lead scientist in diagnostic assay development and validation for food-and-mouth disease and classical swine fever. She is well-recognized worldwide for her expertise in infectious diseases, has authored significant publications in peer-reviewed journals, and has served in a number of technical committees for TAD surveillance and trade for the United States Government. Samia was a member of the design team for the state-of-the-art National Bio and Agro-Defense Facility (NBAF), to replace the Plum Island Animal Disease Center.

Nancy McNally joined the Animal Health Service (AGAH) as Communications Officer in October 2011. She has extensive experience in media relations, public affairs and journalism spanning the last 12 years. Her previous work with FAO includes serving as Communication Officer for the Initiative on Soaring Food Prices, where she developed a new Web site and a communications strategy that included multimedia missions to Burkina Faso and Malawi for awareness raising and media outreach. She also worked with the Emergency Centre for Transboundary Animal Disease Operations (ECTAD) in 2008. Before that first introduction to FAO's work, she worked as Media Officer for Caritas in Rome, as a journalist for Agence France-Presse in Paris and as a television producer for CNN Financial News in New York. Her most recent assignment was as Deputy in Public Affairs at the United States Embassy to the Vatican. She has a Master's degree in newspaper journalism from New York University.

Contributions from FAO Reference Centres

FAO/OIE World Reference Laboratory for FMD, Pirbright, United Kingdom

Report from World Reference Laboratory for FMD, January to September 2011

Country/Territory	No. of samples	Virus isolation in cell culture/ELISA[1]									RT-PCR[2] for FMD[3] (or SVD)[3] virus (where appropriate)		
		FMD virus serotypes							NVD[5]	NT[6]			
		O	A	C	SAT 1	SAT 2	SAT 3	Asia 1			Positive	Negative	NT
Afghanistan	292	89	5	-	-	-	-	-	74	-	128	40	-
Botswana	5	-	-	-	-	5	-	-	-		5	-	-
Bahrain	15	-	-	-	-	-	-	4	11	-	5	7	3
Bulgaria	47	17	-	-	-	-	-	-	30		32	15	-
Cambodia	4	2	-	-	-	-	-	-	-	2	4	-	
People's Democratic Republic of Korea	31	1	-	-	-	-	-	-	30	-	1	30	-
China (Hong Kong SAR)	7	7	-	-	-	-	-	-	-	-	7	-	-
Democratic Republic of the Congo	20	4	7	-	-	-	-	-	9	-	19	1	-
Iran (Islamic Republic of)	91	-	-	-	-	-	-	-	-	-	-	-	-
Iraq	17	6	1	-	-	-	-	-	10		14	3	-
Israel	24	19	-	-	-	-	-	-	5		22	2	-
Lao People's Democratic Republic	4	4	-	-	-	-	-	-	-	-	4	-	-
Kenya	22	9	-	-	4	-	-	-	9	-	20	2	-
Libyan Arab Jamahiriya	52	2	-	-	-	-	-	-	50	-	14	29	9
Malaysia	23	1		-	-	-	-	-	5	17	23	-	-
Pakistan *	130	38	-	-	-	-	-	27	26	-	85	5	-
Republic of Korea	17	9	-	-	-	-	-	-	8	-	15	2	-
Kuwait	2	2	-	-	-	-	-	-	-	-	2	-	-
South Africa	24	-	-	-	-	-	-	-	24	-	-	24	-
Thailand	17	6	11	-	-	-	-	-	-	-	17	-	-
United Kingdom	5	-	-	-	-	-	-	-	5	-	-	5	-
Sri Lanka	2	2	-	-	-	-	-	-	-	-	2	-	-
Turkey**	68	11	37	-	-	-	-	3	18	-	67	1	-
Viet Nam	47	41	1	-	-	-	-	-	5	-	46	-	1
Zimbabwe	2	-	-	-	-	2	-	-	-	-	2	-	-
Total	968	270	62	-	4	7	-	34	319	19	534	166	13

[1] FMD (or SVD) virus serotype identified following virus isolation in cell culture and antigen detection enzyme linked immunosorbent assay (ELISA).
[2] Reverse transcriptase polymerase chain reaction for FMD (or SVD) viral genome.
[3] Foot-and-mouth disease.
[4] Swine vesicular disease.
[5] No FMD, SVD or vesicular stomatitis virus detected.
[6] Not tested.
*One sample from Pakistan contained a mixture of FMDVs of types O and Asia 1.
**One sample from Turkey contained a mixture of type O and A FMDVs.

Stop the press

Since *EMPRES Transboundary Animal Diseases Bulletin* No. 37 there have been reports of more transboundary animal diseases across the world.

African swine fever continues to spread progressively northwards in the endemic southern regions of the Russian Federation. In addition, on multiple occasions during 2011, the virus has jumped thousands of kilometres into novel territories. In many cases, secondary outbreaks are reported in these newly affected areas, and there is now growing risk of the disease becoming endemic there as well. Ukraine is at immediate risk.

Influenza-like illness: The United States Government has reported three cases of human infection with a triple reassortant influenza A H3N2 (swine, human and avian components). Between 10 and 13 November 2011, three children (aged 11 months, two years and three years respectively) experienced onset of febrile respiratory illness. All three children had visited the same health care provider in Iowa State. None of them were hospitalized and all three have recovered. Laboratory testing conducted on 18 November 2011 in the State Hygienic Laboratory at the University of Iowa showed a swine-origin triple reassortant influenza A (H3N2) virus. This was confirmed by sequencing at the United States Centers for Disease Control and Prevention (CDC) on 20 November 2011. These are the 16th, 17th and 18th cases of human infection with swine-origin triple reassortant influenza A (H3N2) detected in the United States of America since 2009, and the 8th, 9th and 10th cases reported this year. (Source: www.who.int/csr/don/2011_11_24/en/index.html).

Foot-and-mouth disease (FMD): In Turkey most of outbreaks in 2011 have been type A, the new lineage A/IRN/05; the PanAsia 2 endemic is not causing many outbreaks at the moment. After nine years, new incursion by Asia 1 (sub-lineage Asia 1 AFG-07) has occurred. Three separate introductions from outside the country were determined as being due to the Asia 1 serotype. Only the introduction detected in Ardahan Province has spread to other areas, causing 60 outbreaks by the end of November 2011. An East African pool SAT2 epidemic is widespread in central parts of the Rift Valley of Kenya. In October 2011, the World Reference Laboratory for FMD completed the testing of samples from the Democratic Republic of the Congo. FMD serotype O (O topotype EA-2) was found in epithelial tissue samples collected from cattle in October 2010, and FMD serotype A (A topotype AFRICA) was found in epithelial tissue samples collected from cattle in February 2011. The serotype A (of which this may be the first occurrence in the Democratic Republic of the Congo) is related to the East African pool.

New vaccine against novel 2.3.2.1 H5N1 viruses in China: The novel 2.3.2.1 H5N1 virus sub-clade that had made some conventional poultry vaccines less effective in Viet Nam and China prompted an adjustment of vaccines production protocols; following thorough testing in China the new vaccine will be more widely applied in poultry across China starting early 2012.

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