

# PROCEEDINGS of the Joint APHCA-OIE Regional Workshop on Zoonoses, Food-Borne Diseases and Antimicrobial Resistance

Thimphu, Bhutan, 24-25 September 2013



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**THAILAND**



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# **Proceedings** OF THE **JOINT APHCA-OIE REGIONAL WORKSHOP ON ZOOZOSES, FOOD-BORNE DISEASES AND ANTIMICROBIAL RESISTANCE**

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REGIONAL OFFICE FOR ASIA AND THE PACIFIC  
Bangkok, 2013**

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# Zoonotic and Food-Borne Disease Challenges in a Globalized World

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## Introduction

Over the last two decades the world has become much more closely connected, not just electronically but also physically through vastly increased frequency and spatial coverage of human travel and trade in livestock-related and other products. At the same time livestock production has increased substantially, in response to increased demand associated with economic development in many low- to middle income countries as well as a continuous increase of the human population. Since the beginning of the 21st century, these developments have contributed to the emergence of several zoonotic disease threats of global significance, including SARS, influenza A subtypes H5N1 and H1N1, as well as antimicrobial resistant pathogens such as MRSA. Furthermore, the increasing complexity of food supply chains represents a significant food safety challenge, as demonstrated during the melamine tainted milk scandal in China in 2008, the EHEC 2011 epidemic in Germany and the horsemeat scandal in Europe in 2013. This means that the global risk landscape has changed enormously and it is necessary to consider new approaches to risk governance. One aspect of this will have to be an integrated approach to research and policy development that takes the complexity of the underlying system into account. It will have to also take account of the need for environmental sustainability of food production (Foley, Ramankutty et al. 2011).

## Global connectivity and complexity

Trade and human travel have changed enormously over the last 100 years, but in particular during the last 30-50 years. As an example, while in the first half of the last century production chains focused on distributing tasks within countries or wider regions such as the European Union, in the second half it gradually became more of a globalised activity that for many products has resulted in very fragmented production chains (Huwart and Verdier 2013, Rodrigue 2013). Agri-business has been included in this development and the influence of large food retailers has also increased substantially (Lee, Gereffi et al. 2012, Reardon, Timmer et al. 2012, Stuckler and Nestle 2012).

While the connectivity associated with economic and cultural drivers is one important aspect, it can be extended into what one might call the ecological connectivity, a term

which expresses the relatedness of the global ecosystems (Peters, Groffman et al. 2008, Lang and Rayner 2012). The research associated with attempting to prove and understand global climate change played a key role in this respect. The connectivity of ecological system results in enormous complexity where non-linear and feedback effects are almost impossible to predict with a meaningful degree of certainty. As an example of complex relationships, consumers and producers have been affected in recent years by increased food price volatility which as it became apparent was influenced by many and very different drivers (Gilbert and Morgan 2010).

### **Animal disease emergence and spread**

The frequency and the impact of animal disease introductions and outbreaks, including zoonotic ones, has increased in the last 10-20 years, despite enormous technological development. The first major example of such a disease event has been the emergence of bovine spongiform encephalopathy (BSE) 25 years ago. It was followed by the classical swine fever epidemic in the Netherlands in 1997-98, Nipah virus in 1998-99 in Malaysia, the foot-and-mouth disease outbreak in UK in 2001, SARS in 2003 affecting multiple countries around the world, avian influenza HPAI H7N7 in the Netherlands in 2003, the since 2004 still on-going avian influenza HPAI H5N1 outbreak in several countries around world and the so-called swine influenza epidemic in 2009 caused by pandemic H1N1/09 influenza virus. Furthermore, there was the introduction of bluetongue virus in 2006 into northern Europe and emergence and subsequent spread of Schmallenberg virus in 2011 also in northern Europe, both of which have demonstrated our limited capability to prevent the spread in livestock production systems of some infectious diseases, in this case vector-borne ones. Similarly, African swine fever was first reported from Georgia in 2007, without being able to identify the exact mechanism of introduction from endemic areas in Africa. The virus has since spread into Russia, without a prospect of being able to eradicate it and resulted instead in the not insignificant risk of further spread, also into EU countries. Other production diseases such as postweaning multisystemic wasting syndrome (PMWS), first reported in 1991 in Canada, and porcine reproductive and respiratory syndrome (PRRS), first reported in 1987 in USA, have extremely successfully spread around the world and become endemic in most pig production systems.

Several of the above outbreaks have been controlled to some extent, but in most of the situations the causative pathogen has not been eradicated from the affected country or there remains a significant risk of re-introduction. Even countries with very high economic and social investment into border biosecurity and disease surveillance, such as Australia and New Zealand, have experienced introduction of PMWS and PRRS, and Australia had repeated small outbreaks of the new Hendra virus affecting horses and humans since 1994 and a large equine influenza outbreak in 2007. The speed at which the pandemic H1N1/09 influenza virus spread around the globe through infected humans should warn us that we currently do not have the capability to prevent the spread of a virus disease with high transmission rate amongst humans. Current evidence suggests that amongst animal populations even a disease with high transmission rate



should be theoretically controllable due to the ability to introduce strict biosecurity measures in animal populations and their compared with humans much lower movement frequency and geographically much more limited contact networks. As a consequence, animal diseases are also much less likely to make sudden jumps over large geographical distances as is common with human diseases due to high frequency of long-distance human air travel.

The causal factors for emergence and spread are multiple, including intensification of livestock production, increased human travel and food-associated trade, reduction of and encroachment on wildlife habitat (Pearce-Duvet 2006, Bordier and Roger 2013, Jones, Grace et al. 2013). There is some understanding with respect to the ecological systems within which new or previously unknown pathogens can emerge (Wolfe, Dunavan et al. 2007, Woolhouse and Gaunt 2007, Keesing, Belden et al. 2010). The role of trade networks has also been demonstrated, particularly in the spread of avian influenza (Soares Magalhaes, Ortiz-Pelaez et al. 2010, Magalhaes, Zhou et al. 2012, Fournie, Guitian et al. 2013). Evolutionary forces that lead to emergence are influenced by diversity and intensity of contact (Ewald 1996, Antia, Regoes et al. 2003). It is also important to recognise the continuous and widely underestimated challenge for human and animal health through emergence of resistant pathogens as a consequence of evolutionary pressure exerted by antimicrobial usage (Lipsitch 2001, Palumbi 2001, Davies and Davies 2010, Orton, Wright et al. 2013). It also needs to be noted that the ability to control virus diseases through vaccination of humans and animals can be compromised through emergence of vaccine-resistant strains, for example as a result of inadequate vaccination coverage that can lead to selection pressure towards resistant virus pathogen variants (Gandon, Mackinnon et al. 2001, Lebarbenchon, Brown et al. 2008). This has been presented as a risk and may indeed already have occurred with avian influenza HPAI H5N1, for which vaccines have been used on a large scale for several years now in China, Vietnam and Indonesia (Pfeiffer, Otte et al. 2011). But this risk needs to be put into perspective, since the likelihood to develop new vaccines for virus infections is substantially higher than that for developing new antimicrobials for bacterial or parasitic diseases. To enhance our understanding of the mechanisms behind emergence and spread of pathogens within the complex system that this planet represents, more relevance needs to be given towards integrated research approaches, where the interaction between social, environmental and biological drivers is investigated.

## **Policy development**

The drive towards more holistic approaches to control and prevention of infectious diseases has not come from the scientific community, but rather from policy makers. They are directly affected by ineffective policies based on scientific knowledge generated by classical single- or multi-disciplinary approaches, and therefore are more likely to recognize the importance of interdisciplinary and –sectoral approaches. The linkage between risk assessment (RA) and management (RM) as defined by the OIE framework for risk analysis should be reviewed, since it needs to emphasize the

importance of integrated approaches towards RA and RM more effectively (Aven 2012). As a potential way forward, the risk governance framework may be more appropriate for policy development (Renn, Klinke et al. 2011).

## Conclusions

The level of commercial and social interaction together with significant, although heterogeneous, economic development around the globe emphasizes the need for a global systems perspective, if we are to deal effectively with the increasing risk of zoonotic disease emergence and spread. As part of this approach, integrated approaches to research have to be adopted, and this should be embedded in risk governance frameworks, which take into account a wider societal context and integrate risk perception and social management of risk.

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# **Control of Zoonoses and Food-Borne Diseases in Bhutan**

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## **Introduction**

The primary zoonotic diseases reported in animals in Bhutan are viral (rabies, highly pathogenic avian influenza H5N1), bacterial (anthrax, brucellosis, tuberculosis, salmonellosis), parasitic (trichinellosis, cysticercosis & hydatidosis) (Dorji, 2011). These zoonotic diseases are scheduled in the Livestock Act of Bhutan 2001 and any outbreaks or suspected outbreaks are liable for official control measures following the relevant procedures outlined in the Livestock Rules and Regulations 2008.

## **Rabies**

Bhutan has an estimated dog population of over 50 000, including 26 000 pets and over 24 000 stray roaming populations (livestock statistics 2010). Human rabies is one of biggest threats in Bhutan costing heavy human toll and accelerating its medical expenses. Between January 2006 to January 2011, nine human rabies deaths have been reported (1.2/100 000 population at-risk). In 2011 alone, there were a total of 5 913 cases of dog bites reported and 5 mortalities are attributed to Rabies (Health bulletin 2012). Un-controllable stray dog population is also impacting negatively to the tourism industry which is the second largest foreign exchange earner for the country. Rabies in animals is mainly prevalent in the southern districts that border India. Between 1996 and 2009, 814 cases of rabies were reported in dogs and other domestic animals in Bhutan (Tenzin et al, 2011). Post exposure treatments for rabies are provided free of charge, resulting in substantial cost to the primary health care system in Bhutan. Over the years, the expenditure for rabies vaccines have been increasing. In 2010 alone, the expenditure increased to Nu10 million from Nu4.5 million in 2009 (HPED report, 2011). In an attempt to address the increasing number of street-dogs, the Royal Government of Bhutan in collaboration with Humane Society International initiated a National Dog Population Management and Rabies Control Project in 2009. The project aims to capture, neuter, vaccinate and release the dogs in excess of 75% of the dog population to achieve significant impact in the population of free roaming dogs and rabies incidence by 2015.

## **HPAI H5N1**

Highly pathogenic avian influenza (HPAI) caused by influenza A subtype H5N1 has emerged as an important animal and public health threat. Bhutan reported its first HPAI outbreak in February 2010 in Chukha district. Subsequently, several HPAI H5N1 outbreaks were reported in 2012 & 2013 from Chukha, Thimphu, Sarpang and Mongar

districts. All of these outbreaks in Bhutan were rapidly contained following the National Influenza Pandemic Preparedness Plan (NIPPP) and standard operating procedures (SOPs) for response to HPAI outbreaks. Counterparts from Health and related agencies were equally involved in response to these outbreaks. The cumulative expenditure for the control of HPAI outbreak in 2010 and 2012 amounted to BTN 9.2 million equivalent to USD 2.04 million (HPAI outbreak report, 2012). A total of 8 495 backyard poultry population was culled in response to the HPAI outbreak involving 874 poultry farmers in over 52 villages.

## **Anthrax**

Anthrax has occurred over the years sporadically affecting wide ranges of livestock and human population in Bhutan. Outbreaks in animals are reported sporadically throughout the country on an annual basis with more cases reported from the warmer areas. An outbreak under Zhemgang district in 2010 killed over 100 livestock and infected eight humans (NCAH, 2010). In 1991, one household was affected in Langthel under Trongsa district after consuming meat from a bull which died from confirmed anthrax. Similarly, there were a series of outbreaks reported from different areas of Bhutan in 2012. It is highly likely that some cases of human and animal anthrax go unreported in the remote places of Bhutan. The major risk of acquiring anthrax is through handling and ingestion of meat of dead animals.

## **Brucellosis and tuberculosis**

Bhutan has not reported clinical cases of bovine brucellosis and bovine tuberculosis as of now. Routine screening against bovine brucellosis using Rose Bengal Test in cattle were so far without any conclusive positive results. However, undulant type of fever is commonly reported in humans in the hospitals and reports have also shown that the incidence of abortions in cattle is 0.25% in six districts of eastern Bhutan (Dorji, 2011). The study on prevalence of bovine tuberculosis in peri-urban dairy farms in Thimphu using intra-dermal injection of purified protein derivative (PPD) indicated negative to bovine tuberculosis (Tenzin et al., 2008). The annual load of new cases of TB (both pulmonary and extra-pulmonary) in humans is 975 of which about 537 were sputum smear positive (MoH, 2011).

## **Salmonellosis**

Salmonella has been recognized as an important zoonotic pathogen of economic significance in animals and humans (EFSA, 2010). Although there are no publications available, there are records of Salmonella isolation from different sources including poultry and food items in Bhutan. Outbreaks in poultry and pheasant farms have been recorded earlier. The study on prevalence of Salmonella in imported chicken showed 13% *S. enteritidis* and *S. typhimurium* (Dahal, 2007). The salmonella isolates were resistant to up to three antimicrobials. All *Salmonella typhimurium* isolates were resistant to nalidixic acid with one isolate showing simultaneous resistance to Cephalexin. *Salmonella enteritidis* was resistant to five of the seven antimicrobials

tested with simultaneous multidrug resistance to up to three antimicrobials (Dahal, 2007).

Accordingly, in a survey conducted by the National Centre for Animal Health, Salmonella was present in 20.3% and 27.1% of imported beef and pork respectively (Dahal et al, 2011). There are frequent outbreaks of salmonellosis reported in humans, either through the water sources or from the food items (Wangdi, 2007). There is no surveillance of Salmonella presently carried out in the country. Implementation and monitoring of Salmonella surveillance in food and food products will be an immense responsibility of the concerned agencies in the near future in Bhutan.

### **Food-borne parasitic zoonoses**

Food-borne parasitic zoonoses cause death and serious diseases in humans and animals worldwide, and are of both public health significance and socio-economic importance (Zhou et al., 2008). Trichinellosis, cysticercosis and echinococcosis are important parasitic zoonoses relevant for Bhutan. However, limited studies have been done with regards to trichinellosis, cysticercosis and hydatidosis in the country and there are no available reports of their incidence in humans.

### **Recommendations**

Epidemiologic surveillance to monitor the incidence of specific zoonotic and food-borne diseases like tuberculosis, brucellosis, salmonellosis, cysticercosis and hydatidosis are not carried out regularly. Both passive and active surveillance can be instituted and the information shared through TADinfo database system that the Animal Health services presently uses. Laboratory-based surveillance should also be incorporated in the system to monitor the incidence of some of the zoonotic and food-borne diseases, which are of low incidence in food animals. Appropriate diagnostic technology for detection of such food-borne diseases should be made available and mandatory to support the meat inspection procedures in the country. The laboratory surveillance should also focus on drug residue testing in beef with available test kits for detection of antibiotic residues, pesticides and mycotoxins.

Managing and responding to risk related to zoonoses and food-borne disease is complex and requires multi-sectoral and multi-institutional cooperation. National preparedness plan for zoonoses incorporating efficient surveillance and stakeholders' collaboration in implementing prevention and control activities to contain such diseases at source to minimize or prevent impact on animal and human health is crucial.

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# Zoonoses in the Southwest Pacific Region

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## Introduction


**ZOONOSIS : Pacific Regional Overview and the need for Collaboration**

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**Outline**

- Introduction
- Zoonotic diseases of current concern in PICTs
- Case study: PRIPPP
- Regional Collaborative Frameworks
- Future Opportunities

**Pacific Region**



**Livestock Production Systems**

**Melanesian countries (5)**

- Large holdings
  - Beef cattle production
  - Dairy production sector (Fiji)
- Some export of livestock products (beef, poultry, eggs, milk)
- Commercial poultry, commercial piggeries (intensive)
- Sheep and goats
- Smallholders also

**Polynesian Group (10)**

- A few large holdings - beef
- Smallholders mainly
- Mainly poultry and pigs

**Micronesian Group (5)**

- Mainly smallholder livestock units for subsistence
- Pigs and poultry

**Characteristics**

- Chronic lack of veterinarians
- Free of major exotic pests and diseases, including zoonotics
- Livestock sectors are generally smallholder-based and contribute significantly to GDP
- Over 60% of our households raise livestock. In the smaller islands, e.g. Cook Islands, > 90%.
- Many different benefits accrue, - income flows and food security
- Cultural significance of livestock is very important, esp. pigs in all PICTs
- A major component of livestock trading and use is still through the informal market
- Some PICTs actually export live animals and livestock products

**Zoonotic diseases of concern in Pacific**

- Infectious diseases were not historically important in the Pacific (i.e. Pre-colonisation)
  - low population densities
  - disparate population centres (i.e. islands) - exception of the PNG highlands where population densities were very high.
  - naive populations (risk): susceptible
- Mammals were largely absent from most PICTs with the exception of PNG
- There are no past verbal records of zoonotic diseases in places like PNG (Kuru/encephalopathy)

Zoonotic diseases of concern in PICTs				
	Diseases	Risk	Control	Collaboration
Bat-borne viruses	Lyssa virus, Hendra (exotic)	Low - Med	Limited	Low
Food-borne diseases	Salmonella and other enterics	High	Good	Low
Zoonoses with direct transmission	Brucellosis/TB Leptospirosis	Moderate to high	Good	Low (local) Low (regional)
	Rabies (Guam, 1967; otherwise exotic)			Low (Guam outbreak)
Influenza/ emerging disease	Exotic	Hard to define ( Low to Med )	Fair/Good	High (post PRIPPP)
Toxin type issues	Ciguatera Fish Poisoning	High	Fair	Low (Local)

### Case Study: PRIPP Project

- Primarily a public health program to improve preparedness for and response to HPAI (H5N1) in both AH and HH sectors
- Involved 22 PICTs in a 6-year dual sector program (AH and PH)
- The goal was to build capacity for surveillance and response to avian influenza in each PICT in all sectors
- Paravet training was the core AH activity designed to raise AH trained manpower capacity
- It successfully brought together human and animal health teams and sector reps
- The result was a significantly enhanced response to other diseases such as pandemic H1N1(2009), Brucellosis, limiting impacts in PICTs.
- The project increased capacity for communication across the sectors, i.e. PH more aware of zoonotic diseases and willing or able to engage with AH Authorities.

### Regional Collaboration

What type of collaboration is needed?:

- Regional coordination mechanisms
- Communication – networks
- Surveillance and early warning systems (information sharing/linkages)
- Capacity building – paravet training, response capacities, diagnostic systems
- Physical capacity – local up skilling and linkages with referral laboratories (AH and HH)
- Human resources – shared resources, i.e. capacity replacement, capacity supplementation
- Project-related collaboration between countries (e.g. FABN – Melanesian countries)

### Regional Networks

- PacVet – AH communication forum
- PAHLNet – Pacific AH lab networks
- PHOVAPS
- Pacific Public Health Surveillance Network
  - LabNet now invites AH labs reps (a consequence of PRIPPP)
  - Epinet





### GLOBAL INITIATIVE

Still a lot of work needed in this at National levels



**Potential Challenges**



- Sectors working in silos esp. PH and AH
- Overlapping and uncoordinated work with the large number of potential partners with differing priorities, working in the region
- Competition for resources (i.e. international agencies, technical partners, universities etc) for the Pacific region.
- Within PICTs: Limited human resources to adopt the management structures for these initiatives and implement activities plus the competing priorities at national levels

**Future Opportunities**



- Encourage close in-country multi-sectoral collaboration esp. between PH and AH
- Focus on Prevention in the Pacific region, esp. in the AH sector
- Ensure preparedness and response capacities in countries
- Regional collaborative frameworks for the Pacific, i.e. treat it as a large country?
- Regional Coordination Mechanism (esp. for early warning, response, mobilisation of resources, lab back up services)
- Further collaboration between technical partners (SPC, WHO, FAO.OIE) mobilising technical expertise from within and outside the region (e.g. Australia/NZ, OIE, FAO for the SPC GFTADs framework)
- Work through existing frameworks/agencies within the region e.g. SPC within Pacific region

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## Zoonoses in Viet Nam

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### Introduction

Zoonotic diseases are a group of infectious diseases that are naturally transmitted between vertebrate animals and humans. Those diseases have made a great impact on human and animal health as well as global socio-economic. The greatest risk for zoonotic disease transmission occurs at the human-animal interface through direct or indirect human exposure to animals, their products and/or their environments. More than 60% of the newly identified infectious agents that have affected people over the past few decades have been caused by pathogens originating from animals or animal products {1}. Therefore, elimination and control of zoonotic diseases is a priority issue in all countries and all sectors need to be involved. In Viet Nam, the National program for elimination and control of zoonoses has been established. The key agencies taking part to this program are the veterinary services, the preventive medicine agency and government at all levels.

### Zoonotic disease situation

#### *Avian Influenza (AI)*

AI A/H5N1 outbreaks have occurred in Viet Nam since December, 2003 to date. In 2011, 92 outbreaks occurred in 71 communes of 40 districts of 21 provinces, infecting 99 780 poultry; a total of 132 667 poultry were destroyed.

In 2012, AI A/H5N1 occurred at 187 communes of 79 districts of 26 provinces, infecting 148 668 poultry; 46 905 poultry died and 361 721 were destroyed. It has been reported that four persons were infected with AI A/H5N1 this year, of which two persons died. Since 2003 to date, 123 people have been infected with A/H5N1, of which 61 died.

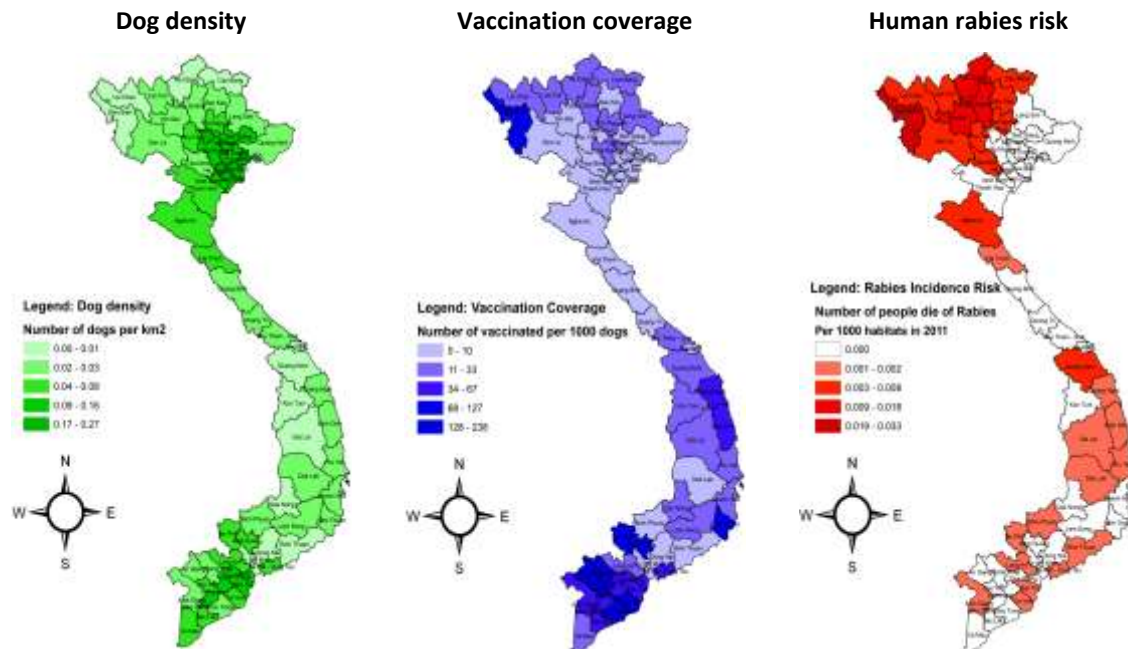
#### *Rabies*

The dog population in Viet Nam is about 6 million head. Dogs are raised in most parts of the country and almost all breeding dogs are of local breed. Some are imported from other countries and cross-breeding between local and imported breeds is practiced. Normally, dogs are raised for house guarding while some are raised as pets. In Viet Nam dogs are kept mainly in delta areas, towns and cities (see Figure 1). Each family has between one and three dogs.

The human and animal rabies situation over the period 2008 to 2012 showed that 1 285 885 persons were bitten by dogs and had been treated against rabies. Of the

persons bitten, 354 died. In the first 8 months of 2013, 175 035 persons were bitten by dogs, of which 63 died. The number of rabies cases in mountainous and midland provinces is higher than in other areas (see figure 1).

**Figure 1:** Dog density, rabies vaccination coverage and human rabies risk



## Control and elimination of zoonotic diseases

Control of zoonotic diseases is an important task in all countries over of the world, especially, in the context of on-going economic integration. In Viet Nam, the National program of control and elimination of zoonotic diseases has been developed and deployed.

Vaccination programs are conducted and joint-work among related parties with the aim of controlling and ultimately eliminating of zoonotic diseases is planned and implemented yearly. To improve the effectiveness of control of zoonotic diseases a joint circular between Ministry of Agriculture and Ministry of Health has been issued on 27 May 2013 as guide for coordination of prevention and control of zoonotic diseases. The joint circular defines the contents and principles of coordination among related parties and requires focal points to be clearly identified.

The capacities of laboratory systems have been assessed and are being improved to meet the requirements for the control of zoonoses. Public awareness programs are also regularly broadcasted in mass media to enhance general public knowledge about prevention and control of zoonotic diseases.

Additionally, the international cooperation on prevention and control of zoonotic disease has been strengthened.

## **References**

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Department of Animal Health of Viet Nam and Department of Prevention Medicine

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## **FAO Activities on Zoonoses and Food-Borne Diseases**

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### **Introduction**

Achieving food security for all is at the heart of FAO's efforts to make sure people have regular access to enough high-quality food to lead active and healthy lives. FAO's mandate is to improve nutrition, increase agricultural productivity, raise the standard of living in rural populations and contribute to global economic growth.

The world faces a major challenge of emergence and spread of high impact infectious diseases (EIDs) affecting animal production and public health due to many factors including growth of human populations, rapid urbanization, intensification of farming systems, forest encroachment, and globalization of trade in animals and animal products. Livestock sector developments in the Asia-Pacific region are creating a fertile ground for the emergence of animal diseases, some of which may have zoonotic potential resulting the impacts not only on livestock productivity but also consumer health as well as health of farmers that may lead to insufficient ability in farming.

### **FAO activities related to zoonotic and food-borne diseases**

Having recognized the importance of emerging and endemic zoonotic and food-borne diseases, FAO has been involved in global and regional efforts to diminish the risk and minimize their potential impacts. With the overall goal of ensuring food security and safety, the livelihoods of poor farming communities and promoting animal health and public well-being, FAO has been focusing on development of veterinary services' disease control related capacities to promote their governance in disease control and emergency response at regional, national and field levels in accordance to the international standards. In addition, assistance has been given to the member countries to develop rational and targeted control program for specific diseases through scientific information derived from field surveillance, disease intelligence and strategic research. FAO also promotes wide-ranging collaboration across sectors and disciplines to address a broader range of drivers of zoonotic diseases. In particular, FAO in partnership with OIE and WHO continue to support the strengthening of existing animal and public health surveillance, prevention and preparedness, and response systems at the country, regional and international levels.

### ***Regional capacity building and networking program***

According to FAO's Corporate Strategy, there are four levels of capacity development: individual, organizational, sector/network and enabling environment levels. At

individual level, people can be trained to increase their knowledge and skills. The organizational capacity can be strengthened by improving structures, mechanisms and procedures and will enable the skilled human resources to utilize their knowledge to perform their services. A network can be formed among the organizations within and among the sectors to share their experiences and resources. Within the network, the coherent policies and strategies of the organizations and sectors are required with good coordination and this would enable to form policies and institutional framework with high-level commitment resulting in a higher scale of development impact. However, aiming at higher level would take longer time and more resources. Following such strategy, FAO has been systematically building the national and regional capacities of the three main technical components, laboratory, epidemiology and environmental health management, to support zoonotic disease control.

#### Laboratory Capacity Building and Networking

Four technical components are focused including: strengthening of diagnostic capacity, assuring the quality of laboratory services, improving laboratory biosafety facilitating laboratory networking at national and regional levels. In addition to the trainings organized for laboratory staff to improve their diagnostic skills.

Since 2010, at least 12 laboratories in Asia have been participating in the Regional Quality Assurance and Proficiency Testing Program and Regional Biosafety Improvement Program aiming to improve the quality of their diagnostic services and biosafety system in their laboratories respectively. Apart from animal diseases, the zoonotic diseases that have been demonstrated to be improved in the quality of their diagnostic services include influenza H5N1 and Rabies. Diagnosis of H7 has been included in the program recently and brucellosis will be included by 2014. At least 29 laboratories of 10 countries have participated the Regional Biosafety Improvement Program since 2010. Shortfalls and gaps in biosafety system in these laboratories were identified and corrected. Approximately 170 biosafety cabinets have been checked and those that were not working properly have been repaired or replaced.

FAO encourages and supports the countries to establish the national laboratory network and also to participate in the regional network. The aims of such networking are to implement the regional quality assurance and biosafety improvement programs as well as to share experience and resources among the network members. To mentor the laboratories in the region, an expert group has been formed consisting of experts from international reference laboratories for the target diseases to provide technical advisory to the network members. The importance of quality assurance program and laboratory biosafety system has been advocated to the laboratory director level at the Laboratory Director Forum jointly organized by FAO and OIE for their support to participate in the program and for the longer term carry out this on a routine basis.

#### Epidemiological Capacity Development and Networking

One of the key activities in building epidemiological capacity that involves in capacity to respond to zoonotic diseases include the establishment of Regional Field Epidemiology Training Program (FETPV). The Regional FETPV program is currently hosted by the Thai



Department of Livestock Development, Ministry of Agriculture and Cooperatives in collaboration with Department of Disease Control, Ministry of Public Health with technical and financial support from the Thai Government, FAO, USAID, USCDC. The program employs the concept “Training through providing services” focusing on field activities using the real situation as the case studies.

The program is closely linked to the Field Epidemiology Training Program (FETP) organized by the Thai Ministry of Public Health having the joint training module on core epidemiological concept as well as joint demonstration outbreak investigation of zoonotic or food-borne diseases. During the training, trainees from both sectors will be assigned to conduct actual investigation for any zoonotic or food-borne diseases together with the relevant authorities in the field. In line with One Health approach, the program also promotes the use of multidisciplinary approach as well as engages the wildlife health sectors to the training.

This Regional FETPV is now expanded to the country level particularly the country program in China has made significant contribution to investigation of H7N9 incursion in poultry in infected areas in China. Modified short-term training program has been launched in South-Asia and several countries including Cambodia, Laos, India and Nepal. There are similar epidemiology training programs in the region including the Applied Veterinary Epidemiology Training (AVET) in Philippines and Viet Nam being supported by FAO.

As the FETPV and AVET have been designed to focus on follow-up activities in the field after the classroom training, trainees are allowed to form the network among themselves, with the relevant authorities in the field and with the trainees and authorities from public health and wild life health sectors. Similar to the laboratory network, a group of epidemiology experts, Epidemiology Consortium, has been formed to provide their technical inputs to countries in the region.

#### Environmental Health Management

Environmental animal health management (EAHM) relates to those aspects of animal health and welfare that are determined by physical, chemical and biological factors, external to the animal in the local farm setting and the broader environmental context of animal production. It also refers to the theory and practice of assessing, correcting, controlling and preventing those factors that may have adverse effects on the health of animal and human populations, and the wider environment.

EAHM is being promoted in line with FAO’s long-term goal of sustainable agricultural and rural development. EAHM studies seek to assess and understand animal diseases in their environmental and production/farming system context, both in space and time. With relatively minor, progressive changes in animal husbandry practices and modification of the production environment (better nutrition, waste-management, bio-security, vector and intermediate host reduction, movement control, land use zoning), substantial benefits can accrue to animal and human health, and the environment. The following is the current progress:

- 1) Capacity to analyze animal disease risk and develop environmental animal health management strategies are fully integrated as core elements in animal production and health services in the Philippines.
- 2) Capacity to analyze animal disease risk and develop and apply strategies on environmental animal health management are further strengthened and applied in selected priority areas in Cambodia and Lao PDR.
- 3) Capacity for database management, analysis and application of GIS to implement environmental animal health management strategies in Myanmar and Vietnam are developed and strengthened.
- 4) Technical/scientific and policy dialogue and network for information exchange and dissemination with the participating countries are established with the Philippines having a coordinating role and the further use of environmental animal health management strategies in animal production and health are thereby promoted.
- 5) National institutions and stakeholders networked and poor livestock keepers empowered and enabled to participate in the policy decision making process of the respective countries.

***Support in planning and policy development and coordination***

Regional strategic framework for laboratory and epidemiology capacity building and networking: For the longer-term impact, building capacity at the institutional level is required. FAO has been working with other international partners including OIE, experts from regional and international leading laboratories that have relevant work in the region to develop regional strategic framework for laboratory and epidemiology development. This is to ensure that the efforts in capacity building in the field of laboratory and epidemiology are carried out in a sustainable way and address needs of the countries and the region. Chief Veterinary Officers, Laboratory Directors and relevant technical officers have been advocated and engaged to key events of laboratory and epidemiology capacity building program. For ASEAN, the member countries took the initiatives of drafting the two regional frameworks with the technical support of FAO in collaboration with other international organizations which were subsequently endorsed by ASEAN Working Group on Livestock as well as by the Senior Officers.

The ASEAN Regional Framework for Laboratory Capacity Building and Networking consists of six key strategic goals including:

- a) Development of regionally-coherent, national laboratory strategies and policies;
- b) Allocation and mobilization of resources to support implementation of national strategies for efficient and cost-effective deliver of laboratory services;
- c) Strengthening of ASEAN Member States (AMS) capacity to provide acceptable quality and proficient laboratory services;

- d) Enhancement and promotion of acceptable biosafety and biosecurity practices and environment in laboratory setting;
- e) Enhancement and promotion of linkages and sharing of information among laboratories and stakeholders to ensure the rationale use of laboratory services;
- f) Strengthening ASEAN Member States capacity on planning, coordinating and implementing research activities under standard ethical research conducts.

Four strategic goals of the ASEAN Regional Framework for Epidemiology Capacity Building and Networking include:

- a) Development of regionally-coherent, national organizational structures and systems to support functions of veterinary epidemiology;
- b) Enhancement and promotion of linkages, partnerships, networks, coordination and collaboration among AMS, development partners and stakeholders to maximize efficient and sustainable uses of available resources
- c) Strengthening human resources capacity and management to ensure effective use of trained veterinary epidemiologists and to effectively deliver national animal health programs in compliance with international standards
- d) Enhancement and promotion of awareness and understanding of veterinary epidemiology to provide support, to ensure science base decision-makings, and to efficiently mobilize resources based needs

**Establishment of ASEAN Coordination Centre for Animal Health and Zoonosis (ACCAHZ):**

Noting the continuing threats of TADs and zoonoses, AMS recognises the need for each AMS to build up its capacities and capabilities, as well as the need for a comprehensive, integrated, and concerted regional coordination mechanism (RCM) to deal with TADs and zoonoses. Most evidently, the 32<sup>nd</sup> Meeting of the ASEAN Ministers of Agriculture and Forestry (AMAF) held on 23 October 2010 in Phnom Penh, Cambodia, affirmed its support and pledged its commitment for the RCM through the Ministerial Statement entitled “ASEAN Cooperation on Animal Health and Zoonoses: HPAI and Beyond”. The Statement commissioned the SOM-AMAF and ASEAN Sectoral Working Group on Livestock (ASWGL) to implement necessary actions to advance the initiative.

Later on at the 33<sup>rd</sup> AMAF Meeting held on 6 October 2011 in Jakarta, Indonesia, ASEAN Ministers endorsed the Comprehensive Proposal for the Establishment of the Regional Coordination Mechanism on Animal Health and Zoonoses (RCM) and later named as the ASEAN Coordination Centre for Animal Health and Zoonosis (ACCAHZ). An ad hoc group consisting of relevant officers from each member country was appointed as the Preparatory Committee (PrepCom) to be responsible to develop the Terms of Reference of the Center and to develop necessary instruments and frameworks to ensure a fully functioning and sustaining ACCAHZ.

The ASEAN Regional Support Unit (RSU) was formed in 2010, as an interim coordination of ACCAHZ. The ASEAN RSU is currently funded by the Food and Agriculture Organization of the United Nations (FAO) through the European Union Highly Pathogenic Emerging and Re-emerging Diseases Programme (EU-HPED). The ASEAN RSU comprises of ASEAN technical experts in the fields of laboratory and epidemiology who provide not only the technical inputs to the regional capacity building program but also provide their coordination roles among member countries, ASEAN Secretariat and relevant bodies to ensure a sustainable capacity to deal with animal and zoonotic diseases. The operations of ASEAN RSU and their outcomes have exemplified the benefits of ACCAHZ, and testify to the continuation of these achievements when ACCAHZ becomes operational.

Tripartite FAO-OIE-WHO Collaboration: FAO-OIE-WHO continue to collaborate and coordinate global activities to address health risks at the animal-human-ecosystems interfaces particularly where a disease has the potential to impact on a large numbers of people and animals. This inter-sectoral and multi-disciplinary approach is considered crucial to addressing the complex problem of zoonoses and other emerging infectious diseases.

FAO is committed to the One Health approach to address emerging and re-emerging infectious animal and zoonotic diseases, which impact negatively on people's well-being, safety and livelihoods.

Under the EU-HPED program and the IDENTIFY component of the USAID funded Emerging Pandemic Threat Program which involves the laboratory capacity building activities, FAO, in collaboration with OIE and WHO as well as other international partners, has supported the coordination and several joint activities between animal and public health sectors at country, regional and global levels for disease specific activities. One Health Events such as symposia, meetings, planning, etc. have been jointly organized with the government authorities and the Tripartites in several member countries.

The Tripartite members have taken turn in organizing the "Regional Workshop on Collaboration between Human-Animal Health Sectors on Zoonoses Prevention and Control for Asia" since 2010 and the fourth workshop will be organized in November 2013. The workshop aims to bring together authorities from relevant sectors, animal, human and wildlife health, to discuss the coordination mechanisms that can be implemented at the country level to improve multisectoral collaboration in managing emerging infectious diseases. Avian influenza, rabies and antimicrobial resistance have been identified as priority health problems that the coordination mechanisms can be applied to.

***Support to the prevention and control of specific zoonotic diseases***

Specifically for avian influenza and rabies control, a summary of FAO activities is as follows:

Influenza Control: Since the start of the avian influenza – H5N1 crises in Asia in 2004, FAO has been providing technical assistance to the affected countries in Southeast and South Asia including China. The activities mostly involve in strengthening the countries capacities in planning and coordination including strategy and policy development and legislation framework and laboratory and epidemiology capacities at individual, organizational and institutional levels. To have better understanding in epidemiology of avian influenza-H5N1 at the country and regional levels, the specific surveillance and risk assessment studies in targeted areas including poultry value chain studies we re conducted in cooperation with member countries. Scientific information derived from these studies has been advocated to relevant authorities to take into account when planning for risk management. Biosecurity improvement along the supply chain particularly in the live bird markets, farms and small-scale commercial flocks has been one of the key risk management approach that FAO has been supporting in the region. At the regional level, linking information on poultry trade and clades of the virus being circulated in various countries has been suggesting the possibility to use “zonal approach” to manage avian influenza spread. FAO has facilitated the cross-border dialogue among the countries in South and Southeast Asia sharing borders with existing cross-border legal and illegal trade of poultry. Certain cross-border collaborations have been in place including agreement to conduct joint surveillance with harmonized approach, sharing of expertise and information.

Since April 2013, the avian influenza A (H7N9) event raises the urgent need to enhance control efforts within the affected provinces (and minimize human deaths), increase preparedness and risk mitigation measures in non affected provinces in China as well as surrounding countries, including the high-risk countries in ASEAN region. The main areas requiring immediate reinforcement are epidemiologic knowledge, surveillance and diagnostic capacity, risk management including preparedness and response, as well as coordination and collaboration among countries in Asia and between animal and human health sector.

Recognizing such importance, FAO has committed its own funds to support the projects entitled **“Emergency Assistance for Surveillance of Influenza A(H7N9) Virus in Poultry and Animal Populations in Southeast Asia - TCP/RAS/3406(E)”** and **“Emergency Assistance for Surveillance of Influenza A(H7N9) Virus in Poultry and Animal Populations in South Asia -TCP/RAS/3407(E)”**. The projects aim at minimizing the impact of propagation of avian influenza A(H7N9) on human health and livelihoods in Southeast and South Asia. The overall objective of the projects is to conduct a coordinated sub-regional surveillance and response to avian influenza A (H7N9) in poultry and other animal populations in high-risk countries in Southeast and South Asia. The immediate objective of the projects is to enable the targeted countries to better detect, control and respond to A (H7N9) influenza. The projects have been launched in September and will be implemented through the coordination of Regional Support Units (RSU) for ASEAN and SAARC.

Rabies Control: The FAO RAP has initiated rabies control activities more rigorously after the One Health approach has been developed and promoted from the regional to the

country levels. The FAO work has also been guided by the recommendations from several meetings namely: the rabies meeting in Incheon and the tripartite meetings especially the second meeting in Chiang Mai where one of the recommendations was to promote the step wise approach to rabies elimination. Field project support was provided to Bali Indonesia, and dog ecology studies were conducted in the Philippines, Lao PDR and Vietnam to assist in the review of respective national rabies control programmes.

Another key activity was strengthening the laboratory diagnosis capacity of countries and a regional training on harmonized laboratory testing protocol and proficiency testing program were conducted.

The conduct of such activities greatly emphasized the need to create simple messages by showing how rabies is prevented, and costs saved for families following simple control measures and that undertaking a rabies control programme allows both sectors to realize the added value of integration hence provides a convincing ***economic case for support*** by the two sectors, human health and agriculture (animal health).

Plans are afoot to develop a rabies control regional strategy for Southeast Asia that covers the animal health and human health sectors.

FAO's activities in prevention and control of key zoonotic diseases in Asia are summarized in Table 1.

**Table 1: A summary of FAO's activities on specific zoonotic diseases in Asia**

Disease	Activities	Coverage
<b>Avian Influenza</b>	<ol style="list-style-type: none"> <li>1. Planning and coordination including policy, legislation framework and compensation</li> <li>2. Laboratory and epidemiology capacity</li> <li>3. Risk assessment and management including biosecurity improvement</li> <li>4. Cross-border collaboration</li> </ol>	China, Southeast Asia and South Asia
<b>Rabies</b>	<ol style="list-style-type: none"> <li>1. Planning and coordination</li> <li>2. Dog ecology</li> <li>3. Laboratory capacity</li> <li>4. Bite case integrated management</li> <li>5. Risk communication and advocacy</li> </ol>	China, SE Asia (Lao PDR, Indonesia, Philippines, Viet Nam) and South Asia
<b>Nipah and other bat carried diseases</b>	<ol style="list-style-type: none"> <li>1. Planning and coordination</li> <li>2. Bat ecology</li> <li>3. Research on WH-AH-HH interface</li> </ol>	SE Asia (Philippines, Thailand, Viet Nam)
<b>Brucellosis</b>	Laboratory capacity (jointly with OIE)	SE Asia
<b>Anthrax</b>	Outbreak investigation	Lao PDR

<b>Antimicrobial Resistance</b>	Meetings and workshops to assess the current status, needs and direction for technical assistance	Regional level
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## Impacts, challenges and ways forward

While it is recognized that country capacities in dealing with specific zoonotic diseases particularly avian influenza have been improved, it is expected that the countries would be able to apply such capacities to other emerging infectious and transboundary animal diseases. Various challenges to achieve this expectation include the limited number of human resources with proper skills. More importantly, political commitment from the government to ensure career path of human resources who have been trained, and to develop the national strategies related to animal health/disease control so financial resources can be in place to sustain activities in longer term. These challenges have even made it more difficult to apply/adapt to the changing environments or future emerging threats.

FAO has made efforts to address the challenges in sustaining the investment that has been made by employing concurrently building capacity at institutional level including strategic planning and system development at national and regional levels. In addition, FAO continues to advocate to the decision makers of the member countries on such challenges that require their commitment and proactive involvement. However, the fact that national financial resources are limited in several developing countries, advocacy needs to be made to developmental partners to continue to support those countries to deal with the key emerging zoonotic and transboundary diseases of the global concerns.

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## Activities of OIE on Zoonoses and Food-borne Diseases in the Asia-Pacific Region

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Tomoko ISHIBASHI and Hnin Thidar MYINT

OIE Regional Representation for Asia and the Pacific

The OIE is an intergovernmental organisation whose objective is to improve animal health and welfare worldwide. Missions mandated by its Members include collection and dissemination of disease-outbreak information, development of international standards for sanitary measures for disease prevention and control methods and safe trade, and for diagnostic tests and quality of vaccines, and establishing a network of Reference Centres of scientific excellence. Discussed below are four approaches of the OIE highly relevant to controlling zoonoses and food-borne diseases in the Asia-Pacific Region.

**The first approach** is the Global Framework for the progressive control of Transboundary Animal Diseases, so-called GF-TADs. This is a cooperative framework agreed by the OIE and FAO in 2004 to coordinate various projects implemented by international and regional organisations and aid agencies, trying to create synergies, to avoid duplication and to enhance effectiveness. In order to make such efforts more tangible, five-year action plans were developed last year both at the global level and at the level of each geographic region, with priority diseases and issues identified. In the regional action plan for Asia-Pacific, rabies, which was not a priority in the original GF-TADs framework, was added as one of the five priority diseases. Also, the importance of the One Health concept, which encourages collaboration between the Animal Health and Human Health authorities, the private sector and, where appropriate, environmental authorities, was stated as one of the guiding principles. The progress in following such plans will be tracked annually.

**The second approach** to note is the development of WHO/FAO/OIE tripartite regional workshops. Since the first attempt in December 2010 at Hokkaido University, led by the WHO, such a workshop has been held annually. The third such workshop was held in Bali in November 2012, led by the OIE. Based on the tripartite priorities identified at the global level, namely rabies, animal influenza and antimicrobial resistance (AMR), topics for discussion at the regional workshop depend on the year: the most recent workshop picked up rabies, Nipah, Hendra and AMR as emerging issues, and the involvement of wildlife and environmental sectors and consideration of socioeconomic aspect as examples of country initiatives under the One Health concept. The fourth tripartite regional workshop will be held in Kathmandu in November 2013.

**The third approach** is the establishment of OIE National Focal Points and the holding of regional seminars every other year. Among the eight different current types of focal points, Focal Points for Veterinary Products and Focal Points for Animal Production Food



Safety are most relevant to the topics of the present workshop: the former covers the issue of AMR and the latter covers food-borne diseases.

At the second Workshop for OIE National Focal Points for Animal Production Food Safety held in October 2012, in total about one day was dedicated to presentations about on-farm control practices for a variety of important food safety issues of animal origin: salmonella and campylobacter in poultry, brucellosis and tuberculosis in cattle, trichinellosis in swine, and echinococcus, as well as a case-study of *Escherichia coli* infection. This series of presentations provided a good explanation of priority issues for veterinary services from the animal production food safety perspective. As to avian influenza and foot and mouth disease, both very important from the animal health perspective and repeatedly commented upon by participants during the discussion, it was clarified that neither were food safety concerns.

In addition, as an issue of the moment, a team from the University of Tokyo's Research Center for Food Safety made a presentation about food safety risks caused by contamination from radioactive substances and related consumer concerns. This topic attracted attention from participants, as Japan's 2011 nuclear disaster has caused anxiety in neighbouring countries. Many participants commented on the freshness of the discussion from the perspective of a different discipline, i.e., the social study of consumer behaviour.

Seizing on this opportunity, OIE RRAP conducted a short survey on regional members' awareness and present state of control of food born disease. The rest of this section will discuss the findings of the survey.

#### 1) Survey outline

Prior to the Seminar, a short questionnaire requesting a country report was sent to all participants from regional members.

##### Summary of country report questionnaire

#### 1. Priority Issues

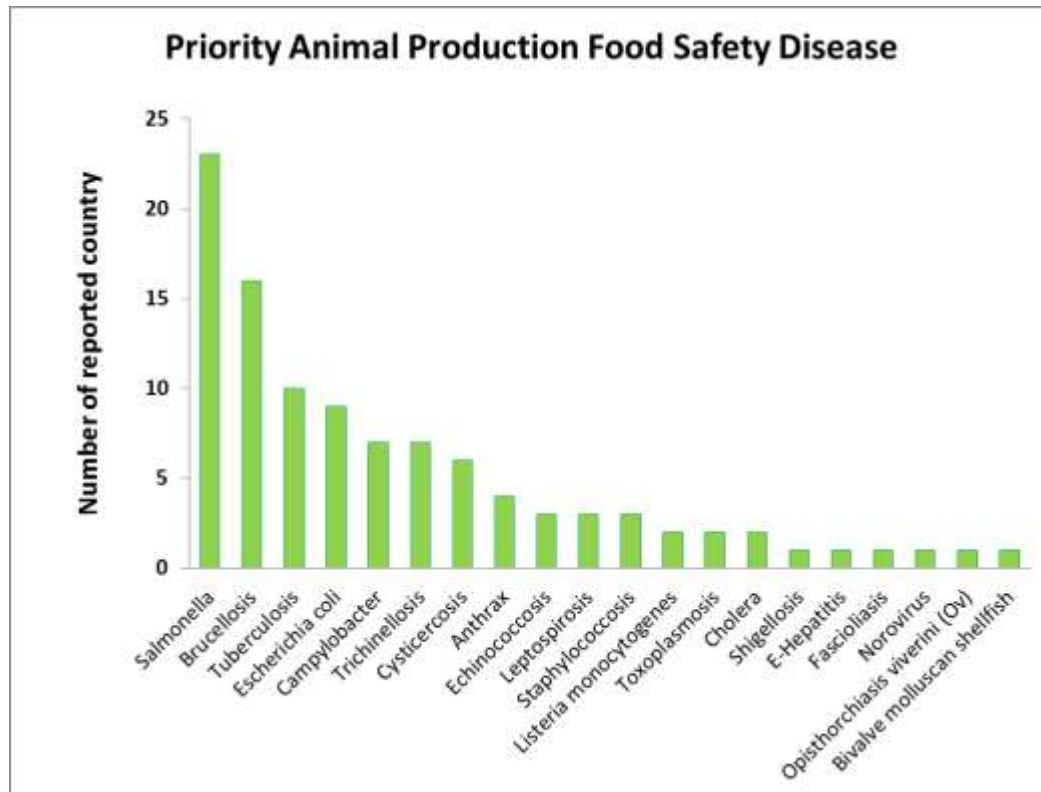
- 1) List of three highest priority animal production food safety diseases in the country
- 2) Legal framework, including that applied at the farm level
- 3) Role of VS in the control programme at the farm level for selected disease

#### 2. Statistics/Records

- 1) Number of incidents of major food borne illness
- 2) Recent example of management of animal production food safety risks

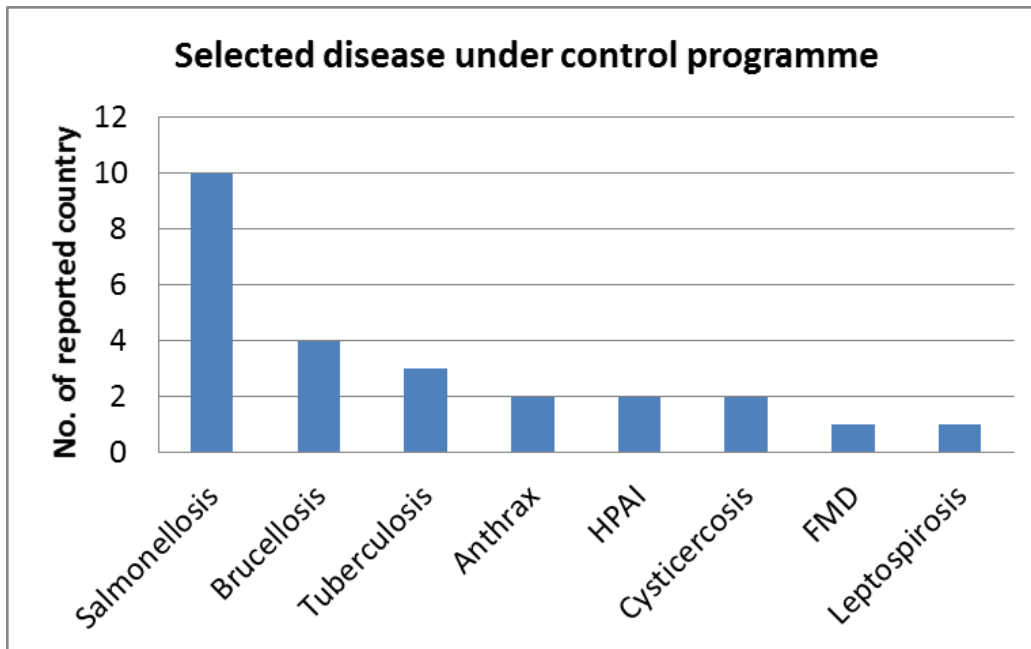
## 2) Summary of responses

25 out of 26 participating countries submitted country reports. In total, 24 diseases were listed as priority animal production food safety diseases, the top three of which were Salmonellosis (listed by 23 members), Brucellosis (16) and Tuberculosis (10). Including these three, more than half of the diseases of concern are caused by bacteria and nearly 30% are parasitic diseases such as Trichinellosis and Cysticercosis. It should be noted that some responses listed avian influenza, FMD or rabies, though these were excluded in the analysis



All but a few regional members stated that they have a legal framework for controlling animal production food safety diseases. While some countries have a system for testing targeted food safety diseases on farm as well as biosecurity standards to be applied on farm, the survey could not conclude the extent to which the existing legal controls of many members can reach beyond abattoirs, i.e. to farms.

Responding to the survey's request to choose one disease and describe the role of veterinary services in the control programme at the farm level, all 25 responses did identify one disease and provide some details. Consistent with the priorities described above, 10 members explained their programmes to control Salmonellosis, followed in frequency by Brucellosis (4) and Tuberculosis (2). Reference to FMD and HPAI by some members might explain the lack of an on-farm control programme for food borne diseases.



Only 12 members could provide some statistics about human cases either for one or more food borne diseases or for a group of food-borne diseases in aggregate. Even among these 12 responses, there was substantial variation in terms of: (1) number of diseases for which statistics were provided or the grouping of diseases; (2) continuity, where statistics of three successive years were provided; and (3) availability of the most recent statistics. The unavailability of any statistics of human cases for half of the regional members might be partly due to lack of communication between veterinary authorities and human health authorities.

Finally, 10 members identified incidents of serious animal production food safety risks during the preceding five years. Again, Salmonella in poultry was the case most frequently raised (3 responses). Although each response reflected the particular situation of the member concerned, the descriptions provided were very informative and illustrated to basic and common lessons: (1) the need for proper treatment of carcasses of sick or disease-suspect animals so as to prevent the possibility of human consumption (from Anthrax panic); (2) pork meat should be properly cooked (from fatal cases of *Trichinella* and increasing numbers of cases of *Streptococcus suis*); (3) eating raw fish should be avoided unless the level of sanitation during the production and preparation is satisfactory; and (4) maximum residue limits for meat, milk and eggs should be established scientifically and implemented with well-grounded monitoring schemes (from cases of antimicrobials and radioactive substances). One of the overall conclusions was the importance of raising public awareness both of the risk itself and of the measures to take against the risks.

**The fourth approach** is the establishment and networking of OIE Reference Centres. The OIE has a network of Collaborating Centres and Reference Laboratories which constitute the core of the OIE's scientific expertise and excellence. In the region of Asia and the

Pacific, the following Collaborating Centres are working for the members in the field of zoonoses, food-borne diseases and veterinary products, including antimicrobials.

- Animal Feed Safety and Analysis:  
Food and Agricultural Materials Inspection Center, Japan
- Diagnosis and Control of Animal Diseases and Related Veterinary Product Assessment in Asia:  
National Veterinary Assay Laboratory, Japan
- Food Safety:  
Research Center for Food Safety, The University of Tokyo, Japan
- Surveillance and Control of Animal Protozoan Diseases:  
National Research Center for Protozoan Diseases, Obihiro University of Agriculture and Veterinary Medicine, Japan
- Veterinary Epidemiology and Public Health:  
EpiCentre, Massey University, New Zealand
- Zoonoses of Asia-Pacific:  
Harbin Veterinary Research Institute, P.R. China

In addition, there are many disease-specific Reference Laboratories in the region. Contact details for all of them are available at <http://www.oie.int/our-scientific-expertise/overview/>

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## WHO Activities on Zoonoses and Food-borne Diseases

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Christian WINTER

World Health Organisation (WHO)

### General overview

The very nature of zoonoses—diseases or infections that are transmissible from animals to humans—means that no single sector can manage the risks alone. Because of this, Asia-Pacific Strategy for Emerging Diseases (APSED) focuses on bringing together the numerous participants who must work together to prevent, detect and control zoonotic diseases. The emergence of avian influenza A(H7N9)—an emerging subtype of avian influenza infecting people for the first time—along with further cases of Middle East Respiratory syndrome Coronavirus (MERS-CoV) and avian influenza A(H5N1) have kept this area of work at the forefront.

Collaboration takes the form of sharing data, conducting surveillance and risk assessment jointly, and working together on the response. Other focus areas, such as laboratories and risk communication, also contribute to building vital collaboration. For most countries, it is evident that close collaboration among multi-sectoral stakeholders is achieved through regular consultation and joint training, and support to priority zoonoses is proving to be instrumental in building trust and establishing long-lasting sustainable coordination for zoonotic diseases.

At the regional and global level, WHO and partners work with the animal health sectors through the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE). This cooperation is mirrored at the nation level, where policies for zoonoses control are ideally supported by close and sustainable collaboration between the animal and human health sectors. In the future, cooperation could expand to include the environmental sector as well.

Under APSED (2010) this coordination is aimed at controlling prioritized zoonotic diseases.

Working collectively during outbreaks and on a routine basis will reduce the risk to human health associated with both known and unknown emerging diseases.

### FAO-OIE-WHO collaboration at regional level

FAO, OIE and WHO have institutionalized a tripartite coordination mechanism at regional level and the three organizations are working together at country level for surveillance, prevention and control of zoonoses and emerging diseases at the human, animal and ecosystem interfaces. As part of the arrangements, it was agreed that a tripartite regional workshop should be organised annually to review progress in

prevention and control of zoonoses made by Member countries and FAO, OIE and WHO and to define the way forward to further strengthen multisectoral coordination and collaboration at the human, animal and ecosystem interfaces. One of the first initiatives to increase collaboration and coordination between the above-mentioned sectors was a Regional Workshop on Collaboration between Human and Animal Health Sectors on Zoonoses Prevention and Control held in Sapporo (2010). This work was taken further and expanded to multisectoral collaboration through a second meeting in Chiang Mai (2012) and a third in Bali (2012). The Bali workshop recognized the need to consider recommendations of the High-level Technical Meeting to Address Health Risks at the Human-Animal-Ecosystems Interfaces” (Mexico, 2011), as well as the priority areas of work highlighted in national IHR/APSED assessments/implementation plans and the results of OIE ‘Performance of Veterinary Services’ (PVS) assessments while operationalizing ‘One Health’ at country level.

FAO, OIE and WHO, regional organizations such as the Association of Southeast Asian Nations (ASEAN), the South Asian Association for Regional Cooperation (SAARC) and other international partners will continue to collaborate closely to provide support to Member countries in strengthening functioning of national coordination mechanisms between animal, human, environmental and other relevant sectors to address zoonotic and other emerging and re-emerging diseases including capacity building and promotion of One health through advocacy, better communication and collaborative activities for control of priority zoonoses.

## **South-East Asia Region**

### ***Regional overview***

Reducing the risk of disease transmission at the human-animal interface is the key to zoonoses prevention in the WHO South-East Asian Region<sup>1</sup>. Risk reduction activates (including behavioural interventions), sharing surveillance information, rapid response and the application of effective public health interventions are all needed to establish effective coordination mechanisms in Member States.

APSED (2010) supports Member States in establishing a functional coordination mechanism between relevant sectors at all levels for zoonotic diseases that will enable sharing of surveillance information, coordinated risk assessment and response and development of risk reduction strategies.

All countries in the Region have established a coordination mechanism between animal and human health sectors for the detection of, and response to zoonotic events but functionality is influenced by prevalence of some diseases, for example outbreaks of avian influenza, anthrax and other zoonotic diseases of common interest. The majority of countries has prioritized zoonotic diseases of national importance and has access to national or international laboratories to confirm priority zoonotic events.

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<sup>1</sup> The region comprises Bangladesh, Bhutan, DPR Korea, India, Indonesia, the Maldives, Myanmar, Nepal, Sri Lanka, Thailand and Timor Leste

Systematic and timely collection of zoonotic disease data is achieved in nine countries. Functional mechanisms for sharing information have also been established between animal surveillance units, laboratories and human surveillance units in these countries. To date, seven countries regularly exchange information between relevant sectors regarding potential/urgent zoonotic risks or events; such as avian influenza, rabies and anthrax.

### ***Regional activities***

A series of regional workshops have been held to advocate for a One Health approach to surveillance, response and research of zoonoses. Workshops have been organized in collaboration with the ASEAN and SAARC Secretariats to strengthen surveillance and response capacity and cross-border collaboration for highly pathogenic emerging diseases.

The Regional Office has provided technical and financial assistance for a number of activities recently, including the development of training modules, organizing study tours, supporting 'hands-on' training on intra-dermal rabies vaccination (IDRV) and shipment and diagnostic support for leptospirosis. Technical staff also supported several workshops during 2013, including a One Health workshop in Dhaka, Bangladesh and an IDRV advocacy workshop in Nay Pyi Taw, Myanmar. A 'Training-of-Trainer' workshop on clinical recognition, case management and control of zoonosis and on application of IDRV was also organized in Myanmar between 27 June and 1 July 2013.

A concept note and project proposal for 'SAARC Human Rabies Elimination Project' has also been finalized and a SAARC strategy for the prevention and control of communicable disease is being developed with WHO support. The Regional Office was also supporting the translation and production of awareness material on priority zoonoses in local languages in Bhutan and Maldives.

A large number of regional activities were undertaken in this technical area, including the following:

- Development of training modules on recognition, prevention and control of EIDs/zoonoses.
- Coordinating supply of leptospirosis ELISA kits for Bhutan and Myanmar
- Providing technical support to Bangladesh, Bhutan, Myanmar, and Sri Lanka for rabies control activities
- Coordinating with WHO Headquarters to supply a regional stockpile with plague rapid diagnostic kits including training of laboratory professionals from National Center for Disease Control, India at WHO Collaborating Centre in Madagascar.
- Facilitating shipment of leptospira strains to NIHRD, Indonesia from the WHO Collaborating Centre, Port Blair, India
- Supporting the Ministry of Health, Myanmar to develop guidelines for human rabies prophylaxis and a One Health strategy for prevention and control of priority zoonoses, 25 September - 2 October

## ***Challenges***

As the veterinary public health services in South-East Asian countries are inadequate, continuous and close collaboration with several sectors especially veterinary services is required to combat these diseases. Zoonoses also remain largely unregulated and attract scrutiny and attention of national authorities only when some major outbreak occurs.

Although progress has been made in establishing a functional One Health approach, much more work needs to be done to establish infrastructure in some Member States. Sustaining awareness for zoonotic diseases and empowering communities at public require sustainable funding support, for example for events such as World Rabies Day. In addition, research on zoonotic diseases is not given sufficient priority in some Member States.

## ***Next steps***

Additional support for world rabies events will be provided. An 'Advocacy Meeting for elimination of Human Rabies from SAARC countries' was organized in Dhaka in mid-August which finalized 'SAARC Rabies Elimination Project to be submitted to the SAARC Development Fund for consideration. FAO, OIE and WHO provided technical support to organize this meeting. Country-level training on the prevention and control of EIDs/zoonoses has been supported or planned in Bangladesh, Bhutan, India, Maldives, Myanmar, Sri Lanka and Timor Leste. WHO in collaboration with FAO facilitated 'One Health' workshops in Bhutan and Nepal to define vision, mission and action plan for operationalization of One Health.

It will also be important in the WHO South-East Asia Region to prepare carefully in collaboration with animal health colleagues for the possible spread of avian influenza A(H7N9).

## **Western Pacific Region**

### ***Regional overview***

General coordination mechanisms between human and animal health sectors for zoonotic disease control have been developed in 25 of 26 Member States<sup>2</sup>, as reported through the 2013 IHR monitoring questionnaire. These continue to be strengthened and expanded to build disease- or activity-specific coordination. These systems were used in the responses to the outbreak of diseases such as leptospirosis in the Philippines in

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<sup>2</sup> The region comprises American Samoa, Australia, Brunei Darussalam, Cambodia, China, Cook Islands, Fiji, French Polynesia, Guam, Japan, Kiribati, Lao PDR, Malaysia, Marshall Islands, Micronesia, Mongolia, Nauru, New Caledonia, New Zealand, Northern Mariana Islands, Palau, PNG, Philippines, Pitcairn Islands, Rep. Korea, Samoa, Singapore and Solomon Islands, Tonga, Tuvalu, Vanuatu, Viet Nam, Wallis and Futuna



August 2012, avian influenza A(H5N1) in Cambodia in the first half of 2013, and H7N9 in China on April-May, 2013.

A main achievement in this focus area at country level is the identification of prioritized zoonotic diseases in order to better focus work. Furthermore, most Member States have started to develop disease-specific coordination and collaboration mechanisms in line with their capacities and the response needed to combat certain zoonotic threats.

Collaboration to combat specific diseases continues in the Lao People's Democratic Republic in anthrax control, and in Mongolia in rabies control. The lessons learned from these activities will be shared with other countries in the region to inform their planning and actions.

### ***Regional activities***

The third Regional Workshop on Collaboration between Human-Animal Health Sectors on Zoonoses Prevention and Control was organized by OIE in collaboration with FAO and WHO. Participants included multidisciplinary groups (human and animal health, environment, wildlife and socioeconomics), regional organizations such as the Association of Southeast Asia Nations, the South Asian Association for Regional Cooperation, and animal and human health officials from 19 countries in Asia Pacific. The workshop reviewed progress made in the establishment of a functional coordination mechanism for prevention and control of zoonoses at country and regional levels, and shared good practices in controlling important zoonoses.

### ***Challenges***

In some Member States, further development of a comprehensive coordination mechanism both at local and national level is required, along with sufficient multi-sectoral coordination beyond animal and human sectors, such as environment and wildlife sectors. Vital field data in each sector, which are collected through routine surveillance, are not fully shared among human and animal sectors. This is unfortunate because the data could contribute to implementing risk reduction activities by creating a clearer picture of where the greatest risks are.

Despite a good foundation, it is important to continue to improve and further expand the coordination and collaboration systems between human and animal health organizations at the national and regional levels. This type of cooperation plays an important role in response to outbreaks.

### ***Next steps***

The WHO Regional Office will continue to encourage the development and expansion of close and sustainable collaboration among the human and animal health sectors both at the national and regional levels. Collaboration will be encouraged in outbreak response, surveillance, information sharing, and risk reduction action to the emerging and re-emerging zoonotic threats.

In order to strengthen cooperation at the regional level, WHO in collaboration with FAO and OIE will organize the Asia Pacific Workshop on Multi-sectoral Collaboration for Zoonoses Prevention and Control, scheduled for November 2013.

### **Reference**

APSED Progress Report 2013

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## CIRAD's Platform in Partnership (GREASE) Activities on Zoonoses in South East Asia

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### Introduction

Globally, the majority (ca. 60%) of emerging infectious diseases are zoonoses (Jones et al. 2008). Such diseases have major economic and sanitary consequences. They affect farmers' incomes and may have serious repercussions on human health (Bordier and Roger 2013). In a recent report, a disease reference group worked on zoonoses and marginalised infectious diseases. It identified the followings key concerns: (a) the general lack of reliable quantitative data on their public health burden; (b) the need to evaluate livestock production losses and their additional impacts on health and poverty; (c) the relevance of cross-sectoral issues essential to designing and implementing public health interventions for zoonotic diseases; and (d) identifying priority areas for research and interventions to harness resources most effectively (Molyneux et al. 2011).

South East Asia (SEA) is a hotspot for emerging zoonoses, especially those originating from wildlife. The most recent emerging zoonoses of importance have been geographically limited to SEA – Nipah virus (NiV), highly pathogenic avian influenza (HPAI) virus and severe respiratory acute syndrome (SARS) virus (Caceres and Otte 2009). The increasing global trade, climate change, urbanization, the weakness of many public health systems, and increasingly intensified animal production are all factors in the emergence of animal and zoonotic diseases in SEA (Bordier and Roger 2013). Neglected by the international community, zoonotic diseases take root in the area, and local public and animal health infrastructures struggle to tackle the diseases. They put a serious threat to socioeconomic, health and wellbeing stakes in SEA. Their management calls for a better integration between animal health science, public health, social science, agriculture and livestock, engineering, ecological and environmental sciences.

The agricultural research centre for development (**CIRAD** - <http://www.cirad.fr/en>) is a targeted research organization, and bases its operations on development needs, from

field to laboratory and from a local to a global scale. CIRAD works with the whole range of developing countries to generate and pass on new knowledge, support agricultural development and fuel the debate on the main global issues concerning agriculture. CIRAD's operations centre on six priority lines of research including animal health and emerging diseases.

Among the different CIRAD's teams working on this topic, the Animal and Integrated Risk Management research unit (**AGIRs** - <http://ur-agirs.cirad.fr/en>) is focusing on the health risks threatening local communities, societies and socio-ecosystems in the South. The unit is organized around two primary, interdependent domains: disease ecology, and socio-ecosystems and public health. Geographically, the unit focuses on two areas: Southern Africa and SEA. The head of the unit and six executive researchers are based in Thailand, Cambodia, Laos and Vietnam and cover different and complementary research areas (veterinary epidemiology, ecology, anthropology, modelling), for the implementation of multi and interdisciplinary research activities for development.

In order to tackle the scientific and development challenges posed by zoonoses in SEA, AGIRs is involved in **research** programs, participates to **development** activities such as education, training and capacity building, and is an active member of different regional and international research networks. AGIRs is conducting its activities **in partnership** with local universities and research institutes where are permanently based its researchers. These activities fall under the One Health and EcoHealth concepts, taking into account all the components of the diseases at the human–animal–ecosystems interface.

## Partnership policy

Following CIRAD's geographical partnership strategy, AGIRs is implementing research and training platforms in partnership in collaboration with other research units (CMAEE, INTERTRYP, GREEN, MOISA,..) . In South East-Asia, AGIRs has initiated the **GREASE network**, which is a regional network with the aim to support research activities for a better management of transboundary and emerging diseases in SEA. The GREASE MoU integrates six "core members": Kasetsart University (Thailand), National Institute for Veterinary Research (Vietnam), National University of Laos, National Veterinary Research Institute (Cambodia), Central Nindanao University (Philippines) and CIRAD. Different regional partners are also associated to the network through collaborations like Hong-Kong University, Institut Pasteur du Cambodge (Cambodia), University of Gadjah Mada (Indonesia), Mahidol and Thammasat Universities (Thailand). International partners are also associated to the network like French IRD and CNRS or international organization like FAO and OIE. The network is expanding geographically and the MoU may evolve to integrate new core members from South East Asia like Malaysian, Burmese, and possibly Chinese institutions in the following years.

Long-term partnerships have been built with local partners where AGIRs researched are based. This allows better communication and collaboration with our partners in SEA. In a One Health perspective, the partnership with the International Pasteur network is a

good example of cross sectoral collaboration involving physicians, veterinarians, virologists, epidemiologists and ecologists. Similarly, in links with InterTryp Joint research unit (CIRAD-IRD), and with the support of OMS, FAO and WAHO, a network on Atypical Human Infections by animal Trypanosomes (**NAHIAT**) was recently set up to gather information on these rare and neglected diseases which include human infections by rodent trypanosomes (*Trypanosoma lewisi*) or livestock trypanosomes (*Trypanosoma evansi*), observed especially in SEA (Desquesnes et al. 2001; Milocco et al. 2012).

Through these partnerships, CIRAD aims at promoting a cross sectoral research for development in SEA. New partnerships with regional initiatives like the Mekong Basin Disease Surveillance or collaborations over other emerging threats like antibiotic resistance are among the potential future activities. Overall, AGIRs researchers are developing tools, methods, knowledge that can be applied to different health problematics in the region with a large set of potential partners.

## **Research activities**

### ***Socio-ecosystems and public health***

The One Health and the Eco-Health concepts require the definition and the effective use of a holistic approach regarding health issues. AGIRs contributes to this paradigm shift by addressing different research and development questions within the domain of socio-ecosystems, including veterinary public health. Therefore, AGIRs develops and promotes an interdisciplinary approach within two main thematic.

The first thematic is the understanding of the interdependence between social structures and the epidemiology of infectious diseases. Indeed, understanding how public health measures are implemented and perceived from local communities to central governments is a main objective for AGIRs. Bringing together researchers from different fields is possible when they share a common research object. The flu (avian, swine and human) has been an interesting model to collaborate with human health actors but also with “non-traditional” health actors like sociologists, economists or environmentalists, with shared question about the perception of risks and other health related issues by local communities or about the type of models that could best describe these socio-ecosystems (Figuie and Fournier 2008; Duboz 2012; Goutard et al. 2012a; Collineau et al. 2013; Binot and Morand In Press). In South East Asia, a strong partnership has been established within GREASE network with the Human Health sector through the Pasteur International Network and led to collaboration on zoonoses like avian influenza H5N1 (Conan 2012), on the spill-back transmission of H1N1p virus from humans to animals (Trevenec et al. 2012; Rith et al. 2013) or on rabies (Ponsich 2012). Other institutions like the Kasetsart University in Thailand, the NaVRI in Cambodia or the NIVR in Vietnam are also long-term partners sharing concerns about zoonoses management in SEA.

The second thematic concerns the evaluation and improvement of surveillance systems in SEA. Indeed, a central issue in disease management is how to construct permanent

surveillance networks that are capable of promptly detecting the emergence of a disease to enable a rapid reaction. This issue is even more important in developing countries where human and financial resources are limited and where the physical access and the communications are sometimes very restricted. To achieve this, the **REVASIA** (<http://revasia.cirad.fr/en/>) research program is developing innovative quantitative methods based on an evaluation of the health situation and the existing surveillance systems in SEA. In REVASIA, the research is based on methods coming from veterinary medicine and public health, as well as modelling and simulation of surveillance systems. The goal is to design generic tools for the evaluation of influenza virus surveillance systems that would be applicable to both developing and industrialized countries. This research program has led to the adaptation of tools for the evaluation of surveillance systems in animal health to the contexts of developing countries (Peyre et al. 2011) like capture-recapture methods (Vergne et al. 2012), probabilistic approaches to optimize the detection of a disease (Goutard et al. 2012b), systemic analysis of surveillance and control (Collineau et al. 2013) and the introduction of costing methods within simulation (Duboz 2012).

Future works: preliminary study has been carried out regarding the risk of introduction and spreading of exotic vector-borne diseases in SE Asia. Thereby, risk assessment methods and MCDA techniques will be applied to Rift Valley fever .

### ***Disease ecology in the One Health and EcoHealth frameworks***

Understanding the impact of biodiversity and wildlife ecology on disease transmission is another important and complementary challenge for AGIRs. With most zoonoses originating from wildlife, studying the patterns of circulation and transmission of pathogens between wild species and at the interface with livestock and human population is key to the prevention and control of zoonoses.

The **BiodivHealthSEA** (<http://www.biodivhealthsea.org/>) project aims at investigating the local impacts of global changes on zoonotic diseases in SEA, with the support of GREASE network. It follows the CeroPath project (<http://www.ceropath.org/>), which focused on the community ecology of rodents and their pathogens in SEA (Bordes et al. 2013; Jiyipong et al. 2013). Southeast Asia is a hotspot of infectious emerging diseases of potential global pandemics and, also, a hotspot of biodiversity particularly at threat due to land use and climate changes. SEA attracts the attention of international organizations, developmental agencies and non-governmental conservationist organizations for its global concerns in terms of biodiversity and health. The project uses SEA as a model to investigate locally the perception and effects of global changes and global governance on the interaction between biodiversity and health and is focusing on rodent-borne diseases, in relation to biodiversity changes. The local perception of biodiversity changes and their links to health is analysed through the global governance, the national public policies and the actions of NGOs in the sectoral domains of health, environment, conservation and development (i.e. the “One Health” approach).

The Southeast Asia encephalitis (**SEAE**) project is a multidisciplinary research program aiming to reduce the morbidity and mortality associated with infectious encephalitis in

SEA by improving diagnosis and medical care for patients and by investigating risk factors driving encephalitis. One specific objective of the project is to document and analyze factors related to clusters of encephalitis cases integrating human health, animal health and environment through the One Health and EcoHealth approaches. This is including ecological and virological monitoring of wildlife reservoir like flying foxes (bats). The SEAE research consortium is associating international research institutes, national authorities in Cambodia, Lao PDR and Vietnam and local major universities and clinical sites (national hospitals and provincial health centers).

## Development activities

GREASE network is involved in different activities such as education, capacity building and training aiming at improving the surveillance and control of zoonoses in SEA. These activities are coordinated with local partners based on their needs and supported by regional and international funders. The **ComAcross project**, under the One Health in Asia call by Europeaid is aiming at reinforcing the development of the holistic approach to health, based on case studies implementation coordinated through a participatory approach to reveal and strengthen the synergies between the various stakeholders involved. The project will be articulated around 3 specific results: (1) Improved awareness and exchange of One Health and EcoHealth best practices within a Community of Practice, (2) Improved vocational competencies: target groups will have better technical skills to address zoonotic diseases' complexity and (3) Raised competencies on "Assessment and management of health risks at the human, animal and ecosystem interface".

This project is based on long-standing collaboration and networking experience in SEA. Notably, since 2009, **training** for academic and technical staff from SEA countries on the use of risk management tools and field work with communities. Different training sessions will be implemented during this project, including training in innovative participatory approaches to improve risks assessment and management at the AHE interface, social and environmental diagnosis, participatory epidemiology, participatory rural appraisal, wildlife and natural resources monitoring provided by experienced teams. **Capacity building** activities focus on technical skills that can be improved within cross-sectoral and interdisciplinary perspective. It deals first with the ability to take into account dynamics at the animal-human-environment interface in the elaboration of diagnostic and control methods, leaning on a better understanding of the interactions between pathogens, hosts, social and natural environment (including vectors). It includes the development of innovative diagnostic tools for zoonotic diseases and the training of laboratories' staff for routine analysis and diagnosis of human, animal and environmental samples and data. The project will also help developing a "Health Geographic Information System" and cross-sectoral data management procedures allowing interdisciplinary data sharing analysis between all partners. The **BioZoonoSEA** platform for Research, Higher Education and Training is a concerted action implemented by Kasetsart University, Mahidol University, CIRAD and IRD under the umbrella of the Franco-Thai DORAS, working for temporary gathering of human resources and

experiences to fill gaps in the knowledge of neglected zoonotic parasitoses, or to respond to specific needs in emerging diseases identified at the regional level in SEA. Its main actions will be the organisation of workshops and trainings, supervising of individual or collective trainings and implementation of data banking.

The ComAcross project will also support the implementation of a new master program opening in September 2014 at Kasetsart University, Thailand: **The InterRisk Master**. This master program aims at delivering postgraduate-level education for individuals with academic degrees from medicine, veterinary medicine or life sciences, currently employed or anticipating a career in the field of public health. This programme will provide advanced academic training in the evaluation and management of health risks related to animals, considering the One Health (human and veterinary health) and ecosystem (animal-human-ecosystem interface) dimensions of these risks. This master's curriculum has been designed to fit the key competencies identified during different regional meetings organised by International organisations (FAO, OIE). Efforts to educate students in a "One Health" perspective will be made, by making veterinary, medical and biosciences students work together. Zoonotic diseases and antimicrobial resistances will specifically be targeted. A focus will be made on cross-country health issues in order to push students to think and work at a regional scale when appropriate. Special attention will be given during the courses to community-based participatory actions. Innovative pedagogical tools (active learning, real case problem-solving, field visits, and computer-based modules) will be promoted.

AGIRs is involved in other **education** activities with researchers teaching and supervising master and PhD students from different universities or institutes in SEA like Kasetsart University and the Asian Institute of Technology in Thailand or the Royal University of Phnom Penh in Cambodia as well as French students working in animal health and doing their field works in SEA.

## Salient findings

**Influenza** (avian, swine and human), a major zoonosis, has been an interesting model to implement interdisciplinary studies involving veterinarians, physicians, virologists, sociologists, economists or environmentalists. Recent studies showed evidences of spillback transmission of H1N1p virus from humans to animals (Trevenec et al. 2012; Rith et al. 2013). Integrated studies allowed us to better understand perception of risks and other health related issues by local communities (Figuie and Fournier 2008; Goutard et al. 2012a).

The **wildlife-livestock-human interface** is key to the emergence of zoonoses in Asia. Rodents, the most diverse group of Mammals, are considered a major reservoir for zoonotic pathogens. Recent studies focusing on the communities of rodents and of their pathogens identified areas with possibly a higher risk of rodent-borne disease for human inhabitants in South East Asia (Bordes et al. 2013) as well as new zoonotic pathogens (Jiyipong et al. 2013).



**Management of Health** and in particular the capacity of surveillance systems to detect zoonotic epidemics has been an important field of research. Research efforts have led to the adaptation of tools for the evaluation of surveillance systems in animal health to the contexts of developing countries (Peyre et al. 2011) like capture-recapture methods (Vergne et al. 2012), probabilistic approaches to optimize the detection of a disease (Goutard et al. 2012b), systemic analysis of surveillance and control (Collineau et al. 2013), participatory approaches and socio-economic issues (Delabougliise et al. 2012) and the introduction of costing methods within simulation (Duboz 2012).

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## **ILRI Research on Zoonoses in the Asia-Pacific Region**

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### **About ILRI and the CGIAR**

The International Livestock Research Institute<sup>1</sup> was established in 1994 through a merger of the International Laboratory for Research on Animal Diseases (ILRAD; Nairobi, Kenya; research focus on African trypanosomiasis and tick-borne diseases especially East Coast Fever) and the International Livestock Centre for Africa (ILCA; Addis Ababa, Ethiopia; socio-economics and policy research), – both centres established in the 1970s and part of the Consultative Group on International Agriculture Research<sup>2</sup> (CGIAR). Other centres focus on different aspects of agriculture, – for many of the 15 it is clear from the institution's title. ILRI's predecessors started out with a geographical focus on East Africa but expanded to other regions: – West and Southern Africa, the Caribbean, and to East and Southeast Asia.

The CGIAR historically acted in the role of coordinator, but managing an increasing number of CG centres made this an increasing challenge – with centres quite independent and a preference to operate in this way. Donors were also moving towards programmatic funding with more substantial amounts. In 2009 came the reform - the most radical change in the CGIAR since its formation. In an effort to consolidate the efforts to reduce rural poverty, increase food security, improve human health and nutrition, and ensure more sustainable management of natural resources, CGIAR Research Programmes<sup>3</sup> (CRP) were proposed to align research focus of all 15 centres, with those having the largest role leading the CRP. ILRI has a key role in the CRP on Livestock and Fish (CRP3), and the CRP on Agriculture for Nutrition and Health (CRP4). The project described in this paper falls under the latter – as a 'legacy project' – one started before the CRPs but reporting under them. All sixteen CRPs have impact pathways incorporated.

### **Zoonoses: Completed projects**

In terms of a broader picture of zoonoses and their impact on poor livestock keepers ILRI undertook a review for the Department for International Development UK in 2012<sup>4</sup>.

Initial Asia-based ILRI projects on zoonoses focused on highly pathogenic avian influenza H5N1 and were located in *Indonesia*. Efficacy of HPAI vaccination research was USAID-funded – with Government of Indonesia and FAO as partners (2007-09) and the other Department for International Development (DfID/UKAID 2007-10) implemented in conjunction with Government, Royal Veterinary College (UK) and International Food Policy Research Institute (IFPRI) – focused more on institutional challenges, and included

a livelihood analysis, evaluation of risk management and communication and advocacy.<sup>5,6</sup>

The most substantial project implemented by ILRI in the Asia Pacific region with a focus on zoonoses was the ***Ecosystem Approaches to the Better Management of Zoonotic Emerging Infectious Diseases in SE Asia*** (EcoZD) project supported by IDRC, Canada. The project recently completed after a 5½ year project cycle. The core objective was to build capacity among researchers and other key stakeholders to utilise an EcoHealth approach in tackling a priority zoonosis(-es). During the first phase researchers and institutions were identified<sup>7</sup> to form multi-disciplinary (trans-disciplinary) teams. More than just a series of training, teams were required to design, implement and write up the research, with mentoring by ILRI scientists and additional external experts.

A number of teams struggled with taking the initiative to coordinate all the research steps. However all of the teams originally convened went on to produce some zoonoses-related research outputs. Partners are listed in Table 1.

**Table 1: EcoZD national partners**

Country	Institutions
<b>Cambodia</b>	Centre for Disease Control, Ministry of Health Dept of Animal Health and Production, Ministry of Agriculture Forestry and Fisheries Centre for Livestock and Agriculture Development
<b>China (Yunnan)</b>	Academy of Grassland and Animal Science Animal Science and Veterinary Institute Yunnan Agriculture University Institute of Endemic Disease Control and Prevention
<b>Indonesia</b>	Centre for Indonesian Veterinary and Analytical Studies Disease Investigation Centre Denpasar EHRC/Gadjah Mada University
<b>Lao PDR</b>	Department of Livestock & Fisheries, Ministry of Agriculture and Forestry Department of Hygiene & Prevention, Ministry of Health
<b>Thailand</b>	EHRC/ Chiang Mai University
<b>Thai-</b>	Chiang Mai University
<b>Vietnamese</b>	National Institute of Veterinary Research, Hanoi
<b>Viet Nam</b>	Department of Animal Health Institut Pasteur Nong Lam University

Cambodia focussed on zoonotic causes of acute diarrhoea in rural communities. The research was designed during a cholera outbreak and although cholera is not zoonotic there was a Ministry of Health led priority on diarrhoea prevention and control. Three priority pathogens were investigated: *campylobacter spp.*, *salmonella spp.* & *E. coli* (enterohaemorrhagic form). Results showed that despite close interface/association infection from household animals was not common.

The team in Yunnan province decided to investigate whether brucellosis was an emerging infectious disease. They chose two sites: one a more developed county close to Kunming city and another less developed close to the Myanmar border. The hypothesis was that legal movement of animals from the highly-endemic northern part of China and/or illegal movement of particularly buffalo from Myanmar posed a risk of introduction of infection into an area where awareness was low and surveillance not deemed a priority. In fact brucella prevalence was low overall and confirmed in the 'more developed' county.

Rabies was introduced into Bali island in 2008. It spread to all parts of the island with hundreds of canine cases and 133 human deaths. Culling of dogs was undertaken which did not control the disease and success was achieved with island-wide dog vaccinations and awareness campaigns. The EcoZD-Indonesia team looked at aspects of dog ecology: movement, fecundity and population. This was complemented by training and awareness activities in several pilot areas using the established 'cadre system'. Following this, roll-out was undertaken in 30 other villages.

Lao research focussed on zoonoses in pigs. Seven zoonoses were selected: Japanese B encephalitis, Hepatitis E virus, erysipelas, *Taenia solium* (& cysticercosis), and trichinella initially. Then with the serum bank tests were conducted for coxiella and brucella serology. In addition three non-zoonoses were chosen to look at disease priorities at household level including economic consideration (PRRS, classical swine fever and FMD). Results are pending for brucella and coxiella but all other diseases were commonly found.

A joint Thai-Vietnamese team considered hygiene in small-scale slaughter-houses. In Thailand the focus was on management and improvements based on questionnaire and focus group discussions with the various stakeholders. The Vietnamese researchers focussed more on analyses of the bacteriological contamination associated with this type of establishment.

The Viet Nam team – based in Ho Chi Minh city – discussed at length about zoonotic disease prioritisation but their retrospective analysis concluded that there was not sufficient data collected/available to undertake this. They chose leptospirosis in pigs as their focus, checking on pigs at point of slaughter and then tracing back to household and testing household members as well as abattoir workers. There was a range of serovars – preliminary analysis suggests that pigs are not a risk for humans but that there are common environmental risks for both.

In order to build capacity in EcoHealth beyond the EcoZD project cycle EcoHealth Resource Centres were established at two universities – Chiang Mai Thailand<sup>8</sup> and Gadjah Mada Indonesia<sup>9</sup>. Academic environment was deemed an appropriate location with training opportunities for under-graduates and post-graduates. Like the original six research teams both EHRCs undertook research – food safety, hill-tribe health in Thailand and leptospirosis in Indonesia.

***'Generating evidence to support enhanced traditional dairying in India'*** (GET Dairy<sup>10</sup>) was funded by the OPEC Fund for International Development between 2011 and 2013. Its aim was to improve milk quality in the informal market sector and reduce milk-borne zoonoses. The project site was in Assam, northeast India. The project's outcomes were improved practices leading to lower levels of hazards and advocacy aimed at the Dairy Development Department.

### **Zoonoses: On-going projects**

Following an ACIAR-supported project on 'Improving the competitiveness of pig producers in an adjusting Vietnam market' (2007-10)<sup>11</sup> a follow-up project entitled 'Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam'<sup>12,13,14</sup> was approved by the same donor. It will run from 2011-15 and has greater focus on zoonoses. Objectives are to assess impacts of pork-borne diseases on human health and the livestock sector, develop and test market-based innovations to improve management of human and animal health risks, and communicate the lessons learned to sustainably improve capacity to assess and manage risks in the pork value chain. Research questions posed are: what are the health risks and economic costs of pork-borne diseases in Vietnam? What is the added utility of risk-based approaches to food safety and pig disease over current hazard-based management?

Under the CGIAR Research Program 'more meat, milk and fish for the poor' Vietnam is one of eight focus countries<sup>15,16</sup>. Within this program, food safety issues are addressed within the 'transport and processing' component. Another ACIAR-supported project undertook a 'Rapid Integrated Assessment of Food Safety and Nutrition' using PRA and biological sampling. One key output was that there is poor knowledge about zoonosis.

### **Zoonoses: Pipeline projects**

A proposal jointly prepared by ILRI and the Public Health Foundation of India has just been funded by IDRC Canada. It will generate evidence and improved understanding of interactions between disease risk, livestock and human health, and sustainable development in different types of peri-urban settings of the country and influence the coordination of policy and practice that supports safe food production, healthy livestock and improved public health.

***'Building a Framework for Assessing the Impacts of Efforts to Enhance Access to Nutritious Foods Through In-Depth Analysis of the Grameen Danone Foods Ltd Case'*** (in partnership with BRAC and IDS UK) is value chain focussed; part of the nutrition component of the CRP ***Agriculture for Improved Health and Nutrition***. It will develop capacity and an analytical approach for the analysis of value chains-based initiatives aimed at enhancing access and consumption of nutritious foods by the poor and to use this learning to develop research proposals on leveraging value chains for nutrition. A better understanding of value chains could assist with risk assessment of zoonoses.

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## Zoonosis Research Activities at Oxford University Clinical Research Unit Viet Nam

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### Introduction

The major research activities of the Zoonosis working group focus on *Streptococcus suis*, antimicrobial resistance in foodborne pathogens, and avian influenza.

### Streptococcus suis

*Streptococcus suis* (*S. suis*) is an emerging but neglected bacterial infection that has caused large sepsis outbreaks in China and has been identified as the commonest cause of bacterial meningitis in adults in Vietnam. In the most recent review, over 700 cases of *S. suis* infections had been reported worldwide by 2009, most of them from China and Vietnam in the last few years. *S. suis* infection requires approximately 10 days of intravenous antibiotic treatment. The mortality rate varies, but is approximately 3-7%, deafness is a common sequela in survivors.

*S. suis* is well known opportunistic pathogen in pigs, and is commonly carried in the nasal cavities, tonsils as well as respiratory, alimentary and genital tract in pigs. *S. suis* can also be isolated from healthy pigs and these healthy carriers are a source of *S. suis* transmission in and between herds. Of the 35 known serotypes, serotype 2 has been identified as the most common serotype accounting for the vast majority of human cases (~99% of cases), and human cases infected with other serotypes (4, 14 and 16) have also been reported. The risk factors for human infection include direct exposure to *S. suis* infected pigs, pig products or consumption of undercooked contaminated pork products such as fresh blood pudding, internal organs. In one case control study conducted by OUCRU in Vietnam, up to one in two cases with *S. suis* infection reported eating high-risk pig dishes in the past two weeks prior to illness including fresh/undercooked pig blood, tonsils/ tongue, stomach/ intestines, or uterus. Cases were much more likely to have consumed these high-risk dishes compared to their community controls (OR 4.44, 95%CI 2.15-9.15).

Our studies of Vietnamese pigs have shown that at least 41% and 8% of healthy market-weight pigs sampled at slaughterhouses in southern provinces carried *S. suis* and *S. suis* serotype 2, respectively (Hoa *et al*, 2011a). *S. suis* serotype 2 (SS2) is known to harbor significant virulence factors, and SS2 is the principle serotype associated with severe human cases in Vietnam (Hoa *et al*, 2011b). Since 2007, Porcine Reproductive and Respiratory Syndrome (PRRS) virus has become endemic in Vietnam causing large outbreaks with enormous economic losses in pig industry; importantly, we have demonstrated elevated levels of PRRSv and *S. suis* serotype 2 systemic co-infections in



pigs during livestock outbreaks, and epidemiological associations with human clinical cases presenting to hospital (Hoa *et al*, 2013).

Our research activities to date have focused on further characterizing the prevalence of *S. suis* in animal reservoirs and in the food chain, to better understand the relationship between healthy carriage of *S. suis* in pigs and the exposure dynamics to people. We have established cohort studies of people with high levels of occupational exposure to pigs (on farms and in slaughterhouses and markets) to better understand transmission routes and sero-epidemiology of population immunity. We are actively investigating the implications of antimicrobial resistance, and attempting to identify potential preventive measures to better control or reduce zoonotic transmission in Viet Nam. One recent study has focused on better understanding food consumption practices and behaviors, in relation to some of the high-risk pig derived dishes commonly consumed in Vietnam, such as tiet canh (*raw blood pudding*) and tonsils/tongue, stomach/intestines, or uterus. The study is using a qualitative approach with focus group interviewing, aiming to understand how individual perceptions, contextual and environmental set-ups, and local values and beliefs play into and influence food consumption behaviors. We are interested to explore the differences in perceptions and experience about tiet canh between urban and rural dwellers, between men and women, and between the government. The participatory approaches will also be used in other related community-based research projects, where we seek to better understand the social dynamic and context in which animal-human interactions may have health impacts.

## **Antimicrobial resistance**

Antimicrobial resistance (AMR) is one of the most important public health issues of our time, since it has important consequences for treatment of human diseases in hospital and community settings, as well as in veterinary medicine. Indiscriminate use of antimicrobials within the livestock sector for increased animal production may be contributing to this worldwide problem, and research in this area will require a One Health approach to address the diverse interests of stakeholders in both human and animal health. Selection for antimicrobial resistance may occur not only in the animals themselves, but also in the environment where antimicrobials are discharged.

In Viet Nam, antimicrobial resistance represents a serious challenge to the veterinary and public health authorities, and OUCRU engages in a number of projects designed to explore the impact of antimicrobial usage on AMR in poultry and pig production, and the associated health risks in farming communities. Our studies are investigating the epidemiology of antimicrobial resistance in animal populations, in the environment, and its impact on human populations; and will establish the basis for further interventions to reduce antimicrobial use when it is not necessary in animal production. The provinces in which we have established field sites and collaborations with local partners include: Tien Giang, Dong Thap, Soc Trang, Dong Nai, Ho Chi Minh City, Hue, Thai Binh, Ha Noi. Our partners for implementing the One Health projects include provincial hospitals, SubDepartments of Animal Health, Regional Animal Health Offices, and local Centers for Preventive Medicine.

As the primary focus of OUCRU research is hospital-based and patient-centered, the majority of our work on AMR is conducted in clinical settings, and addresses the consumption/usage patterns of antibiotics, resistance patterns within key nosocomial and community-acquired pathogens, the laboratory issues for monitoring AMR, and the range of therapeutic implications for patient treatment and management.

## **Influenza**

As in all regions of the world, the disease burden of human influenza in Vietnam is substantial and constitutes a major cause of morbidity and mortality. Understanding the onset and burden of seasonal influenza epidemics is critical for public health, and to date there are research gaps in our understanding of how disease dynamics in the tropics differs from temperate regions. Influenza viruses in tropical regions may circulate year-round – unlike in temperate zones where the virus is present exclusively in the winter – and the persistence of viruses in the tropics may be one reason why wintertime influenza epidemics in temperate regions seem to be seeded from Asian influenza viruses. Studying influenza in Asia will help determine the seasonality of epidemics, or lack thereof, and will help us understand whether and how viruses persist in this region. A better understanding of tropical influenza dynamics will help inform global vaccine selection for influenza.

In addition to human influenza, East and Southeast Asia is a critical region for the maintenance of certain avian influenza viruses that are pathogenic to humans. The endemicity of highly pathogenic influenza A/H5N1 in Vietnamese poultry, and the recent emergence of A/H7N9 in coastal China, both of which can cause severe human disease, have reemphasized the need for continued investigation of the epidemiology and ecology of influenza viruses in animals in South East Asia. The influenza research programme at OUCRU-VN encompasses a number of different multidisciplinary projects on both human and avian influenza epidemiology, and involves faculty members who are based both in Ho Chi Minh City and Hanoi.

### ***Clinical research***

Over the last decade, OUCRU has been at the forefront of research on severe influenza, including some of the first clinical descriptive studies on human infections with H5N1, published in the *New England Journal of Medicine* in 2004 and 2005, and *Nature Medicine* in 2006. Understanding the pathophysiology of H5N1 infection, in particular the role of high viral load and cytokine response, OUCRU played a leading role in establishing the Southeast Asian Influenza Clinical Research Network (SEAICRN), and has served as a regional reference lab for clinical diagnosis and trials relating to H5N1. This work led to early observational studies during early phases of H1N1 pandemic emergence published in *PLoS Medicine*, multi-center clinical trials of neuraminidase inhibitors (*Brit Med J*), and evaluations of novel rapid diagnostics (*J Clin Micro*). Ongoing research investigations include in-depth studies of immune responses and clinical correlates of protection to both avian and human influenza viruses.

### ***Serial sero-epidemiology***

Geographically and demographically representative serum banks are being prospectively collected using residual serum from hospital sites in Vietnam. These collections will enable in-depth studies of influenza population-level antibody responses to influenza. With ongoing cross-sectional serial serum collections, these data will also enable the reconstruction of past influenza epidemics in Vietnam. The serum samples will be tested for influenza antibody with a novel protein microarray method, in collaboration with the Dutch Institute for Public Health and the Environment. The antigen arrays currently comprise both historical and contemporary seasonal H3 and H1 antigens, as well as representative avian H5 antigens; in the future we hope to expand these arrays to include swine-origin H1 and H3 antigens that represent the contemporary circulating SIV in Vietnam.

### ***Epidemiology and evolution of avian influenza virus***

The government of Viet Nam continues to invest significant resources in surveillance and control of highly pathogenic avian influenza (HPAI) in domestic poultry populations. Both HPAI and low pathogenic strains (LPAI) cause severe losses to commercial and backyard poultry, and the co-circulation of diverse viruses presents major *technical challenges to the design of appropriate control and prevention programs*. Ongoing studies between OUCRU and the Department of Animal Health in Vietnam are using spatial analysis of surveillance data, phylogenies, and antigenic characterizations to better understand the evolution of subtype H5N1 influenza in Vietnam. These studies aim to inform poultry vaccine seed strain matching with circulating field virus and perform systematic risk assessments to assist the design and evaluation of alternative intervention strategies. The most recent work coming out of this collaboration aims to map the antigenic phenotypes of Vietnam's H5N1 viruses to determine the pattern and directionality of H5N1 evolution over the past ten years.

### ***Environmental persistence of AI H5N1 virus***

Little is known about persistence of HPAI in the environment or the role of environmental contamination in perpetuating transmission of HPAI. Should environmental contamination play an important role in the epidemiology of HPAI, it is likely that measures aimed at on-farm interventions may not be entirely successful in reducing the cycle of infection. In order to formulate more effective interventions, we are conducting in-depth longitudinal studies of farm sites with prior confirmed H5N1 positive duck flocks, and developing and evaluating standardized methods for environmental sampling. We work directly within farming communities to examine the social impact of zoonoses, and changing perceptions of disease risk.

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## **International Research on Antimicrobial Resistance at the Animal-Human Interface in the Asia-Pacific region**

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### **Introduction**

The use of antimicrobials in veterinary medicine contributes to an unknown level to antimicrobial resistance (AMR) in zoonotic pathogens. Depending on the geographical region of the world, there is more or less concern about this problem and intention to reduce the use of antimicrobials in agriculture. In Northern Europe several countries have recognized the problem and converted the concern into action with as result a reduced use of antimicrobials in the animal production sector. The concern about use of antimicrobials and associated resistance in the animal production is mainly driven by public health and to a lesser extent by resistance problems in veterinary medicine (treatment failure). In many countries there are activities (eg, research, monitoring/surveillance, policy support projects) on agriculture-associated AMR at different levels.

### **Activities on AMR**

Activities on AMR in the veterinary field are performed with different aims. First of all, *research in the direct scope of public health and policy-support*. The aim of this research is to show the presence of antimicrobial resistance that may alert local/national policy makers for existing or emerging resistance problems. This can be done in small scale projects with a clear focus. Ideally this information is used to rank the AMR problem amongst other public health problems being able to set priorities. This step, however, is difficult as the burden of AMR is hard to define and therewith to rank. As a consequence, in many countries the problem is not perceived as “urgent”. Another point has to be noticed: often research projects are carried out by scientists, not always sharing the results with policy makers but only within the scientific community. The translation of science into policy remains a weak point worldwide. Like scientists are rewarded for their scientific activities by Impact Factors and H-indexes, they should be rewarded for translation their work into policy support. However, the different languages of the scientists and policy makers hamper this translation.

Another activity is the *research on and implementation of monitoring/surveillance systems* to show the prevalence and trends of resistance. This public health activity can be organized by the veterinary sector (often supported by the Ministry of Agriculture) or by the human sector (mostly supported by the Ministry of Health). In the ideal world

there is an integrated surveillance in which data from humans and animals are collected and analyzed in the integrated way. Although there is the perception that this integration may increase the costs of surveillance considerably, it is in fact just a more efficient way of use of the collected data. Technically, surveillance can be done in pathogens (*Salmonella*, *Campylobacter*, *Listeria*, *E. coli*) or in commensal flora with indicator organisms (Enterococci and *E. coli*). In Europe, the surveillance in animals and food is done using indicator organisms. This is a validated approach showing trends of resistance in production animals. This information is now combined with antimicrobial use.

Besides the aforementioned activities in the direct scope of public health and the monitoring/surveillance systems, there are other types of *research projects*. These comprise the characterization of resistance mechanisms, relations between usage and resistance in specific animal groups, transfer of resistance and many other types of research projects not only on technical aspects but also combining social sciences with technical sciences. There are many collaborative projects between e.g., Europe, the America's and Australian/New Zealand countries at one side and Asian countries at the other. The collaboration can be on the basis of individual scientists, formal institutional collaborations, within the focus areas of specific countries or part of networks. Examples of the latter are European projects (the recent call for Asian-European collaboration) or the ongoing activities of WHO/FAO/OIE networks (eg, Agisar - WHO Advisory Group on Integrated Surveillance of Antimicrobial Resistance and GFN – WHO-Global Food-borne Infections Network). Very sustainable collaborations are based on organizations with a location in one of the Asian countries. An example is the Oxford University Research Unit in Vietnam. Other examples of sustainable collaboration is through the local institutions of the Network of Institut Pasteur (eg, Laos, Cambodia and Vietnam) and the Fondation Mérieux. In all APHCA countries there are activities on AMR. Due to the different levels of collaboration and the diversity of projects, it is impossible to list an overview of the existing collaborations and projects. There is the risk of overlapping and duplicating activities as coordination is difficult.

In fact, the above described activities are largely descriptive and of technical nature, mostly reporting that there is a misuse of antimicrobials in agriculture and a threatening presence or emergence of antimicrobial resistance. In general, most studies conclude that there is a need for change in agricultural practices. Remarkably, studies on interventions with the aim to reduce the use of antimicrobials are extremely scarce. This type of studies should get much more attention in the near future. They are hard to perform and preferably baseline data on antimicrobial use and resistance are available. Based on the lack of these data people sometimes argue that we are not yet ready for intervention studies. With well-designed studies however, this is not a prerequisite as intervention and control groups can be run together and compared. The intervention studies should be interdisciplinary as it is not only about technical aspects but also about behavioral changes in certain settings (see also the paper of David Speksnijder).

## **Integration of veterinary, food and public health**

Studies on AMR in the animal-human interface should be performed in an integrated way between the animal, food and human domains, and multidisciplinary with microbiologists and epidemiologists. As these studies requires usually input from at least two ministries, this is a challenge in many countries. At supranational level this integration is reached by OIE, FAO and WHO in the so called Tripartite: collaboration on the control of zoonoses and AMR. Two programs/networks exemplify this collaboration: WHO Advisory Group on Integrated Surveillance of Antimicrobial Resistance (AGISAR) and WHO Global Foodborne Infections Network (GFN). As the latter one is an open capacity building network with free membership, a short description is given.

### ***An integrated approach to food safety and zoonoses: the Global Foodborne Infections Network (GFN)***

A 1997 survey of National Reference Laboratories showed that only 69 (66%) of 104 responding countries conducted routine Salmonella serotyping for public health surveillance. This study, which showed the lack of basic infrastructure for laboratory-based Salmonella surveillance, prompted the establishment of the WHO Global Salm-Surv (GSS), now called the Global Foodborne Infections Network (GFN). This is a network of institutions and individuals committed to enhancing the capacity of countries to detect, respond to and prevent foodborne and other enteric infections. In addition to detection of pathogens, also susceptibility patterns of the pathogens are included. In brief, WHO-GFN is a capacity-building programme that promotes integrated, laboratory-based surveillance and fosters intersectoral collaboration among human health, veterinary and food-related disciplines through training courses and activities around the world. Key activities include training courses, country-specific projects, the Country Databank and an external quality assurance system for serotyping Salmonella (EQAS). Participants from several ACPHA countries have been trained and are member of GSS. Membership is free ([www.who.int/gfn/activities/en/](http://www.who.int/gfn/activities/en/)).

## **Challenges for the future**

As AMR is a threat with a poorly defined burden, there is not in all countries priority for action. Export requirements for AMR for products of animal origin may put the problem not only on the public health but also on the economic agenda. There is in many countries in the world an overwhelming use of antimicrobials with antimicrobial resistance as a consequence. In many countries around the world the problem is, although not quantified, clear. At supranational level policy makers and animal production sector are provided with guidelines (OIE/FAO/WHO) to reduce the use of antimicrobials in animal production. The challenge for the future is to implement these guidelines in daily practice. To explore the possibilities to implement prudent use of antimicrobials and more precisely identify the barriers this implementation, intervention studies should be designed and implemented. This is a logical next step as follow-up of the descriptive studies. No action today, no cure tomorrow!



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## **FAO-OIE-WHO Tripartite Approach and OIE Activities on Antimicrobial Resistance**

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### **A Tripartite approach to containing AMR at global level**

The Tripartite [Food and Agriculture Organization (FAO), the World Organisation for Animal Health (OIE) and the World Health Organization (WHO)] speak with one voice and take collective action to contain the emergence and spread of antimicrobial resistance

Antimicrobial resistance (AMR) is a global human and animal health concern that is influenced by both human and non-human antibiotic usage. The human, animal and plant sectors therefore have a shared responsibility to prevent or minimise antibiotic resistance selection pressures on both human and non-human pathogens. Antimicrobial resistance is not a recent phenomenon, but it is critical to take action now to address the increasing threat of AMR to human and animal health.

Starting about ten years ago, tripartite expert consultations were organised in 2003, 2004, and 2006 followed by the establishment of an Ad hoc Codex Intergovernmental Task Force on Antimicrobial Resistance. The work was completed in October 2010 and 'Guidelines on Risk Analysis of Foodborne AMR' were adopted by the Codex Alimentarius Commission in July 2011.

To identify further areas of collaboration and develop common communication, the three organisations designated technical focal points and organised two meetings in 2009 and 2011. A workplan with short, medium and long term objectives was drafted, in line with the mandate of each organisation.

Important progress has been achieved on training, capacity building and the establishment of pilot projects at country level to illustrate the strength of the tripartite approach to tackle antimicrobial resistance worldwide through a coordinated approach with shared responsibilities.

The World Health Day 2011 on Antimicrobial Resistance organised by the WHO with the participation of the FAO and the OIE further illustrated the commitment of the three organisations to take collective action and speak with one voice.

## **OIE's activities on antimicrobial resistance**

### ***The background***

The World Organisation for Animal Health (OIE) is an intergovernmental organisation with 178 Member Countries, whose mandate is to improve animal health, veterinary public health including the sanitary safety of animals and animal products at production level, and animal welfare worldwide. Within its mandate, the OIE has recognised the need to tackle the issue of antimicrobial resistance already in the late 1990s and the OIE organised two international conferences on antimicrobial resistance, one in 1999 and the other in 2001. In addition, an OIE *ad hoc* Group on antimicrobial resistance was given mandates such as development of risk assessment methodology for the potential impact on public health of antimicrobial resistant bacteria of animal origin, development of guidelines for prudent use of antimicrobials in animal husbandry, and standardisation and harmonisation of laboratory methodologies used for the detection and quantification of antimicrobial resistance. As of today, five Chapters in the *Terrestrial Animal Health Code*, four Chapters in the *Aquatic Animal Health Code*, and one Chapter in the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (2013 versions) have been adopted by the World Assembly of Delegates.

Regarding the mechanism by which bacteria acquire antimicrobial resistance, some aspects are known and others are yet to be revealed. One of the most troubling questions from the veterinary viewpoint is the extent to which the use of antimicrobials in animals leads to the generation of antimicrobial resistance. We know that antimicrobials are used in human medicine, veterinary medicine, animal production, aquaculture and horticulture and all sectors have therefore a shared responsibility to prevent or minimize antimicrobial resistance selection pressures on both human and non-human pathogens.

It is our responsibility to pursue risk management options for sustainable use of antimicrobial agents in animals, while giving due consideration to the risk of generating antimicrobial resistant bacteria.

Antimicrobial resistance is one of many issues where the OIE has been working in collaboration with the FAO and WHO. The WHO/FAO/OIE tripartite initiatives for expert consultations on antimicrobial resistance started in 2003 and one of the results is the development of an OIE list on veterinary important antimicrobials that was adopted in 2007. A revised version has been adopted in 2013. This updated version takes into account that some molecules are of critical importance for human and animal health. Therefore specific recommendations for third and fourth generation Cephalosporins and Fluoroquinolones have been added.

Both FAO and WHO were participating in this update. The tripartite cooperation led to the meeting of the OIE/FAO/WHO Consultative *ad hoc* Group on Collaborative Activities on Antimicrobial Resistance, organized in 2009 in OIE Headquarters in Paris with the aim of finding common areas for cooperation and maintaining good communication in this field. Follow-up meetings to further develop collaborative activities and improve

coordination, were held in the WHO Headquarters and in the FAO Headquarters (August 2012).

### ***Major OIE activities***

#### **(1) OIE Standards and publications**

Since first adoption in 2004, the number of Chapters related to antimicrobials in the OIE *Terrestrial Animal Health Code* (<http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>) has been completed and existing texts revised. The FAO and WHO participates in these updates.

In its 2013 version, the following Chapters are contained in Section 6 Veterinary Public Health:

- Chapter 6.6. Introduction to the recommendations for controlling antimicrobial resistance;
- Chapter 6.7. Harmonisation of national antimicrobial resistance surveillance and monitoring programmes (update adopted in May 2012);
- Chapter 6.8. Monitoring of the quantities and usage patterns of antimicrobial agents used in food producing animals (update adopted in May 2012);
- Chapter 6.9. Responsible and prudent use of antimicrobial agents in veterinary medicine (update adopted in May 2013);
- Chapter 6.10. Risk assessment for antimicrobial resistance arising from the use of antimicrobials in animals (under review, Member Country comments addressed).

To help laboratories determine which in vitro antimicrobial susceptibility testing methodology to use, the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (<http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/>) provides General Guidelines in Part 3:

- Guideline 3.1 Laboratory methodologies for bacterial antimicrobial susceptibility testing (adopted in May 2013)

Given the importance of and concerns over the use of antimicrobials in aquaculture, over the last several years guidelines have also developed and adopted in the *Aquatic Animal Health Code* (<http://www.oie.int/international-standard-setting/aquatic-code/access-online/>):

- Chapter 6.2. Introduction to the recommendations for controlling antimicrobial resistance;
- Chapter 6.3. Principles for responsible and prudent use of antimicrobial agents in aquatic animals (adopted in May 2011);
- Chapter 6.4. Monitoring of the quantities and usage patterns of antimicrobial agents used in aquatic animals (adopted in May 2012);
- Chapter 6.5. Development and harmonisation of national antimicrobial resistance surveillance and monitoring programmes for aquatic animals (adopted in May 2012);
- A chapter on risk assessment is under development.

These standards should be respected for promoting prudent use of antimicrobials and for conducting scientifically valid resistance surveillance and monitoring.

The *OIE List on veterinary important antimicrobials* developed in 2007 has been updated in 2013. This version, adopted in May 2013 is published on the OIE Website: [http://www.oie.int/fileadmin/Home/eng/Our\\_scientific\\_expertise/docs/pdf/OIE\\_List\\_antimicrobials.pdf](http://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/OIE_List_antimicrobials.pdf)

Further information is available at: <http://www.oie.int/en/our-scientific-expertise/veterinary-products/antimicrobials/>

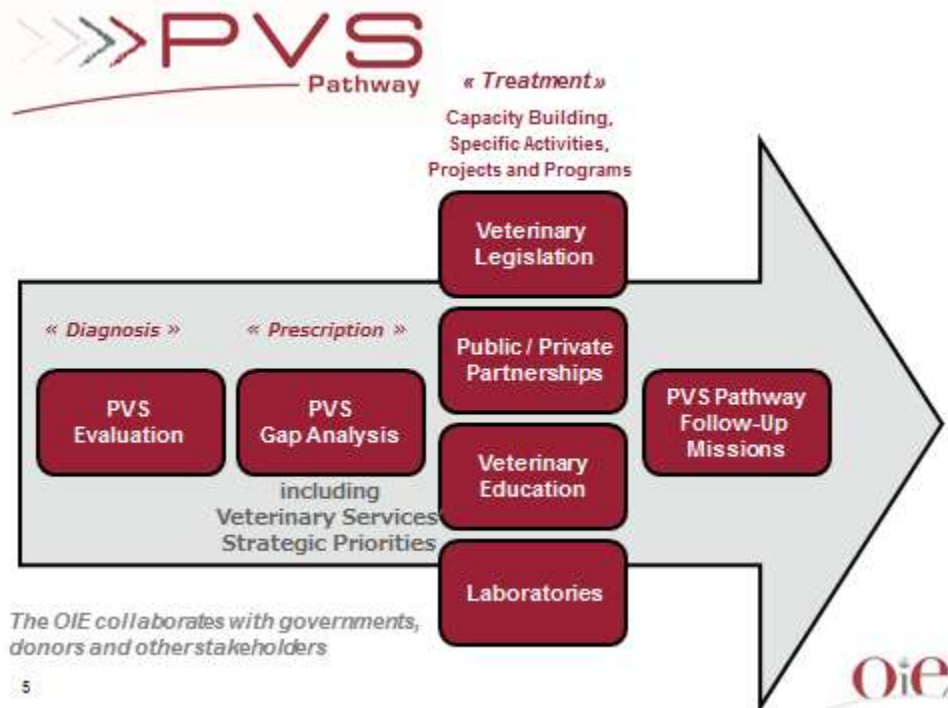
In addition, the last *OIE Scientific and Technical Review* published in April 2012 (*VOLUME 31 (1)*) was dedicated to “Antimicrobial resistance in animal and public health” It contains a wide range of scientific articles about mechanisms for resistance, surveillance and monitoring of resistance and consumption in human and animals, consequences of resistance, risk assessment and containment, all available free at: [http://web.oie.int/boutique/index.php?page=ficprod&id\\_produit=1074&fichrech=1&lang=en](http://web.oie.int/boutique/index.php?page=ficprod&id_produit=1074&fichrech=1&lang=en).

## **(2) PVS Pathway and legislation missions**

The OIE well recognises that, like all other aspects of the animal health system, responsible and prudent use of antimicrobials can be supported by “good governance” of a country’s Veterinary Services. The OIE PVS Pathway, starting with a PVS Evaluation by an OIE-certified expert team using the OIE-developed PVS tool, followed by a GAP analysis and other specific activities, has been helping Member Countries to identify their gaps and target for a wide range of critical competencies. PVS analysis includes many “critical competencies” related to the capability of responsible use of antimicrobials, notably: II-9 veterinary medicine and biologicals; II-10 residue testing; and VI-2 implementation of legislation. Needless to say, the capability of collaboration with the public health authority for responsible use of antimicrobials is one of the important issues.

As a follow up to an evaluation of the Performance of Veterinary Services (PVS) using the OIEPVS Tool, and at the request of Members, the OIE conducts missions to help governments that wish to modernise the national veterinary legislation and thereby help the veterinary services to meet the OIE standards. After an initial ‘identification’ mission the country may request a longer term collaboration with the OIE, under a formal agreement, with the objective of modernising the national veterinary legislation.

As with other elements of the OIE PVS Pathway, legislation missions are undertaken by experts who are trained and certified by the OIE for this purpose. Mission reports are confidential unless/until the country authorises release to donors or other OIE partners.



### (3) OIE National Focal Point system

As the OIE's mandate has broadened, there has been need to develop support for OIE Delegates to more actively participate in OIE activities. Thus, a system of OIE National Focal Points for specific subject areas was created. In 2009, the World Assembly adopted Resolution XXV regarding veterinary products, which recommends each OIE Member Country to nominate a National Focal Point for the OIE on matters related to veterinary products (it should be noted that such Resolution also recommends each OIE Member Country to promote responsible and prudent use of antimicrobials).

The OIE has organised regional capacity building workshops for National Focal Points for Veterinary Products in all OIE regions. In addition to providing National Focal Points with information about the OIE's work in the subject field and how to help their Delegates, these workshops allow them to develop a network among themselves. In the region of Asia and the Pacific, two workshops have already been held for National Focal Points for Veterinary Products, one in June 2011, followed by second round training in July 2012 in Bangkok. While the first round covered general topics, the second round programme allocated substantial time to the issue of antimicrobials: 1) Chapters 6.7 and 6.8 of the OIE *Terrestrial Animal Health Code* on antimicrobial resistance: detailed presentation, implementation, 2) Strategy of the OIE regarding Veterinary products and 3) Workshop: Monitoring of antimicrobial resistance and quantities used in animals. The third cycle is under development. The third of such workshop is planned in 2014 for the region of Asia and the Pacific.

Focal Points from the region participated in the workshop, whose success was evidenced by the participants' active discussion.

#### **(4) OIE Reference Centres**

For the OIE to develop standards, publish scientific information and support members' capacity building, the contribution of Collaborating Centres is indispensable. In addition to the three Collaborating Centres on Veterinary Medicinal Products (in France, Japan and USA) a Reference Laboratory on antimicrobial resistance supports the OIE's activities concerning veterinary medicinal products.

#### **(5) International Conferences**

In addition to the two conferences in early years around 2000, the OIE hosted in September 2012 the "International Symposium on Alternatives to Antibiotics" with the aim to present the main outcomes to the participants of the OIE Global Conference on the Responsible and Prudent Use of Antimicrobial Agents for Animals in March 2013.

**The OIE Global Conference on the Responsible and Prudent Use of Antimicrobial Agents for Animals**, International Solidarity to Fight against Antimicrobial Resistance was organized in Paris (France), from 13 to 15 March 2013 with the participation of FAO and WHO.

The conference objectives were:

- present an overview of the current situation regarding antimicrobial use in animals and antimicrobial resistance;
- inform on initiatives taken by the OIE and other international organisations to promote prudent and responsible use of antimicrobial agents in animals at a national, regional and international level;
- promote good governance practices, including national legislation and regulatory frameworks for import, registration, distribution and use of quality veterinary drugs worldwide, by using the OIE PVS Pathway in evaluating and strengthening national Veterinary Services and their compliance with OIE standards;
- encourage international cooperation to help all Member Countries to effectively implement measures for responsible and prudent use of antimicrobial agents in animals;
- foster and strengthen cooperation with Veterinary Statutory Bodies and the veterinary profession for the respect of OIE standards on prudent use in animals worldwide;
- explore the opportunities to improve data collection in animal antimicrobial usage and antimicrobial resistance;
- present research on new molecules and scientific findings on the alternatives that could be used in animal production replacing antimicrobial agents.

The conference recommendations are available at [http://www.oie.int/eng/A\\_AMR2013/Recommendations.htm](http://www.oie.int/eng/A_AMR2013/Recommendations.htm). They will guide OIE's future activities and in particular the *collection of harmonised quantitative data on the use of antimicrobial agents in animals with the view to establish a global database* (Recommendation 7 to the OIE). The first meeting of a dedicated *ad hoc* Group is scheduled for January 2014.

This collection of data will take into account the results of the *OIE questionnaire on monitoring of the quantities of antimicrobial agents used in animals* developed after the second cycle of Focal Point trainings. The results of the survey, that compiled the data from 152 OIE Member Countries (85% response rate), were presented at the OIE Global Conference [http://www.oie.int/eng/A\\_AMR2013/Presentations/S2\\_4\\_FrancoisDiaz.pdf](http://www.oie.int/eng/A_AMR2013/Presentations/S2_4_FrancoisDiaz.pdf).

The OIE Regional Representation for Asia and the Pacific, in consultation with OIE Headquarters, will reflect the Conference's recommendations in the regional context to support members in the years to come.

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## Tailored Interventions to Promote Prudent Antimicrobial Use: Theory and Practice

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### Introduction

In the last century, livestock production systems all over the world increased their efficiency and productivity. Major technological improvements supported this transition, as did the introduction of antimicrobials that were used as growth promoter and as an effective aid in the control of infectious animal diseases in the second half of the 20<sup>th</sup> century.<sup>1,2</sup> Despite these major benefits of antimicrobials, it became apparent that antimicrobial use, both in humans and animals, also has its negative effects. Antimicrobial application will result in the development and selection of antimicrobial resistant bacteria. In the last two decades, it is increasingly recognized at both national and supra national levels (World Health Organisation (WHO), Food and Agriculture Organisation of the United Nations (FAO) and the World Organisation for Animal Health (OIE)), that unlimited application of antimicrobials might eventually bring the world back into the pre antibiotic era in which there is no effective treatment for even uncomplicated bacterial infections anymore.<sup>3-6</sup> In response to this threat of extensive antimicrobial resistance, many policy documents and (mostly voluntary) guidelines were published to enhance prudent (veterinary) antimicrobial use. These documents and guidelines contained both general recommendations for prudent application of antimicrobials to animals and guidelines for the use of specific antimicrobial substances to treat certain specific infections.

Some individual countries with sufficient governmental and financial capacity to develop and enforce very strict regulations concerning antimicrobial dispensing and antimicrobial application in both humans and animals, were able to accomplish a reduction in antimicrobial use in animals in the last couple of years. Examples are highly regulated countries like Denmark and Sweden and more recently the Netherlands.<sup>7,8</sup> However, these examples are scarce and antimicrobial resistance is still not highly prioritized in many countries or capacity is lacking at regulatory levels to develop and enforce antimicrobial stewardship programs. Regulations to enhance prudent use of antimicrobials are often non-existent, not enforced or just voluntary. Therefore, there still is an overwhelming and unrestricted use of antimicrobials in both animal production and humans and there is an urgent need for effective antimicrobial stewardship programs.



## Wicked problem

Similar to, for example, the issue of climate change, the problem of antimicrobial use in animals and its contribution to antimicrobial resistance in human pathogens is very complicated, subject of much controversy and variously prioritized by different countries.<sup>4, 9-12</sup> The issue of antimicrobial usage in livestock and the attempts to regulate and affect policy changes therein, are marked by many competing and conflicting paradoxes, that differ greatly around the world and even within countries. The circumstances in which antimicrobials in animals are used vary greatly around the world depending on environmental circumstances (climate, soil type et cetera), economical aspects, availability of non adulterated drugs of good quality, the interests and concerns of a wide range of individuals and groups ranging from the pharmaceutical and agricultural production side through the consumer and health care advocacy lobbies and many more. These all affect the amount and characteristics of the used antimicrobials in animals. A systematic analysis, identification and understanding of the barriers and opportunities for change in antimicrobial use in every specific situation (animal production system, region et cetera), and the unique aspects that can lead to improvements in antimicrobial use in different countries around the world is a prerequisite for the design of effective interventions to achieve prudent use of antimicrobials in animals. Because of this great complexity, the issue of antimicrobial use in animals can be regarded as a “wicked problem” and there is a need for interdisciplinary approaches whereby professional and lay communities, in cooperation with professionals from different disciplines (physical, natural and social sciences), work collaboratively together to find a “satisfying solution” to tackle the problem of antimicrobial resistance.<sup>13</sup>

The challenge for the global community, and for more national or regional focused interest groups particularly, is to develop tailored interventions to counteract the development of antimicrobial resistance through reduction of overuse and inappropriate use of antimicrobials in animals worldwide. In every specific context, there are specific reasons for people to use antimicrobials in animals and why antimicrobials are overused or misused. These reasons, or determinants for antimicrobial overuse and misuse, should be thoroughly investigated in order to address these specific determinants in tailored interventions with the ultimate aim to reduce overuse and misuse of antimicrobials to an absolute minimum. This approach is comparable to tailored interventions that are increasingly developed and implemented to address overuse and misuse of antimicrobials in hospitals and outpatients. It should be acknowledged however that antimicrobial overuse and misuse in animals has very different determinants.

Several social psychology theories and models can be applied to find and/or develop feasible and tailored interventions to promote prudent antimicrobial use in animals in every specific and unique context. A very useful approach is *Systemic Intervention*, which can be defined as “purposeful action by an agent to create change in relation to reflection upon boundaries”.<sup>14</sup> A crucial aspect of systemic intervention is boundary analysis. It is important that the very core problem that underlies many other problems

is defined. When multiple problems are addressed simultaneously, the level of complexity increases rapidly which might hamper the finding of proper solutions. Therefore, it should be agreed upon where the boundaries are set; which core problem will be subject of the analysis and which side problems will be excluded from the analysis of the problem. The same accounts for stakeholders. Many stakeholders do have interests when it comes to antimicrobial use in animals and antimicrobial resistance (livestock owners, veterinarians, pharmaceutical companies, retailers, medical doctors, public health agencies, consumers, patients et cetera). It is crucial that the multiple perspectives of all stakeholders that are important for solving a problem are taken in account on the nature of the problem and possible solutions in order to find solutions that are accepted and supported by all important stakeholders. Setting the boundaries too wide results in including too many problems and too many stakeholders into the analysis. This might end up in endless debates between many stakeholders about vague definitions and many compromises to reach some consensus. However, excluding important core problems or stakeholders from the process (marginalization) might also have detrimental effects. Not involving stakeholders with great power to jeopardize interventions in the process might result in defining solutions that are not supported by these stakeholders and because of their hindering power also not executed.

### **Social cognitive theories**

Several social cognitive theories like the Theory of Planned Behavior (TPB), are extensively used to study and influence health related behavior of people like unsafe sexual behavior, smoking behavior, and therapy compliance behavior. These theories and models are also increasingly used to study and influence practices like prescribing behavior of physicians.<sup>15, 16</sup> Changing practices of physicians can be very challenging and requires comprehensive approaches tailored to specific settings and target groups.<sup>17</sup> Lots of efforts have been spent the last decades on developing methodologies and instruments to change practices of physicians and other health care workers in such called *Implementation Research*.<sup>18, 19</sup> These social cognitive theories have sporadically been applied in agricultural research and only recently beliefs of veterinarians regarding antimicrobial resistance and prescribing practices were explored using the TPB.<sup>20</sup> The application of these theories and methodologies to change behavior of stakeholders regarding antimicrobial application in animals can nevertheless be very promising and might very well be part of the systemic intervention approach.

The TPB makes the assumption that actual behavior can be predicted by intention to perform that specific behavior. The intention for a certain behavior is fed by beliefs about 1) attitude; the efficacy of the contemplated behavior (will the proposed behavior result in the desired outcome and how is this outcome perceived), 2) subjective norm; whether persons important to the individual wish it done (normative beliefs about how other people, who may be in some way important to the person, would like them to behave and the positive or negative judgments about each belief), 3) perceived behavioral control; the ability of the individual to successfully perform the behavior

(how much a person has control over the behavior and how confident a person feels about being able to perform or not perform the behavior).<sup>21</sup> Later versions of the model have added moral obligations, perceptions of risk and trust and previous behavior. Research may indicate how much each of these beliefs contribute to the intention and actual behavior. The most important beliefs can then be targeted in tailored interventions in an attempt to change this behavior. This can best be clarified with some examples.

Studies from the United States and the Netherlands indicate that for example the perceived pressure (subjective norm) of farmers and nutritionists is an important reason to prescribe antimicrobials by veterinarians.<sup>20, 22, 23</sup> Interventions to change prescribing behavior of veterinarians might for example address this perceived pressure and may provide veterinarians with tools and arguments to withstand this perceived pressure to prescribe antimicrobials. It is also important that by veterinarians and farmers perceived trustworthy people or institutions communicate the message of antimicrobial reduction.<sup>23</sup>

Studies after incentives and barriers for farmers to adopt practices that improve animal welfare consistently show that a major barrier for farmers to adopt practices that are supposed to promote animal welfare, is their disbelief in the economic viability and actual improvements of animal welfare of these practices or their disbelief that they can manage higher welfare schemes<sup>24, 25</sup> These are examples of attitudes (perceived outcome of the behavior) and behavioral control (perceived ability to perform the behavior) that can be addressed in interventions, for example by communicating knowledge with regard to this particular behavior to farmers in order to convince them of the benefits (or absence of negative consequences) of changing behavior or by coaching them into adopting new practices. It is very likely that the same type of arguments are used by farmers when it comes to reduction of antimicrobial use in their animals. These beliefs of farmers can probably be changed by using clear communication strategies about feasible methods to reduce antimicrobial use without adverse effects on productivity, animal health and animal welfare.<sup>7, 26</sup> Another strategy can be to support waiting farmers in changing behavior by using an external coach that continuously motivates farmers to change behavior.

## Conclusions

There are many reasons why antimicrobials are applied to animals. There are also many stakeholders that have different interests (or stakes) in using antimicrobials in animals. In order to stop a further development of antimicrobial resistant pathogens that both affect humans and animals, there is an urgent need to reduce antimicrobial use in animals and humans. As the context of antimicrobial use in animals differs from country to country and even within countries, there is no “magic bullet” or “one size fits all approach” that can be applied everywhere in the world to reduce antimicrobial use in animals. Therefore it is important to analyze the specific context of antimicrobial use in animals; who are the stakeholders why do they behave like they do behave, and how can their behavior be changes in order to reduce antimicrobial use in animals.

Multidisciplinary approaches whereby social psychology theories and methodologies are applied might be effective in reducing antimicrobial use in animals worldwide.

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## **Trends in Bacterial Food Poisoning and Possible Control by Normal and Beneficial Bacteria**

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### **Reporting system for “food poisoning” in Japan**

In Japan, the term “food poisoning” is more widely recognized than the term “food-borne disease” because of the nationwide reporting system for “food poisoning” based on the Food Sanitation Act established in 1947. Department of Food Safety, Ministry of Health, Labour and Welfare (MHLW) gathers information on food poisoning through this system and publishes annual statistics. In this system, doctors who diagnosed food poisoning (including suspected cases) have to report immediately to the local public health center which then starts investigation on causative agent, implicated food, food preparing facility responsible for the incident etc., and takes measures against the case. The information of food poisoning cases is then reported to the governors of prefectures and municipalities, the mayors of cities that have public health centers or the chiefs of special wards, and eventually to MHLW.

The definition of “food poisoning” differs among countries and has been changing even within a same country over time. In Japan, food poisoning was defined as “acute gastrointestinal illness caused by consumption of food containing natural poison, chemical substance, bacteria or toxin produced by bacteria” when the present reporting system started in 1952. Since then, there have been several changes in reporting practices and revisions of Ordinance for Enforcement of the Food Sanitation Act. Among bacterial food-borne diseases, dysentery, typhoid, paratyphoid and cholera were administratively classified as “contagious disease”, not “food poisoning”, and surveyed under another system, but since 1999, these diseases has also been included in “food poisoning” when the infection is related to food consumption. From 1998, viruses (“small round virus” at that time, and divided into “norovirus” and “other virus” in 2005) are added to the list of causative agents. Today, “food poisoning” means all health hazards related to the consumption of food except for food allergy.

### **Trend in food poisoning in Japan**

Around 1960, about 2 000 incidents were reported per year. The number gradually decreased and became less than 1 000 in 1990’s. Although the number sharply increased in 1997 and 1998, this is because of the change in reporting practice, i.e., food poisoning involving only one person that had not been reported before started to be reported as food poisoning. When this artificial increase in incidents is taken into account, the incidence of food poisoning in Japan has retained its level since late 1960’s.

Although the number of patients suffered from food poisoning has been 30,000 to 40,000 in the past sixty years with occasional fluctuation due to large outbreaks, the number of death cases has decreased during the period.

Outbreaks of food poisoning are influenced by social background, such as food culture, standard of life, lifestyle and eating habit, as well as the factors of pathogens (e.g., amount of pathogen necessary for onset, amount of pathogen contaminated) and hosts (e.g., age, nutrition, health condition). Recent improvement of standard of life and change in lifestyle in Japan may have affected food poisoning pattern, such as frequency of incidents, number of patients involved and mortalities. For example, major place or food preparing facility responsible for food poisoning was “home” until 1970’s, which occupied more than 30% of the incidents. However, “restaurant” now occupies more than half of the incidents and “home” occupies only about 10%. These changes can be the results of social changes in Japan, such as increased opportunity of eating out and less food preparation in home.

More than 30% of the causative agents were unknown until 1975, but most of the causative agents are now identified, owing to the technological advancement of laboratory diagnosis and addition of newly identified pathogenic agents to the list of causative agents on the report form for food poisoning. Bacteria used to be the most frequent causative agents. However, since 1998, when “virus” was added to the statistics, food poisoning caused by viruses, most of which are norovirus, continuously increased and is now on the top of the list.

### **Recent trend in bacterial food poisoning in Japan**

Although viral food poisoning became most frequent and bacterial food poisoning is decreasing in Japan, bacteria are still important issues in food safety. Until early 1990’s, the most frequent bacterial causative agents of food poisoning were *Vibrio parahaemolyticus*, *Salmonella* species and *Staphylococcus aureus*. *S. aureus* began to decline from 1980’s, but *V. parahaemolyticus* and *Salmonella* kept increasing and were in their peak at the end of 1990’s. Since late 1990’s, incidents caused by *Campylobacter jejuni/coli* became prevalent, while *V. parahaemolyticus* and *Salmonella* showed sharp decrease. These trends in bacterial causative agents in Japan may closely relate to our food culture as well as measures against the diseases.

Japanese people like to eat various foods raw. A typical example is “Sushi” and high consumption of fish and shellfish in Japan was closely related to high incidence of *V. parahaemolyticus* food poisoning. As a result of sanitary measures against fish and shellfish, incidence of *V. parahaemolyticus* food poisoning is quite low today. Based on Specifications and Standards for Foods, Food Additives, etc., under the Food Sanitation Act, fresh fish and shellfish for raw consumption must not contain more than 100 CFU/g *V. parahaemolyticus*. They have to be processed using potable water, artificial seawater prepared with potable water or sterilized seawater. Storage should be kept under 10°C.

Major implicated foods for *Salmonella* food poisoning are meat and egg. As Japanese people also like to eat egg raw, sanitary measures against eggs have been promoted. By

quarantine (imported chicks) or regular inspection on farm (domestic chicks) and maintenance of hygiene in farm, laying-hens with *Salmonella* are excluded from the production to prevent “in egg” contamination. Grading and Packing (GP) Center plays a critical role in sanitary measures for eggs including sorting out of cracked or irregular eggs and cleaning of eggshell. Proper shelf life display and temperature control during the course of distribution and in the market have been enforced. As a result, *Salmonella* food poisoning has decreased dramatically today.

*S. aureus* is often found as commensal on skin and in intestine of animals and humans. Major implicated foods of *S. aureus* food poisoning are dairy products and meat in the Western countries, while important sources of *S. aureus* in Japan are rice and its products contaminated from cook’s hands. Factors like diversification of eating habit, proper temperature control during the course of distribution and in the market, improved sanitary knowledge at home and spread of “convenience store” may have played a role in reduction of *S. aureus* food poisoning.

Because some Japanese like to eat even beef and beef liver raw, there have been some serious outbreaks of food poisoning caused by enterohaemorrhagic *Escherichia coli* (EHEC). Although pathogenic *E. coli* is not at the top of the ranking, pathogenic *E. coli*, especially EHEC, is one of the most important causative agents because it often causes severe symptoms and may even lead to death. Strict standards on beef for eating raw have applied and raw liver has been prohibited to serve at restaurants since 2012.

## **Research for food-borne disease control**

As the effects of measures applied and changes observed in the society mentioned above, the most frequent bacterial food poisonings in 2012 are those caused by *C. jejuni/coli*, both in number of incidents and patients, followed by those caused by *S. aureus*, *Salmonella*, *Clostridium perfringens* and pathogenic *E. coli* in incidents, and those caused by *C. perfringens*, *S. aureus*, *Salmonella* and pathogenic *E. coli* in patients. These bacteria colonize in the intestine of healthy livestock and some of them need only small amount of organisms to establish health hazard. It means that it is often difficult to prevent these pathogens from contaminating foods. One of the measures considered effective to control these food-borne diseases is the elimination of these pathogens from livestock themselves. However, if we use prophylactic antibiotics to eliminate these bacteria, we may increase the threat of emergence of antibiotic resistance and there is also the problem of residue. Development of novel elimination strategies without using antibiotics is expected.

Bacteriocins, antibacterial peptides produced by bacteria, can be a candidate to solve the problems. The property that they are easily decomposed by intestinal proteolytic enzymes and environmental stress including heat and acid may be one of the advantages of bacteriocins because it makes bacteriocins less probable to cause antimicrobial and residual problems. We are searching new bacteriocins with novel and useful properties from lactic acid bacteria, which are regarded as safe bacteria, isolated from humans and various animals. On the other hand, their instability becomes a



disadvantage when we want to apply bacteriocins to intestinal pathogens. We are also trying to develop and evaluate new delivery system of bacteriocins or bacteriocin producing strains to protect them from acid and enzymes in the intestine.

Another possible solution is application of probiotic bacteria or commensal microbiota. For example, even in the same outbreak by EHEC O157, large individual variations in symptoms were observed. The difference in the composition of intestinal microbiota is considered to be one of the important factors contributing to such variation. When germfree mice are mono-associated with EHEC O157, the animals die within 7 days. Then different strains of *Bifidobacterium*, typical beneficial bacteria in human intestine, including isolates from healthy babies are mono-associated prior to the EHEC challenge. Some strains protected mice from EHEC mortality while others did not. Interestingly, even in the same species, only some specific strains had protection ability. We are trying to elucidate the mechanisms of the protection. Although this model can reduce the symptom of EHEC, the colonization of EHEC cannot yet be prevented. Therefore, we are also trying to find bacterial strain(s), which can eliminate EHEC from intestine.

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## ANNEXES

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### Workshop Programme

#### Tuesday, 24 September

08:30 – 09:30	<b>Registration</b>
09:30 – 10:30	<b>Opening Session</b> Welcome: APHCA Chairperson Keynote: Zoonotic and food-borne disease challenges in a globalised world - <i>Prof. D.U. Pfeiffer, RVC</i>
10:30 – 11:00	<b>Tea / Coffee Break</b>
11:00 – 12:30	<b>Session 1: Country Reports on Incidence, Impact and Control of Zoonoses and Food-borne Diseases</b> (3 reports of 20 minutes each plus 10 minutes discussion) – Chair: tbd Bhutan - <i>Dr N.P. Dahal</i> SPC - <i>Dr K. Cokanasiga</i> Viet Nam - <i>Dr N.H. Tung (tbc)</i>
12:30 – 14:00	<b>Lunch</b>
14:00 – 15:30	<b>Session 2: Activities of International Organizations on Zoonoses and Food-borne Diseases in the Asia-Pacific Region</b> (3 reports of 20 minutes each plus 10 minutes discussion) – Chair: tbd FAO - <i>Dr W. Kalpravidh and Dr C. Benigno (FAO Bangkok)</i> OIE - <i>Dr H. Kugita and Dr T. Ishibashi (OIE Tokyo)</i> WHO - <i>Dr C. Winter (WHO Bhutan)</i>
15:30 – 16:00	<b>Tea / Coffee Break</b>
16:00 – 18:00	<b>Session 3: International Zoonoses and Food-borne Disease Research Programmes in the Asia-Pacific Region and Salient Findings</b> (4 reports of 20 minutes each plus 10 minutes discussion) – Chair: tbd ACIAR - <i>Dr M. Nunn (ACIAR, Australia)</i> CIRAD - <i>Dr J. Capelle (CIRAD, Cambodia)</i> ILRI - <i>Dr J. Gilbert (ILRI, Lao PDR)</i> Oxford University - <i>Dr J. Bryant (OXCRU, Viet Nam)</i>
18:30 – 20:30	<b>Dinner hosted by FAO-APHCA and OIE (at the Folk Heritage Museum Restaurant)</b>

**Wednesday, 25 September**

- 08:30 – 10:30      **Session 4: Antimicrobial Resistance (AMR) associated with Animal Production, its Management and Alternatives to Antimicrobials**  
(4 reports of 20 minutes each plus 10 minutes) – Chair: tbd  
U. Utrecht – *Prof. J. Wagenaar: International research on antimicrobial resistance at the animal-human interface in the Asia-Pacific region*  
OIE – *Dr E. Erlacher-Vindel: FAO-OIE-WHO Tripartite approach and OIE activities on AMR*  
U. Utrecht – *Dr D. Speksnijder: Tailored interventions to promote prudent antimicrobial use; theory and practice*  
U. Tokyo - *Dr K. Hirayama: Trends in bacterial food-borne diseases and possible control by normal and beneficial bacteria*
- 10:30 – 11:00      **Tea / Coffee Break**
- 11:00 – 13:00      **Session 5: Discussion, Conclusions and Recommendations**  
Chair: tbd
- 13:00 – 14:00      **Lunch**
- 14:15 – 18:00      **Field trip organized by GoB** (Druk Wangyal Chorten Dochula, Kuensel Phodrang: Buddha Point, Tashi Choe Dzong)
- 18:45 – 20:45      **Dinner hosted by His Excellency Minister for MoAF (Namgay Heritage)**

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