Introduction
Coordinating surveillance policies in animal health and food safety ‘from farm to fork’

Animal health and human health are closely interlinked – more than sixty percent of the pathogens that cause diseases in humans originate from domestic or wild animals. In addition, both animals and humans are affected by, and affect, the environment in which they exist. Zoonotic pathogens may be transmitted to humans via food, through direct contact between animals and humans, or by other routes. In this issue of the Scientific and Technical Review interest is focused mainly on pathogens transmitted from animals to humans via food.

Although attempts have been made in some countries and regions to coordinate control systems across the animal health, food safety and human health sectors, most systems are generally poorly coordinated. In view of the recognised need for, and importance of, better coordination of surveillance policies for animal health, food pathogens and foodborne diseases, it was thought appropriate to devote an issue of the Review to this subject. Such coordination has many different aspects and the papers have been grouped under four main headings:

– mechanisms for integrating animal health and food safety surveillance
– implications for international organisations
– practical examples
– the scientific and technical basis of coordinated policies.

Mechanisms for integrating animal health and food safety surveillance

Global legal basis for notification of animal and human diseases

Successful control of animal and human diseases, and possible epidemics, depends on rapid access to complete information on the disease situation. In order to ensure a timely response, diseases must be immediately notified in a transparent manner. The rapid exchange of information about animal diseases, including zoonoses, was the main objective in establishing the World Organisation for Animal Health (OIE) almost 90 years ago and facilitating such an information exchange is still one of its most important activities. The current OIE and World Health Organization (WHO) requirements and systems for notification of animal and human diseases are described in this issue. The notification of diseases may have a negative impact on a country’s economy (e.g. by causing loss of export markets or discouraging tourism). However, new information technologies and practices make it difficult to hide the occurrence of serious notifiable diseases. A country that does not fulfill its notification obligations loses international credibility and makes the spread of disease more difficult to prevent. However, political will to report diseases is not enough – there is also a need for adequate scientific, technical and other resources to detect them, collect and collate the information and transmit it rapidly to the OIE and WHO. Both these organisations provide support to their members to develop such resources.

Integrating animal health and foodborne disease surveillance

To develop effective integrated programmes for animal health and foodborne disease surveillance, several key questions must be addressed, including: what is the relative incidence, morbidity, mortality and economic cost of the foodborne disease in humans? what kind of surveillance is needed to identify the disease-causing agent in the animal population? Do we have the ability to control the disease in the animal population? What disease detection tests are available and what is the sensitivity, specificity and cost of these diagnostic tests? Does the country, region or agency involved have the legal, financial and educational resources to carry out the surveillance and follow this up with appropriate actions? After the key questions have been addressed the veterinary and public health sectors together have to decide if surveillance and control are feasible and, if they are, they can then start to develop the programme.

The role of veterinarians and Veterinary Services

Food safety activities are best undertaken using an integrated, multidisciplinary approach that considers the whole of the food chain. The education and training of veterinarians, which includes both animal health and food safety components, makes them uniquely equipped to play a key role in the surveillance and control of animal health, food safety and foodborne disease. Traditionally, the
role of the Veterinary Services extended from the farm to the slaughterhouse, but in many countries their role has been broadened to include subsequent stages of the food chain. Veterinary Services play a key role in investigating outbreaks of foodborne disease all the way back to the farm and in formulating and implementing remedial measures once the source has been identified. In order to make best use of the often limited resources for preventing, detecting and controlling foodborne disease, it is important that Veterinary Services work in close cooperation with all other professional groups and stakeholders, including human and environmental health professionals, analysts, epidemiologists and food producers, processors and traders. The OIE has developed the ‘Performance of Veterinary Services (PVS) Pathway’ to help countries evaluate the organisation of their Veterinary Services and identify what could be done to improve the surveillance and control of animal and public health.

**Antimicrobial resistance**

Antimicrobial resistance is an important and growing problem worldwide, with serious implications for both animal and human health. Recognising this, the OIE has published a *Scientific and Technical Review* on ‘Antimicrobial resistance in animal and public health’ (Vol. 31 [1], 2012) and organised a Global Conference on the Responsible and Prudent Use of Antimicrobial Agents for Animals in March 2013 to further develop methods to deal with this problem. This issue of the Review discusses the progress made so far in integrating systems for surveillance of antimicrobial resistance and antimicrobial use, the technical aspects and challenges and possible solutions.

**The role of veterinary medicines regulatory agencies**

Veterinary medicines are important for both food safety and food security as they help to prevent animal disease and maintain animal health. The responsibility for controlling such medicines, and for monitoring whether or not they are being used prudently, lies with many different organisations and individuals, including regulatory agencies, pharmacists, veterinarians and farmers. The responsibilities of veterinary medicines regulatory agencies include pre-market reviews and assessments, approval, post-market adverse-effect monitoring (including monitoring of antimicrobial resistance in foodborne microorganisms) and enforcement.

**Integrating animal health and food safety surveillance data from slaughterhouse control**

Surveillance at the slaughterhouse level for animal health and food safety purposes encompasses examination for the presence of pathology, pathogens, drug residues, chemical contaminants and antimicrobial resistance. Government, industry and academia are the primary proponents of such surveillance. The results of slaughterhouse control should be communicated to the authorities responsible for animal health and to farmers for action, where appropriate. Information related to food safety is used by those responsible for deciding whether to approve the food for human consumption or other purposes or reject it. Efforts to integrate data across government, industry and academia can encounter significant legal, logistical and financial challenges. It is proposed that policies to encourage effective integration of animal health and food safety surveillance data from slaughterhouse control should promote a long-term approach to integration, the application of risk-based schemes, the transparent provision of data to the public, and the generation of consumer-oriented communications derived from these data.

**Veterinary education**

Effective surveillance of animal health, food pathogens and foodborne disease is dependent on the availability of adequate human, scientific and technical resources, and in particular on the availability of sufficient numbers of well-educated and experienced veterinarians. This is clearly recognised by the OIE, which appointed an Ad hoc Group on Veterinary Education to propose ways of supporting its Members, in particular developing countries, to improve their veterinary education. The OIE has developed guidelines on education and is currently organising its third conference on this theme (4–6 December 2013, Foz de Iguazu, Brazil). The requirements for veterinary education in the area of food safety (including animal health, food pathogens and surveillance of foodborne disease) and training projects aimed at meeting these requirements are discussed.

**Implications for international organisations**

**OIE’s role**

The OIE’s role in information exchange and the control of animal diseases, including zoonoses, is described. Its mandate since its establishment in 1924 has been to facilitate the exchange of animal health, public health and scientific information and to further the control and eradication of animal diseases. The OIE is recognised by the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (‘SPS Agreement’) as the international reference organisation for animal health and zoonoses, especially for standard setting. Its standards are contained in the *Terrestrial Animal Health Code*, the *Aquatic Animal Health Code*, the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* and...
the Manual of Diagnostic Tests for Aquatic Animals. The Codes and Manuals are of great importance not only for animal and public health, but also for international trade in animals and foods of animal origin. In a context of emerging new diseases, both zoonotic and non-zoonotic, and an increased risk of animal diseases and zoonoses spreading across the world, the OIE's role in promoting the transparent exchange of animal health and other scientific information is vital.

**Estimating the global burden of foodborne diseases**

One of the major problems in trying to estimate the number of cases of foodborne zoonotic diseases, and in identifying their causes, is under-reporting – many of those affected do not contact the medical services and, even if they are reported, many disease outbreaks are not investigated or the investigations do not result in identification of the source of the problem. In 2006, in order to address these challenges, the WHO launched the Initiative to Estimate the Global Burden of Foodborne Diseases. This initiative aims to provide policy-makers with more complete information on the public health impact of unsafe food in a comprehensive, integrated manner. The background to this initiative and the results achieved to date are presented.

**Planning for rapid response to outbreaks of foodborne zoonotic diseases**

Despite the implementation of preventive measures, outbreaks of foodborne zoonotic diseases have occurred and will continue to occur. Guidance on planning for a rapid response to outbreaks of such diseases is given in a paper from WHO. The importance of coordination between all the agencies involved, for example those responsible for public health, food and feed safety, agriculture and fisheries, industry and trade, local authorities, inspection and tourism, is emphasised. The Food and Agriculture Organization of the United Nations (FAO) and WHO have produced guidance documents for use by national authorities on foodborne outbreak investigation, establishing food safety emergency response plans, applying risk analysis principles during food safety emergencies and developing national food recall systems. The OIE, FAO and WHO are working together to develop an intersectoral mechanism to conduct robust and timely joint risk assessments when faced with foodborne-disease outbreaks or other food safety emergencies. Three international instruments (the FAO/WHO International Food Safety Authorities Network [INFOSAN], the FAO/OIE/WHO Global Early Warning System for Major Animal Diseases, including Zoonoses [GLEWS]+ and the FAO Emergency Prevention System for Food Safety [EMPRES Food Safety]) can help countries prepare themselves to deal with outbreaks of foodborne zoonoses.

**Implementing Codex Alimentarius standards**

Codex Alimentarius standards are specifically recognised by the WTO SPS Agreement as the international benchmarks in the area of food safety. Similarities in the risk analysis methodologies used by the Codex Alimentarius Commission (CAC) and the OIE in the case of zoonoses are highly enabling of integrated food control systems. The CAC and the OIE are increasingly working together to develop their respective standards for foodborne zoonoses so that they are non-duplicative, cohesive and cover the whole food chain. At the national level, it is important that all the Competent Authorities involved are well coordinated and that information is shared with other food safety stakeholders.

**Practical examples**

The third section of this issue of the Review provides a number of practical examples of the integration of surveillance for different pathogens and in different regions of the world.

**Anisakis**

As aquaculture production and consumption of aquaculture products increases, the possibility of zoonotic infection from either handling or ingesting these products also increases. A paper on Anisakis includes information about the prevalence of infection and larval burden of Anisakidae in fish, human infection, economic impact and control measures.

**Contact zoonotic infections from fish**

An account of worldwide human cases of zoonoses caused by the principal fish and shellfish zoonotic pathogens is presented. The principal pathogens acquired topically from fish or shellfish through spine/pincer puncture or open wounds are identified. All of these pathogens have also been associated with disease outbreaks in food fish. Outbreaks are often related to management factors such as the quality and quantity of nutrients in the water and stocking density.

**Surveillance of Salmonella serovars other than S. Enteritidis and S. Typhimurium**

This paper discusses the practical aspects of surveillance of Salmonella serovars other than Enteritidis and Typhimurium (SE/ST). In most countries of the world no formal surveillance systems for human salmonellosis are in place, and data are limited to ad hoc studies. Data on animals, food and animal feed are even scarcer. The identification of non-SE/ST serovars may be hampered by the lack of experience in serotyping and availability of (high-quality) antisera.
Subtyping of Salmonella remains important to identify sources for human infections and to target interventions. However, in the future, culture-independent diagnostic assays will be used increasingly, which will result in the loss of epidemiological subtyping and antimicrobial susceptibility data. The validation of these assays for all serovars, particularly the rare ones, needs attention. Although current subtyping based on the Kauffmann-White scheme is well established and has been shown to be robust, a new generation of subtyping methods will replace it in the near future.

**Integrating animal health, food pathogen and foodborne disease surveillance in different regions**

Three papers review regional attempts to integrate the surveillance of animal health, food pathogens and foodborne diseases. The first paper describes the situation in the European Union (EU), where there is an integrated approach to risk assessment with a special focus on human health and the whole food chain and on science-based interventions to reduce the risk to consumers. This coordination is achieved mainly through cooperation between the European Food Safety Authority, the European Centre for Disease Prevention and Control and the authorities in the 27 EU Member States.

The second paper provides a description of the characteristics of surveillance and the attempts made in the Americas to institute truly integrated surveillance systems that bring together disease surveillance of medically treated clinical populations with disease surveillance for food-production animals. The paper also describes the characteristics of an ideal, integrated food safety system.

The situation in developing and in-transition countries is reviewed in the third paper. In these countries, animal diseases, foodborne pathogens and foodborne diseases have enormous impacts upon the health and livelihoods of producers and consumers. Unfortunately, human and financial resources for the effective surveillance of infectious disease threats are often limited, leading to chronic under-reporting. This further contributes to an under-estimation of the impacts of these diseases and an inability to implement effective control measures. However, innovative communication and diagnostic tools, as well as new analytical approaches and close cooperation within and between animal and human health sectors, can be utilised to improve the coverage, quality and speed of reporting and generate more comprehensive estimates of disease burden. These approaches can help tackle endemic diseases and build essential surveillance capacities to address changing disease threats in future.

**Scientific and technical basis of integration policies**

This final section includes papers on the scientific and technical basis of coordinated policies.

**Improved analytical methods for surveillance and source attribution**

Robust and accurate diagnostic assays are needed to detect the infectious agents rapidly and to limit their spread. The large arsenal of novel assays that has been developed during the last three decades and which have had a tremendous impact on the detection of infectious agents is reviewed. The new diagnostic methods are mostly laboratory based and expensive, as they require sophisticated equipment and specialist skills. However, rapid and cheap field-based assays are also being developed. Several examples of the development of novel assays are given, including methods for avian influenza viruses, noroviruses and hepatitis A viruses, Salmonella spp., and Campylobacter spp.

**Foodborne parasites**

Humans suffer from several foodborne helminth zoonotic diseases, some of which can be deadly (e.g. trichinellosis, cerebral cysticercosis) while others are chronic and cause only mild illness (e.g. intestinal taeniosis). The design of surveillance and control strategies for the various foodborne parasite species and the involvement of veterinary and public health agencies vary considerably because of epidemiological features and the different life cycles of these parasites. The strategies and methods required for surveillance for these parasites in livestock are discussed, including the required policy-level actions and the necessary collaborations between the veterinary and medical sectors to achieve a national reporting and control programme.

**Animal identification and traceability**

It is rarely possible to successfully contain an outbreak of an infectious animal disease, or to respond effectively to a chemical residue incident, without the use of a system for identifying and tracking animals. The linking of animals at the time they are slaughtered, through the use of their identification devices or marks and accompanying movement documentation, with the meat produced from their carcasses adds further value from the perspective of consumer safety. Over the past decade, animal identification technology has become more sophisticated and affordable. The development of the internet and mobile communication tools, complemented by the expanded capacity of computers and associated data-management applications, has added a new dimension to the ability of Competent Authorities...
and industry to track animals and the food they produce for disease control, food safety and commercial purposes. The importance of animal identification and traceability is recognised in two chapters of the OIE Terrestrial Animal Health Code and in a Codex Alimentarius standard dedicated to this subject.

Antimicrobial resistance in microorganisms associated with aquatic animals

The OIE Aquatic Animal Health Code recommends that programmes for the monitoring and surveillance of antimicrobial resistance in microorganisms associated with aquatic animals be initiated by appropriate authorities. The last paper in this issue discusses the classes of bacteria to be studied in such programmes and the methods of sample collection that should be employed. The susceptibility test protocols appropriate for use in such programmes, the interpretive criteria that should be applied to the data they generate and the form in which the output of such programmes should be reported are also reviewed. Surveillance programmes should employ standardised and internationally harmonised susceptibility test methods to the greatest extent possible.

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