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FUTURE TRENDS IN VETERINARY PUBLIC HEALTH

Report of a
WHO Study Group

World Health Organization
Geneva

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1. Introduction

A Study Group on Future Trends in Veterinary Public Health (VPH) met in Teramo, Italy, from 1 to 5 March 1999. The meeting was opened by Dr F.-X. Meslin, Coordinator, Animal and Food-related Public Health Risks, World Health Organization (WHO), who pointed out the increasing importance of VPH for both developing and developed countries, as well as its role in helping to achieve the *Health for all in the twenty-first century* strategy adopted by the World Health Assembly in resolution WHA51.5 in 1998 (*1*).

2. Background

In the 25 years since the adoption of the 1975 report, *The veterinary contribution to public health practice* (*2*), many significant developments have occurred in VPH. A review of this area was therefore timely and the participants welcomed the opportunity to re-examine the role and functions of VPH.

The predominant concern of VPH during the 1970s and for most of the 1980s related to risks of chemical pollution of the environment and the food chain (e.g. from pesticides, groundwater pollution by animal waste, natural toxins and drug residues in food). However, in the past two decades, emerging and re-emerging zoonotic diseases have acquired global significance for VPH. These include *Salmonella enteritidis* in poultry the most frequently reported zoonotic disease in many countries, multidrug-resistant *Salmonella typhimurium*, Marburg and Ebola viral haemorrhagic fevers in Africa, Rift Valley fever in east Africa, the Arabian Peninsula and Egypt, the New World screw worm (*Cochliomyia hominivorax*) in north Africa and new rabies-like viruses in bats in Australia and Europe.

The unexpected link between bovine spongiform encephalopathy (BSE) and variant Creutzfeldt–Jakob disease (vCJD) called for close intersectoral cooperation to elucidate this connection. Hantaviruses, and more recently West Nile virus in the Americas, are further examples of zoonotic agents causing human illness and death that require rapid responses from, and teamwork between, physicians, veterinarians and biologists. Resistance to antimicrobials among zoonotic bacteria has also become an issue of increasing concern for animal production and human health. In recent years, the threat of a global influenza pandemic has resulted in renewed research actions in relation to mammalian and avian reservoirs.

Common to all these emerging problems have been new trends in animal production practices, changing patterns of wildlife populations, demographic changes, such as population growth, mobility and urbanization, and globalization of the food industry. These developments call for increased levels of epidemiological surveillance and preparedness, and for novel approaches to control and prevention. However, awareness of these developments is not always translated into effective action. In light of these developments, international organizations will have to increase their involvement at the interface of animal and human health.

The following objectives should be understood in the context of these emerging situations and of the public health needs related to these developments.

3. Objectives

The major goals of the Study Group were to review the contribution of veterinary science to public health and to assess the needs of Member States, particularly in developing regions, concerning the organization and management of VPH programmes and activities. The aim was to provide the Food and Agriculture Organization of the United Nations (FAO), the Office International des Epizooties (OIE), WHO, WHO collaborating centres, nongovernmental organizations and the food and animal health industry with guidance on how to respond better to these needs.

The objectives of the Study Group were as follows:

1. To review current VPH programmes and needs in Member States with respect to developing and developed regions, and urban and rural communities.
2. To develop recommendations for model interdisciplinary, cost-effective VPH programmes at national and regional levels consistent with the strategy of *Health for all in the twenty-first century* (*1*), and with projected trends in population growth, mobility and urbanization, international trade, and livestock intensification and movement, as well as climatic and other environmental changes.
3. To develop recommendations for delivering VPH services at the community level that are consistent with community involvement in health promotion, and take into account the increasing privatization of veterinary services. Consideration was given to the use of paraveterinary or auxiliary staff, to gender and cultural issues, and to collaboration with nongovernmental organizations.

4. To review the role of intersectoral collaboration, particularly between medical and veterinary personnel, in the surveillance and control of zoonoses and foodborne diseases, and to develop recommendations for strengthening collaboration at all levels.
5. To develop recommendations for the further development of country- and region-specific guidelines for the diagnosis, epidemiological surveillance, prevention and eradication of established, emerging or re-emerging zoonotic and other diseases common to humans and animals.
6. To review the role of VPH in food safety and food quality, in both developing and developed countries.
7. To review the need to expand VPH activities to animal-associated human problems related environmental pollution, and natural disasters and occupational and recreational zoonoses.
8. To review, and to make recommendations on the role of FAO, OIE and WHO collaborating and reference centres with VPH activities.
9. To review and to make recommendations on the future national and international role of VPH in providing up-to-date evidence-based information to Member States, and on the role of VPH in assisting epidemiological investigations, training and design and evaluation of research projects.
10. To evaluate the need for human health indicators specific to VPH, and for expanded studies on the economic impacts of zoonotic diseases. The use of risk analysis techniques in the design of programmes aimed at controlling and preventing zoonotic diseases should also be examined.
11. To discuss the need for the accreditation of organizations, veterinary schools and colleges to improve and expand instruction in VPH, and for a database of opportunities for both short-term (on-the-job and continuing education) and long-term (graduate level) training, with emphasis on acquiring technical and management skills and knowledge.

The format of the report consists of summaries of invited papers[1] under the three sections:

[1] Draft working papers prepared by Members of the Study Group were distributed through an electronic conference organized by WHO during December 1998 and January 1999. Comments were received and reviewed by the Study Group. Some 300 people participated in this pre-Study Group electronic conference. A paper submitted by Sebastian E. Heath on *Veterinary public health in disasters in developing countries* (see Annex 2) was also circulated through the electronic conference.

- New and future trends that will influence VPH.
- Organization and management of VPH services and programmes.
- Professional development and utilization of VPH staff.

The three sections are followed by the conclusions and recommendations.

4. The scope of VPH in the twenty-first century

In 1975, VPH was defined by a Joint FAO/WHO Expert Committee on Veterinary Public Health as "a component of public health activities devoted to the application of professional veterinary skills, knowledge and resources to the protection and improvement of human health" (*2*). Because VPH activities must be carried out in close partnership with other public health efforts to ensure positive health outcomes, the Study Group redefined VPH and the scope of its collaborative efforts.

For the purposes of its meeting, the Study Group defined VPH as "the sum of all contributions to the physical, mental and social well-being of humans through an understanding and application of veterinary science". Veterinary science covers all veterinary activities, including animal production and health, and is a core discipline that performs essential public health functions and directly influences human health in the following ways:

- Professional knowledge and experience is used to respond to infectious disease outbreaks and intoxications from animal and environmental reservoirs, including products of animal origin.
- Health care services and health research for both humans and animals have common activities.
- All veterinary science graduates undergo comprehensive medical training.
- Veterinary science emphasizes preventive, economic and population aspects of animal health and production, as they relate to human health and well-being.

In the forthcoming decades, there is an urgent need to expand the links between human and animal medicine. For example, at least one-half of the 1700 agents known to infect humans have an animal or insect vector reservoir, and many emerging infections either are, or appear to be, zoonoses.

The scope of VPH is multidisciplinary. It involves not only veterinarians in governmental, nongovernmental and private sectors, but also other professionals such as physicians, nurses, microbiologists,

environmental specialists, sanitarians, food technologists, agricultural scientists, paraveterinary staff and auxiliaries who contribute to the treatment, control and prevention of diseases of animal origin. VPH directly improves human health by reducing exposure to hazards arising from interactions with animals and animal products. Examples of these hazards include zoonoses, vector-borne infections and other communicable diseases, chemicals and veterinary drugs used in animals, envenomations, and injuries from occupational and recreational exposure to animals.

Veterinary science contributes to human health by promoting the health of animals, which provide necessary income, food, transport, draught power and the raw materials for clothing throughout the world. By promoting animal health, the quality and quantity of animal products is enhanced. This is especially important in developing countries, where foods of animal origin help to improve the nutritional status of malnourished people by providing high-quality protein and micronutrients. In the same way, using animals for draught power and their manure for fertilizer and fuel increases crop production, especially on small-scale farms. In all countries, improved animal health and quality assurance of foods of animal origin contributes to food security at local and national levels. Agricultural policies that encourage both small-scale producers and larger operators contribute to economic development through national and international trade in animals and animal products; increased livestock productivity facilitates rural development and reduces rural–urban migration by stimulating the rural economy.

Equitable distribution of food within the family, community and nation will contribute to health equity, one of the global health targets of *Health for all in the twenty-first century* (*1*). Another target calls upon all countries, through intersectoral action, to make major progress in making available food, safe drinking-water, adequate sanitation and shelter in sufficient quantity and quality to every person in the world. VPH workers are already active in promoting human health and, because of their credibility among producers and consumers, can be powerful advocates for current food distribution issues and can stress the importance of high-quality food, especially for children and for women who are either pregnant or breastfeeding.

The core domains of VPH include the following: diagnosis, surveillance, epidemiology, control, prevention and elimination of zoonoses; food protection; management of health aspects of laboratory animal facilities and diagnostic laboratories; biomedical research; health education and extension; and production and control of biological products and medical devices. Other VPH core domains may include

management of domestic and wild animal populations, protection of drinking-water and the environment, and management of public health emergencies.

Specific emerging domains in VPH that can make significant contributions to public health include:

- Investigation, epidemiology and control of non-zoonotic, communicable diseases.
- Social, behavioural and mental aspects of human–animal relationships (including animal-facilitated therapy and development of animal welfare standards).
- Epidemiology and prevention of non-infectious diseases (including the promotion of healthy lifestyles).
- Leadership, management and administration of public health and environmental agencies, including government institutions, private sector organizations and academic institutions.
- Risk analysis, health economics, cost–benefit, cost–analysis, effectiveness analysis and other methods of evaluating health service delivery and public health programmes.
- The social context of delivery of VPH services, especially to women in rural areas who have traditionally been underserved by veterinary services, yet who have great potential for preventing zoonotic diseases and diseases of animal origin.

VPH contributes to many areas of public health that are not related to animals, including the design and analysis of public health programmes. The efficiency of such programmes, particularly in developing countries, can be improved by ensuring that VPH skills are fully integrated at both local and national levels.

VPH will continue to develop against a rapidly changing background of population growth, increasing urbanization, an increasing poverty and technology gap between developed and developing countries, and changes in land use, the environment and the climate. These changes will present new challenges for VPH as part of human health systems. In addition, there will be widespread changes within the immediate scope of VPH itself that will involve issues such as:

- *Farming methods*:
  - — changes in the intensity of livestock production;
  - — new and expanding activities, such as aquaculture and game farming, and the need to adopt environmentally friendly approaches;
  - — the development and uptake of new technologies, such as genetic engineering and transgenesis;

— the use of additives and antimicrobials in feedstuffs, and safe sourcing of feedstuffs;
— the use of antimicrobial agents for growth promotion and for prophylaxis against disease;
— waste disposal;
— increases in marginal holdings and rural poverty, and the advancement of women's rights in rural areas;
— ruralization of urban areas as people move to cities, bringing their livestock and culture from rural areas with them.

- *Food production chain*:
  — a change in focus from individual animals to herds and populations, and systems-based controls (e.g. hazard analysis critical control points (HACCP));
  — increased responsibility of participants at all points in the food production chain to certify the quality of all phases of production and the final products;
  — development and implementation of new technologies for food and feed production, preservation and commercialization, and related problems of toxic residues and improved standards of hygiene;
  — new social needs, in particular greater attention to consumers' requirements.
- *Trade*, *travel and movement*:
  — continuing expansion of international travel (both as individuals and as populations) and of international trade in animals and animal products;
  — changes in food habits associated with travel or migration;
  — implementing and ensuring compliance with the requirements of international agreements and conventions (e.g. the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures) and national regulations, both to allow access to international markets and to guarantee the internal market by certification of products;
  — changes in consumer expectations, including export and tourist markets, and increased consumer awareness.
- *Interactions between humans and animals*:
  — changing incidence of animal-related hazards (e.g. those associated with tourism);
  — role of companion animals and human well-being;
  — new requirements connected with increasing urban and peri-urban animal populations;
  — biomedical applications (e.g. xenotransplantation).

- *Natural and man-made disasters*:
  - — increasing demand for VPH services to respond to non-epidemic emergencies such as weather-related problems (e.g. droughts, famines, floods, hurricanes), earthquakes, industrial and nuclear accidents, and to epidemics accidentally or intentionally caused by humans.
- *Emerging and re-emerging zoonotic diseases:*
  - — expansion and increasing importance of zoonoses and other communicable diseases common to humans and animals.
- *Reduced resources*:
  - — reduced governmental funding and a trend towards privatization of services;
  - — maintaining sustainability of traditional VPH services;
  - — developing alternative mechanisms for delivery of VPH services;
  - — commitments and priorities of national governments;
  - — poor perception and understanding of VPH within the public health sector.
- *Pace of change*:
  - — reliance on new disciplines and improved evidence-based decision-making within VPH (e.g. risk analysis, social and gender analysis);
  - — information overload, media attention and the need for rapid and accurate communication;
  - — the need for flexibility and innovation.

There are essential differences in the nature of VPH services required by developing countries compared to those required by developed countries. The organization of government varies between countries, and these differences must be borne in mind. Essential to the delivery of VPH is the need for horizontal coordination mechanisms at local, regional and national levels. To complement this, strong vertical communication between different tiers of government, nongovernmental organizations and the private sector is required to ensure that community-level programmes are adjusted as needed.

At the community level there are concerns about the inappropriate restructuring of veterinary services that has taken place in some countries. Governments of Member States should bear in mind that, in their search to find an appropriate balance between the public and the private delivery of veterinary services, VPH is essentially a "pub-

lic good". Governments should therefore recognize their primary responsibility to ensure the provision of VPH to all sectors of the population, even though the actual mechanisms for service delivery may vary between countries.

The public health content of veterinary curricula does not adequately prepare graduates in many aspects of VPH. This is true in developed countries, but the problem is even more acute in developing countries. Therefore, the VPH content of veterinary curricula should be expanded and should provide a basis for pursuing postgraduate training in VPH. Postgraduate training in VPH must be organized systematically, recognizing the local and regional needs and skills of veterinary and other related professions. VPH professionals must be able to meet the demands for straightforward and clear answers regarding the potential risks (microbial and non-microbial) associated with consumption of, or exposure to, products of animal origin, animal welfare and protection of the environment. The objective of an enhanced VPH curriculum is to provide graduates of all learning backgrounds with up-to-date knowledge and expertise, so that they can actively contribute to VPH programmes.

It is well recognized that auxiliaries and paraprofessionals play an important role in VPH. In addition to providing clinical services in animal health, veterinary and other related technicians and auxiliaries can also deliver health messages to livestock producers, and teach them about transmission and prevention of diseases and other health subjects.

5. New and future trends that will influence VPH

5.1 Promoting VPH within the *Health for all in the twenty-first century* strategy

The "health for all" strategy is guided by two policy objectives: making health central to human development, and developing sustainable health systems to meet people's needs. Over the past two decades, the impetus for health for all has come from primary health care. However, although some improvements have been made, progress has been hampered for several reasons, including insufficient political commitment towards implementing the necessary measures, and to achieving intersectoral actions for health.

The role of VPH within the global health agenda is to promote activities that contribute to the achievement of health for all and help realize its objectives. A number of global changes will occur during the next 25–30 years that will have a dramatic impact on most

professional groups, especially physicians and veterinarians. A number of these changes are under way and their consequences are already apparent; in two to three decades these changes will reach a point where to delay recognition of them might result in providing inadequate responses. The major foreseeable changes that will have an impact on VPH activities are:

- The human population is expected to double before 2015.
- The proportion of the total population of developing countries that lives in urban areas will increase from an estimated 37% in 1990 to 52% by 2020.
- Health problems related to environmental pollution are likely to increase in both developing and developed countries.
- The global temperature will continue to increase and produce environmental changes.
- Patterns of zoonotic diseases will change. During the past few years many zoonotic diseases have occurred as newly recognized (emerging) or previously recognized (re-emerging) diseases. There are many reasons for the increased occurrence of zoonotic disease, including alteration of the environment, establishment of human settlements in formerly uninhabited areas, a greater demand for animal protein, intensification of animal production, and acceleration of trade in live animals, animal products and other foodstuffs.
- Patterns of human disease will change. The patterns will be affected by high population densities, movements of human populations within and between countries, and changes in lifestyles. Infectious diseases will remain the major causes of mortality in most developing countries, with human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) and opportunistic infections (including zoonoses) being especially important. The problem will be exacerbated as the proportion of immunosuppressed people in the population increases.
- Global trends in the organization of national health services. These include trends towards decentralized decision-making and privatization as ways of increasing economic efficiencies and responding to changes in government policies. Concomitant with these changes in national health services, governments and the general public will increasingly recognize that many functions of national veterinary services aim to improve public health and well-being. The recent BSE crisis in Europe, for example, has shown the need for a clearer delineation of responsibilities between that part of the public sector that deals with economic issues of animal health, production and trade, and that concerned with public health and consumer protection.

VPH covers a dynamic and complex set of activities affected by trends in demography, society, politics, economics and the environment. The interactions between these trends and VPH are discussed in more detail below.

5.1.1 *Population increases*

The steadily increasing global population is responsible for a range of complex social and environmental changes. For example, the world has witnessed the global expansion of towns and cities as rural populations move into urban areas in search of work, health services, education and basic services. Moreover, as some urban industries have developed, others have collapsed, changing the urban structure and cohesion. The consequent movements of people and animals form new settlements and ecological niches with unprecedented features. In developing countries subsistence farming and animal husbandry have evolved in cities as a result of these changes.

5.1.2 *New technologies*

Many new technologies have been applied to animal husbandry and the food industry, and these have led to the intensification of farming systems. However, the introduction of new technologies carries increased microbiological and toxicological risks, as well as problems related to animal welfare. New technologies can also bring about profound changes in farming practices, which in turn mean that farmers need to acquire new knowledge about animal well-being and health, and to provide appropriate training for their workers. Training may be needed, for example, in the proper use of animal drugs, because of their potential impact on human health, and because of the risk of development of antimicrobial-resistant microorganisms.

The intensification of farming has also led to other problems. While food production and quality may be increased, the introduction of new technologies reduces the demand for labour. Rural populations and services decline as younger workers move away to urban centres in search of work. Further pressures for rural depopulation can come from price controls on farm production and other market restrictions that make agriculture unprofitable for small- and medium-sized farms. Moreover, farmers from such farms cannot generate the economies of scale of those from large farms, and unless they can find a profitable niche in the market, they are unable to make a living. In such cases, they become impoverished and are unable to afford medical and veterinary services, and this provides the potential for chronic ill-health in both humans and livestock.

Large-volume, high-density livestock rearing systems also generate huge quantities of wastes and pollutants. These represent short- and long-term risks to animal and human health, as well as to the environment. Such risks can be extreme in poor countries. Too often the procedures to handle waste materials merely transfer them from one place to another, without any biological or chemical pretreatment. Consequently, research in waste management and health maintenance is urgently needed in order to develop suitable methods for dealing with waste materials, and farmers need to be informed about the risks involved.

5.1.3 *Climatic changes*

Projected climatic changes are expected to increase the risks of vector-borne and other diseases in humans and animals, such as malaria and cold-water vibriosis in fish. Many of the potential impacts of climatic change will take years or even decades to become obvious. Consequently, there is a need for greater integration of data-collecting efforts by all concerned. Much of the burden of global climatic change will fall on developing countries with few monitoring capabilities. Simultaneously, a danger exists that monitoring will focus disproportionately on the problems affecting developed countries with advanced technologies. Thus, a partnership is needed between developed and developing countries to devise cost-effective methods to mitigate the effects of climatic change.

5.1.4 *Globalization of trade*

Globalization of trade has facilitated the spread of foodborne infections and diseases, such as BSE in cattle. Accordingly, food and livestock feed need to be closely monitored during production, as well as during handling, processing and distribution. It is not enough to blame outbreaks on conditions during production if product control at later stages is substandard. Similarly, the whole chain of responsibility must be transparent from beginning to end. Leadership is needed to achieve this, because a disease outbreak in one country cannot be seen as merely a local disaster; it must be perceived as a global problem. No country is sufficiently isolated or protected to ensure that the population — human and animal — is safe. It is vital for the control and maintenance of health to have "forward defences" to prevent and control foodborne infections and diseases. This process demands an international partnership capable of guaranteeing food quality and food safety programmes that are integrated with strategies for public health and sanitary control.

5.1.5 *HIV/AIDS epidemic*

The HIV/AIDS epidemic has also caused an additional challenge to VPH service delivery in developing countries. More than 90% of the estimated 36 million people living with HIV/AIDS live in developing countries. The impact of the epidemic in these countries has been greatest in rural areas and has spread to remote villages, where it has impaired food production, including animal husbandry (*3*). AIDS, therefore, undermines the agricultural system of developing countries, affecting food security of families in rural areas, and threatens the sustainability of the already weak delivery of VPH to those areas.

One of the major challenges for the Study Group was to propose measures that would ensure a wider understanding of the concepts of VPH. This would require a major cultural change among health professions, especially veterinarians, many of whom have little or no background in public health. Ultimately, these changes will have to be achieved by modifying curricula at both the professional and the postgraduate levels.

In a period of reductions in government veterinary staff and growing demand for services, the questions to be answered are: how can current and future functions of VPH services be fulfilled, and what kind of delivery systems will have to be designed? The concept of "multifocal leadership" combines multidisciplinary technical collaboration with cooperation within and between different sectors, and recognizes the fact that leadership should be shared to achieve common objectives. Success or failure will ultimately depend on the ability to translate these concepts into practice.

5.2 The implications for VPH of increasing national and international trade in animals and animal products

The Office of the United States Trade Representative, for example, has estimated that international trade in food has increased fivefold since the signing of the General Agreement on Tariffs and Trade in 1947. In the years following this agreement virtually the entire industrialized world has been able to obtain, on a year-round basis, foods formerly thought of as seasonal. The creation of the World Trade Organization in 1995 resulted in significantly increased trade in food of animal origin and live animals between different countries. Regional trading blocs, modelled in some cases on the North American Free Trade Agreement, are further intensifying food trade between nations.

The emergence and re-emergence of zoonotic diseases may be the consequence of the new patterns in food trade or, in some cases,

increased awareness and surveillance. Enterohaemorrhagic *Escherichia coli*, for example, was confined to North America until the mid-1990s, but is now found throughout the world. *Salmonella enteritidis* and the multidrug-resistant form of *Salmonella typhimurium* (DT 104) via eggs have likewise spread widely since they were first detected in the United Kingdom. BSE has also spread rapidly from the United Kingdom to a number of countries since the 1980s and now threatens to become endemic in certain European countries.

Further examples of the potential dangers of the new patterns in food trade can be found in the pig industry. In 1997, the pig industry in Taiwan, China, was virtually ruined by foot-and-mouth disease. This was the first outbreak there since 1930 and the implicated viral strain was closely related to strains found in Hong Kong Special Administrative Region of China (Hong Kong SAR) and the Philippines. Classic swine fever cost the pig industry in Germany US$ 1000 million in 1995 and caused additional problems in Belgium and the Netherlands; African swine fever infected Portugal and Spain in 1993 and 1994, respectively.

Other examples include porcine reproductive and respiratory syndrome, which spread throughout Europe in the early 1990s and even Canada, Mexico and the USA. Similarly, cold-water vibriosis was confined to fish off the Norwegian island of Hitra for some years, but in 1993 it spread to Atlantic salmon in Canada and the USA. New Zealand, although relatively isolated, has seen the introduction of new diseases, including infectious bursal disease in chickens and rabbit calicivirus in the 1990s. In one of the more dramatic developments, *Cyclospora cayetenensis*, a coccidium usually found in migrating birds, contaminated raspberries in Central America and caused a widespread outbreak of human disease in the USA.

Notwithstanding the potential animal and human health problems, enhanced international trade in food and live animals has been, and will continue to be, of positive benefit to importing and exporting countries (*4*). Among these benefits are an improved national nutritional status, major economic advantages including job creation, and improved diplomatic relations between the countries concerned. Nonetheless, increased trade necessitates new and different approaches to food safety and to the control of exotic and zoonotic animal diseases. The goals of these approaches should be to prevent livestock infection and food contamination in the exporting country. These goals could be accomplished through food safety assurance programmes, such as those based on HACCP or developed by the International Organization for Standardization. However, reliance on

testing and other forms of inspection, by either the exporting or the importing country or both, is likely to be inadequate. What is required is an effective control programme in the exporting nation.

Issues involving the international transport of live animals should be debated at the Office International des Epizooties (OIE), which is also the official reference point of the World Trade Organization for trade disputes involving animals.

The Codex Alimentarius Commission is the official reference point of the World Trade Organization for trade disputes involving food. The Codex Committee on Food Import and Export Inspection and Certification Systems is doing a great deal to achieve international consensus in this area. Among the disparate concepts that must be reconciled are the specific roles of the exporting and importing countries. Emerging trading norms give the importing country the right to demand certain specifications as long as these are not, in fact, trade barriers. The exporting nation, on the other hand, is increasingly placed in the position of a trusted supplier who is expected to behave ethically and to take all the measures necessary to prevent food contamination. However, since it is scientifically impossible for the importing country to inspect or test the safety of all foodstuffs, only the country of origin can make a significant contribution to food safety. This can be done only by strict application of HACCP by the exporting country, which should also improve local food safety standards. The importing country, for its part, should maintain a limited inspection and sampling programme, so as to be vigilant against accidental or intentional contamination. It should also have the legal authority to block trade with any country incapable of assuring the safety of its food products.

5.3 Surveillance and control of emerging and re-emerging diseases and the challenge for VPH

In the years following the Second World War, it was widely believed that humans were winning the centuries-long war against infectious pathogenic microorganisms, particularly in developed countries. Coupled with earlier improvements in urban sanitation and water quality, vaccines and antimicrobials dramatically lowered the incidence of infectious diseases. As early as the 1950s, however, penicillin began to lose its ability to cure *Staphylococcus aureus* infections. In the 1970s, several new diseases were identified, including Legionnaire disease, Lyme disease, Ebola haemorrhagic fever and enterohaemorrhagic *Escherichia coli* O157:H7 infection. In the 1980s, as public health support for infectious disease surveillance was declining (*5*), HIV/AIDS spread rapidly worldwide.

By the early 1990s, health experts no longer reported that the threat of infectious diseases was decreasing in the developed world. Growing concern about the threat of emerging infectious diseases was expressed in a 1992 report issued by the Institute of Medicine of the National Academy of Sciences in the USA. The report emphasized the links between international health and the health of the population in the United States and described the major factors contributing to the emergence of infectious diseases, including societal changes and the ability of microbes to evolve and adapt (*6*). The report concluded that emerging and re-emerging infectious diseases represent a major threat to public health and that the significance of zoonoses could not be overstated. The United States government was challenged to take urgent action.

In 1994, the Centers for Disease Control and Prevention launched a national effort to revitalize the capacity to protect the public from infectious diseases (*7*). In 1998, the Centers for Disease Control and Prevention published the second phase of its strategy to address emerging infectious diseases. The plan outlined a long-term commitment and sustained effort to combat infectious diseases (*8*).

Such concerns were also shared by the international public health community. In 1995, the Forty-eighth World Health Assembly adopted resolution WHA48.13 (*9*), calling for renewed efforts to strengthen national and global surveillance of infectious diseases, including those due to antimicrobial-resistant microorganisms. As a result, a new department that included a team of VPH officers with expertise in the areas of zoonoses, foodborne disease surveillance and control, and other related subjects (*10*) was established at WHO Headquarters in Geneva (see Annex 1). WHO has subsequently further strengthened its commitment to surveillance and control of infectious diseases (*11*).

Emerging infectious diseases, as defined by the 1992 Institute of Medicine report (*6*), include diseases whose incidence in humans has increased within the past two decades, or threatens to increase in the near future. Several modern demographic and environmental conditions have been recognized as favouring the spread of infectious diseases, including globalization of the food supply, widespread use of antimicrobial agents in humans and animals, and increased human contact with animals. VPH provides particular expertise and influence in addressing three issues concerned with infectious diseases: (i) foodborne and waterborne diseases of zoonotic origin; (ii) antimicrobial resistance; and (iii) vector-borne and other zoonotic diseases. These issues are discussed below.

5.3.1 *Foodborne and waterborne diseases of zoonotic origin*

Each year millions of people are affected by foodborne and waterborne diseases and thousands die, especially children in developing countries. Improper methods of food production, storage, handling and preparation have resulted in many recognized international outbreaks. Food animals are the reservoir for many emerging and important foodborne diseases, including those caused by *Escherichia coli* O157:H7, non-typhoidal *Salmonella* spp., *Campylobacter* spp. and *Yersinia* spp. VPH leadership is essential to respond to the threat posed by these diseases, particularly in the development of sustainable, integrated safety measures for the reduction of health risks along the entire food chain, from the point of primary production to the consumer (i.e. the "farm-to-table" approach).

5.3.2 *Antimicrobial resistance*

Antimicrobial drugs have undoubtedly saved the lives of millions of people. However, the widespread use of such drugs in hospitals, health centres, the community and agriculture has led to the emergence of resistance among bacteria (*12*). Antimicrobials are commonly used in food producing animals for treatment, prophylaxis and growth promotion. However, such use can also lead to the development of drug-resistant bacteria, which may be transmitted to humans through the food supply. VPH leadership is therefore essential to evaluate and respond to the human health consequences of using antimicrobials in food producing animals.

5.3.3 *Vector-borne and other zoonotic diseases*

Numerous emerging and re-emerging diseases are directly transmissible from animals to humans; in some cases, the animals act as intermediate or accidental hosts, while in others transmission occurs via arthropod vectors. Animal-borne pathogens are important, not only because of the diseases they cause, but also because new human diseases can arise from unsuspected animal reservoirs. For example, pandemic strains of influenza can emerge from reservoirs in birds or pigs and it is widely believed that HIV evolved from a virus carried by non-human primates. Environmental and ecological changes can also have profound effects on the rate of appearance of vector-borne and zoonotic diseases. VPH programmes need to emphasize the importance of prevention of such diseases by highlighting their economic and health consequences.

5.3.4 *The role of veterinarians and other VPH professionals*

VPH expertise is an essential component of the public health response to emerging and re-emerging infectious diseases. Veterinarians

and other VPH professionals, however, have more to offer to the public health response than expertise in traditional surveillance and control of zoonoses. In many health departments, communicable disease activities do not include or have access to VPH expertise. Complete integration of VPH into the full range of communicable disease control activities will result in a broader perspective for responding to emerging and re-emerging infectious disease issues. For example, the involvement of VPH professionals in investigations of outbreaks of foodborne diseases would provide additional expertise for addressing public health concerns at the source of such outbreaks.

Public health surveillance is the ongoing and systematic collection, analysis and dissemination of health data. Disease reporting from clinical and veterinary diagnostic laboratories is a critical element in public health surveillance. VPH professionals are essential partners, together with other public health officials, and agricultural and diagnostic laboratory staff. VPH staff are needed to develop and enhance surveillance of outbreaks of emerging and re-emerging diseases, and to monitor changes in the incidence and geographical distribution of these diseases.

Controlling and preventing emerging infectious diseases is a multidisciplinary and multifaceted endeavour. It requires the skill and expertise of many health care providers, including VPH professionals. VPH leadership is particularly needed to develop and implement guidelines for the diagnosis and prevention of zoonotic diseases.

Including VPH expertise in the response to emerging infectious diseases will improve the ability to detect, control and prevent them. The VPH component is essential for the public health infrastructure to be adequately prepared to respond to known and unexpected disease problems, regardless of whether they are caused naturally, accidentally or intentionally.

5.4 The implications of structural adjustment programmes, economies in transition and privatization of veterinary services for VPH

During the past decade consumers have become increasingly aware of food safety issues, and this has resulted in a new focus on government guarantees to consumers and trade partners in agricultural products. However, the reaction by governments in response to these demands has varied considerably.

5.4.1 *The implications of structural adjustment programmes for VPH*

In countries such as Canada, New Zealand, the United Kingdom and the USA, structural changes in service delivery have consolidated the

multiple legislative and functional activities related to food safety. The changing environment appears to have polarized VPH involvement into either meeting or compromising on national or international demands. Most of the structural changes give practical meaning to the "farm-to-table" approach, and recognize the multidisciplinary nature of VPH service delivery at a national level. However, it is still too early to determine whether these changes will be able to serve both national and international demands. Even more important is whether these changes will enhance VPH service delivery and support the concepts and purpose of VPH as an interdisciplinary approach, as outlined in several WHO and other publications (*13–17*).

Many of these structural adjustments attempt to resolve past arguments about the ideal placement of a VPH unit within government services by grouping related responsibilities under one controlling body. In many of these structural models, services to nongovernmental organizations are outsourced, with government assuming an auditing and monitoring function to ensure uniform standards of service delivery. Recognition has also been given to newer technologies and advancements in food and related technologies and to control strategies such as HACCP and risk management. As a result, the focus has been on functional control (i.e. control of production, processing and distribution) rather than on different food commodities per se.

In developing countries, economic, social and cultural constraints and perceptions may present obstacles to the establishment of a hygiene culture and a commitment to VPH. As a result, the delivery of VPH services in developing countries in particular calls for an interdisciplinary approach.

5.4.2 *The implications of privatization for VPH*

Privatization is defined as the transfer of ownership from the public to the private sector, especially where service delivery by the state is less cost-effective. Delivery of VPH services by individuals or private agencies is well established in most developed countries, but it would be wrong to assume that privatization can be applied with equal success to developing countries. The stage at which a particular function or service is identified for privatization is critical and privatization should only be considered if:

- The state can afford the risk of withdrawing from any further involvement in the function or service.
- The legislative objectives set by the state (e.g. the control or eradication of a zoonotic disease) are not compromised.

- Privatization of a service or function would ensure the same (or a better) service.
- Privatization can be done without additional regulatory controls and with the absolute minimum of financial support from the state.

5.4.3 *The implications of economies in transition for VPH*

Countries in the process of economic transition pose an unique challenge to VPH, especially when the transition takes place in a dualistic economic structure in which the traditional agricultural sector remains stagnant in favour of a fast-developing industrial sector. The most common concern is the effects of urbanization on the delivery of, or need for, VPH services. People moving towards urban areas bring with them their animals, their traditional practices and their cultural preferences, all of which pose inherent health risks (e.g. zoonoses, waste disposal, food contamination) to the urban population. These risks are especially great when developed and developing country cultures exist side by side, each with its own established VPH culture. The end result is often a compromise between two different cultures, to the detriment of VPH service delivery.

5.5 The need for basic and applied research to meet the new challenges of VPH

VPH research is often handicapped by a lack of basic knowledge of host–parasite interactions and for many zoonotic species even the route of transmission to humans remains uncertain. For vector-borne diseases, the biology of the vector–host interaction is also of fundamental importance, yet this often remains poorly understood. Typically, the molecular biology of host–parasite interactions is even less well understood and identifying the molecular mechanisms underlying immunosuppression, antigenicity, attachment and virulence remain priorities for basic research. In some cases, the molecular biology of the agents in human and animal hosts may be very different. For example, there is now a major research effort directed at identifying virulence factors for *Escherichia coli* O157:H7, and the reasons for their differential expression in humans and cattle.

Recent advances in molecular biology have been crucial to improving understanding of the links between animal and human diseases. Several different techniques have been applied, including enzyme electrophoresis, DNA probes, random amplification polymorphic DNA-polymerase chain reaction, restriction fragment length polymorphism, amplified fragment length polymorphism and DNA

sequencing. These techniques have been used to trace the origins (both epidemiological and evolutionary) of many infectious agents such as those responsible for African trypanosomiasis (human sleeping sickness), *E. coli* O157:H7, infections and rabies, and HIV.

Clearly, molecular genetic methods will become more rapid, easier and less expensive over the next few years. These technical advances are unlikely to be driven by VPH research, but they will undoubtedly be extremely useful for that research. The most likely limitation lies not with the methods themselves, but with the analysis of the data they generate. There is considerable research interest in developing and improving methods for the analysis and interpretation of molecular genetic data (bioinformatics), which will be extremely valuable for VPH research.

Several recent events have highlighted the need for improved epidemiological understanding of diseases of actual or potential significance for VPH. Examples include the increasing number of outbreaks of *E. coli* O157:H7 infection and the epidemics of novel diseases such as BSE in cattle, other animal-transmissible spongiform encephalopathies and vCJD in humans. The first requirements for undertaking epidemiological studies of such diseases are accurate diagnosis and timely surveillance. In this regard, immunological and molecular biological methods are essential for the development of diagnostic tools.

Surveillance involves not just the mechanics of designing the actual programmes, but also training VPH personnel and obtaining the cooperation of the farming community and the public. In many cases these programmes are proving difficult to implement, such as the programme aimed at controlling scrapie in sheep in Europe. Disease surveillance programmes are now frequently supported by geographical information systems (GIS). Such systems will become increasingly useful for surveillance and other VPH research as satellite data become more accessible and data handling methods more refined. In particular, GIS can track changing land-use patterns (e.g. clearance of forests or irrigation) associated with changing distributions of infectious diseases.

The preliminary establishment of a causal link between human and animal disease relies on the identification of risk factors, usually by case–control studies. These may be supported by the molecular studies described above. However, although risk analysis has become a standard tool, it can only be used where there is sufficient epidemiological information. There are two additional possibilities for strengthening confidence in causation. The first is mathematical theory, which can be used to develop testable hypotheses for field

studies or for the results of interventions. Although the literature on the mathematical theory of epidemics and endemic diseases is very extensive, relatively little attention has been paid to zoonoses. A second possibility for establishing causation is experimental epidemiology, which may involve either field or laboratory research. Examples in the field include: recent plans to study the impact of badger culling on bovine tuberculosis in the United Kingdom, to test the hypothesis that transmission is from badgers to cattle; and ongoing studies to look at the impact of dog vaccination on the incidence of rabies in humans and wildlife in the United Republic of Tanzania to test the hypothesis that domestic dogs are the main reservoir of infection.

Animal vaccines exist for several important zoonoses: brucellosis, Rift Valley fever and leptospirosis, and there is ongoing research into many others, including the causative agent of bovine tuberculosis, *Mycobacterium bovis*. However, there are few human vaccines for zoonoses that have been approved for marketing by regulatory bodies such as the European Agency for the Evaluation of Medicinal Products in the European Union or the Food and Drug Administration in the USA. In a number of countries, most of the human vaccines for zoonoses that are employed (e.g. against anthrax and brucellosis) would not meet the national requirements set for vaccine registration or their potential national and international markets would not justify the costs of registration. New approaches to vaccination, such as those using vaccines developed in cell culture, have so far tended to focus on non-zoonotic pathogens. Although some research into the development of new antimicrobial and anthelminthic drugs continues, it is increasingly difficult to finance and more emphasis is now given to research into the consequences of drug use, the development of drug resistance, and the optimal design of treatment and prophylaxis protocols.

There is increasing concern over the development of antimicrobial resistance in zoonotic microorganisms, an example being the multidrug-resistant *Salmonella typhimurium* DT 104. More basic research is urgently needed into factors that promote the development of drug resistance, the mechanisms by which genetic elements conveying drug resistance spread, and the epidemiological relationships between drug resistance in animal and human populations. Applied research is needed into alternative means of control of zoonotic diseases (such as probiotics or changes in husbandry practices), the short- and long-term consequences of reduced use of antimicrobials in animals (especially for prophylaxis and growth promotion), and the potential use of drug combinations for overcoming resistance.

Mathematical modelling may also be a useful aid in the design of control programmes. The advantage of models is that they can be used to explore a far wider range of epidemiological and control scenarios than could ever be studied in the field. This approach has proved extremely successful for the control of human diseases, notably in the design of measles vaccination programmes, and has recently been used to guide decision-making in the eradication of BSE from cattle in the United Kingdom.

An important component of a control programme is economics, in the form of cost–benefit or cost-effectiveness analyses. Again, these approaches have not been widely applied at the interface between animal and human diseases. In addition, there is a lack of reliable information on the burden of many zoonotic diseases. Complicating matters is the fact that public attitudes to VPH issues are often complex. For example, it is often claimed that farmers are more willing to invest in animal than in human health. However, sociological cost–benefit research may be helpful in addressing these and similar issues.

There is a clear need for integrated, multidisciplinary research programmes involving collaboration between microbiologists, parasitologists, immunologists, molecular biologists, clinicians, epidemiologists, statisticians, economists, sociologists and veterinarians. Often such research will involve several different institutions and will require long-term effort and funding. This type of programme is becoming increasingly common and will be further encouraged by funding agencies moving away from supporting isolated, short-term research projects. It is also important that research activities maintain a truly international perspective: there are many profound differences in VPH problems between developing and developed regions of the world, and the former should not be neglected in favour of the latter.

5.6 Approaches to VPH and its evolution

VPH is an essential part of public health and includes various types of cooperation between the disciplines that link the health triad, people–animals–environment, and all of its interactions. Examples of subjects related to this triad include zoonoses, chemical residues, animal production systems, nature conservation, wildlife and water pollution. To better understand the local and regional differences involved in implementing VPH in different geographical areas, it is proposed to classify countries and regions into three stages of socioeconomic development.

Stage 1

Stage 1 is characterized by virtually no organized agricultural society, very basic actions against animal diseases, and little systematic governmental support for improving livestock and the production of food of animal origin. Because national income is directly linked to production, countries and regions at this stage are among the poorest in the world. The low productivity also leads to malnutrition and a lower physical ability to produce food, further undermining the ability of these countries to feed their own populations. In countries and regions at this stage, the major role of VPH almost completely overlaps with that of basic veterinary medicine (i.e. taking care of primary needs at the local level, such as animal power for transportation and traction, food production and the control of animal diseases).

Stage 2

Stage 2 is characterized by some wealth and the existence of legislation for public health and control of animal diseases. Inspection, condemnation and rendering of meat are well organized, at least on paper. However, modern quality assurance systems based on good manufacturing practices (GMP), HACCP or good veterinary practices do not exist. VPH is thus largely involved in meat and food inspection and in programmes for controlling some zoonoses. There is an emphasis on prevention of human diseases, rather than on programmes to eradicate zoonoses, and the diagnostic skills of veterinarians form the basis of the VPH system. The more advanced systems involve veterinarians in food hygiene in areas such as fish, vegetables and retail markets. Although there is some discussion of environmental pollution, animal welfare and the health risks associated with companion animals, in most cases these are considered as merely a formality in the work of VPH veterinarians.

Stage 3

Stage 3 is characterized by a relatively affluent life style, highly organized agricultural production systems, and industrialized meat and milk production. Large production animal units are often kept indoors with controlled feed, water, waste disposal, quarantine procedures for imported animals, and quality assurance systems based on HACCP or good veterinary practices. Records are kept on all critical control points and the responsibility for animals, products or disposals is at the production level. Governmental control consists primarily of monitoring the herd or flock and the actual production system, rather than inspection of individual animals.

It is clear that success in broadening VPH activities in a region or country will be largely dependent on its stage of development, and that VPH will evolve as the country or region moves from one stage to another. It should be kept in mind that many developed countries are still at stage 2. In developed countries, VPH has evolved into preventive medicine, supported by use of epidemiological tools and risk analysis. Whenever possible, VPH policy decisions should be based on actual health and production data. Furthermore, since consumers demand that products be of high quality and safe, and that they be produced with due consideration for animal welfare and protection of the environment, part of the duties of VPH professionals are to ensure that such demands are met and to act as public health advisers.

An important aspect of the development of VPH services concerns urbanization, where large populations of humans live in close contact with animals in rapidly growing cities. In poorer urban centres, VPH may involve control programmes against specific zoonoses and animal-related injuries (e.g. dog bites), as well as dog population management. In wealthy areas, by contrast, VPH may be more concerned with pollution of public parks and playgrounds, and responsible pet ownership. Increasingly, people report being affected by allergies, which may be related to companion or synanthropic animals, and to pests or vectors such as dust mites, ticks, fleas, etc. Local, county or municipal health centres in largely urbanized areas often employ their own VPH staff.

5.6.1 *Challenges for effective implementation of VPH*

The primary challenge for effective implementation of VPH should be the establishment of an effective VPH system, with staff well trained in the broad areas of public health and preventive medicine, and well integrated in the public health team. Unfortunately, in many parts of the world VPH staff, mainly veterinarians, are focusing efforts on clinical or meat inspection work. A further challenge is to address the lack of VPH staff in key policy-making positions. Training in management and communication skills should receive much more attention in VPH education programmes. An additional challenge is to supply trained VPH staff to keep pace with new developments in society. Public health is directly related to changes in our society, and may be affected by, for example, the introduction of novel food products of animal origin, changing production systems, and changes in sources of animal protein, such as game farming and aquaculture.

In addition, it should be noted that some environmentalists promote sustainable agriculture, or a return to natural production systems, and

are opposed to modern production methods. Any proposed de-urbanization or "return to nature" should thus be carefully scrutinized by VPH experts and documented by a study on the potential health effects before policy-makers reach a final conclusion, as such practices could lead to a return of zoonoses to areas where they used to be under reasonable control.

Within this framework, VPH officers should also contribute to public or political discussions on international trade and provide objective, evidence-based information. Too often an assumed public health threat is misused to guard economic markets, while the real health problems that affect many of the world's population are neglected.

6. Organization and management of VPH services and programmes

6.1 Organizational and managerial requirements for applying VPH programmes at the international level

VPH does not fit a single organizational template and its functions, activities and resources are dispersed throughout various agencies and sectors such as agriculture, health and the environment. A VPH programme may act as a focal point with liaison functions, or it may have extensive operational responsibilities for providing technical cooperation to national programmes. Organizational requirements at the international level include global and regional coordination units, country and intercountry advisers, and specialized reference centres.

One of the central roles of a VPH programme is to serve as a catalyst for intersectoral action, especially between agriculture and the health sectors, where functions and resources related to food production and the control of zoonoses exist, but are often dispersed or separate. An effective institutional programme must be established at the highest political level to coordinate and oversee intersectoral collaboration. An example of such a programme is the Inter-American Meeting, at the Ministerial Level, on Animal Health (RIMSA), which is convened by the Pan American Health Organization, with the participation of representatives from the Ministries of Health and Agriculture of the countries in the WHO Region of the Americas. FAO, OIE and WHO routinely collaborate on VPH subjects of common interest. However, stronger political commitment by Member States is needed to make this collaboration more effective.

The management of VPH programmes at the international level requires:

— skills for organizational leadership and vision;
— the ability to mobilize resources, disseminate information and promote intercountry cooperation;
— the skills to administer available technology and to integrate it with national programmes;
— the ability to articulate VPH issues effectively to politicians and policy-makers, to the scientific and technical community, and to the population in general;
— knowledge and understanding of sociocultural issues, particularly those relating to prevention of zoonotic diseases, including and food hygiene practices.

6.2 Organizational and managerial requirements for applying VPH programmes at national and subnational levels

There is debate about the most appropriate location for a VPH coordinating entity within the administrative structure of individual countries. Possible placements include the Ministry of Agriculture or Health, the latter, such as in the case with Italy, being the exception rather than the rule (*18*). Regardless of where the VPH functions are located, it is recommended that administrations such as health, consumer protection, agriculture and the environment, pay sufficient attention to cooperation in zoonoses control and food hygiene. Arrangements should be made to establish efficient coordination and collaboration when different administrations are involved in VPH programmes.

VPH has a fundamental role within the scope of primary health care. Attainment of optimum human health in any country calls for sustainable relationships between humans, animals and the environment. Crucial activities of VPH in formulating programmes aimed at solving animal-related problems include the following:

- Assessing public health needs related to zoonoses, general animal health and welfare, hygiene of food of animal origin, and animal production.
- Determining strategies for combining VPH with techniques aimed at improving animal health, with special reference to pharmacological issues, such as control of veterinary drug residues and antimicrobial drug resistance.
- Identifying the needs and availability of technical and other resources, analysing managerial problems related to planning, administration and regulations, and identifying and mobilizing resources from different sectors.
- Encouraging community involvement and intersectoral action.

- Analysing and developing educational activities.
- Monitoring and evaluating the effects of animal health and the safety of products of animal origin.

VPH programmes may be formulated as long-term objectives on an international basis with the active participation of international organizations concerned with animal and/or human health, such as FAO, OIE and WHO, which are charged with providing technical advice and assistance to Member States, especially developing countries. National VPH programmes should be developed with clear prioritization of objectives, which may include control of animal diseases, including zoonoses, food hygiene, environmental protection, and assistance in the management of emergencies. Local programmes should be developed and adapted to specific circumstances. Individual areas with similar features may be chosen to implement pilot programmes that simulate more general strategies, and the results may be taken as mutually comparable models for future action. Follow-up of these pilot programmes is essential and the results should be evaluated on a regular basis.

At any level of planning and implementation, VPH programmes need effective management to ensure that the best use of resources to achieve social goals (*18*, *19*).

6.3 Intersectoral collaboration and liaison

VPH aims to protect human health, animals and the environment from risks that are rapidly evolving as a result of the dramatic changes that are outlined in section 4. Work in such a complex area requires strong intersectoral cooperation, resource mobilization and community participation. In ensuring food quality and safety, for example, VPH must focus on integrating health professions, and food chain and environmental partners, in a single system. Within VPH, close liaison must exist between veterinarians, medical and other health professionals, including epidemiologists, occupational health workers, food technologists, specialists in environmental control and laboratory personnel.

In view of the emphasis now being placed on developing an integrated "farm-to-table" approach to food safety, the pivotal role of VPH must be recognized. Animal production, animal health and welfare and food safety are closely linked, and a leading role for VPH is essential to ensure that the necessary integration is achieved. VPH professionals need strong scientific and technical competence in the prevention and control of zoonotic and foodborne diseases, as well as skills in the management of natural and man-made disasters. To achieve the

improvements in the administration and functioning of VPH that are required to face new challenges, VPH staff will need to be familiar with the principles of epidemiology, management, economics, sociology, information technology and risk assessment, as well as with the relevant aspects of public policy, legal concepts and other disciplines of the medical and social sciences.

6.4 The roles and needs of national and international collaborating and reference centres

Some of the tasks and functions of collaborating and reference centres may include:

- Providing services such as diagnosis, identification and typing of pathogenic agents.
- Contributing to epidemiological investigations of diseases in the field.
- Providing biological materials, such as vaccines, sera, antigens, DNA probes for polymerase chain reactions and reference stains.
- Collecting, analysing and documenting health information.
- Maintaining culture collections.
- Training, advising, consulting, reporting, organizing meetings and symposiums, quality control and research.
- Contributing to the development of measures to prevent or control human and animal diseases of public health importance.

To serve VPH and address relevant problems, collaborating and reference centres should overcome constraints and focus on the appropriate goals. In recent decades, the decreasing attention paid by governments and development agencies to infectious diseases has led to the closure of some collaborating and reference centres, or a drastic reduction in their functions, through lack of funding. To sustain their activities, collaborating and reference centres need a solid base of ongoing financial support.

Support from FAO, OIE, WHO and other international or national agencies might help collaborating and reference centres to attract funding; alternatively, they could form consortiums or partnerships with other centres, to develop a problem-orientated approach that might have greater appeal compared to individual disease-orientated approaches. Centres should also team up with other health and science professionals, including those responsible for the health of domestic and wild animals.

As public health authorities and the general public show renewed interest in infectious diseases, especially emerging zoonoses, many centres are now working beyond their capacity. This trend has been

reinforced by an increasing demand from developing countries for health care. The problem of an excessive workload could be met by setting up national or regional networks of satellite centres. These satellite centres could have a mission more modest than those of the official international reference and collaborating centres which concentrate on highly specialized tasks.

Many collaborating and reference centres are situated in developed countries with a temperate climate, yet most zoonoses occur primarily in developing countries with warm climates. Furthermore, costs for services provided by these centres might be too high for developing countries. For example, the costs of transporting potentially pathogenic material according to the International Civil Aviation Organization/International Air Transport Association regulations is almost prohibitively expensive for developing countries. This problem could be solved in part by transferring skills and knowledge to developing countries, and by setting up networks of national and regional reference centres to meet local needs at lower costs.

Most outbreaks of zoonotic disease occur in tropical countries, often far from sophisticated health care services, and reliable data on their distribution, incidence, morbidity and mortality are lacking. This is at least partly due to the lack of appropriate diagnostic tools, that are simple and stable and offer rapid and reliable results at an affordable cost. Collaborating and reference centres usually offer services in diagnosis and detection of pathogenic agents, which are basic requirements for prevention and control. However, many problems remain, such as how to set priorities in health care when the extent of a zoonotic disease is not known, or how to attract funding from public health authorities and industry when basic data are lacking or unreliable.

Collaborating centres and their networks can play a key role if they are able to develop appropriate diagnostic tools and make them available to developing countries to estimate the extent of zoonotic diseases. However, research proposals on new diagnostic tools are often not attractive to funding sources, particularly in academic settings. In addition, because of the lack of awareness of issues relevant to developing countries, the research work carried out in laboratories in developed countries may not help to solve the priority problems of developing countries.

6.5 Recent advances in information technology and VPH

Recent advances in information technology mean that large volumes of information are available essentially instantaneously. It is not yet

clear how these advances will impact on public health, and particularly VPH, but they have provided an extraordinary array of new opportunities. In general, the emerging information technologies all have a combination of high fixed costs (the one-time costs of writing articles for electronic publication, developing web sites and building datasets, etc.) and low marginal costs (the costs per person of reading an electronic article or accessing a web site). In addition, the greater the number of users that read information made available electronically, the more widespread it becomes, which in turn increases the number of users accessing such information.

One of the major obstacles to developing and delivering better health care in developing countries is the limited ability of their health professionals (medical and veterinary) to consult with colleagues and specialists, to track patients and populations through databases, to share and collaborate on research, and to monitor infectious and emerging diseases. Moreover, the ability to change these obstacles is often blocked by problems related to the existing infrastructure, such as a lack of telephone lines, limited and unreliable electric supplies, an absence of trained staff to maintain the necessary technology, and the prohibitive costs of communication. Technical solutions exist, but are often not applied because of problems related to financing, implementation, upgrading and development, access and sustainability.

While computer memory size and processing times are no longer constraints, and prices have fallen, there are technical limitations, such as global accessibility, massive data storage, and transmission band width, availability and cost. However, over the next 20 years it is likely that these and other technical limitations will cease to exist, allowing many parts of the world to be in instant communication.

6.5.1 *Communication and dissemination of information*

Currently, risk perception and risk communication are rarely applied to the dissemination of information. Community stakeholders play a significant participatory role in risk resolution and therefore need to be appropriately informed in order to interpret such information objectively. This is not just a matter of principle but one of common sense, since most epidemiologists are likely to work for organizations that are stakeholders (e.g. the government or industry), but that are not valid proxies for the public. In this information age the public are likely to have almost as much information as the experts, though not always the knowledge to interpret it accurately. Therefore, ethical ways that foster credibility and trust must be found to share plans and findings with all relevant stakeholders.

The number of Internet web sites will continue to expand, providing ever more sources of reference information, and these will be increasingly graphic and multidimensional. Most academic departments, libraries and research institutes, as well as government agencies and private companies, have or will soon have their own web sites. The rapid sharing of information via the Internet has significant implications and advantages for the audience.

6.5.2 *Reporting systems*

Each country differs in its quality of reporting of diseases, irrespective of its level of economic development. The quality of reporting is influenced not only by the willingness of countries to report diseases, but also by their ability to diagnose those diseases. Government-funded diagnostic laboratories, whether provincial or federal, should actively investigate outbreaks of zoonotic diseases, whereas routine diagnostic services could be provided by private laboratories. In addition, there is an urgent need for real-time information on livestock movements, both nationally and between countries, in order to understand better the spatial implications of diseases for their control.

ProMED-mail (*20*) is one example of an unofficial early global warning system for reporting emerging diseases in humans, animals and plants, and disease activities that might indicate the use of biological warfare agents. Since 1994, membership of ProMED-mail has grown from 40 to over 20000 in more than 160 countries. Although it has been criticized as unreliable, ProMED-mail is considered an indispensable news medium by health experts worldwide. It is independent and is therefore able to resist the desire of some governments to cover up health problems or be purposely slow in reporting them. Thus, similar sources of informed information can be expected, as well as the expansion of existing information networks such as the WHO global outbreak network (*21*).

6.5.3 *Virtual databases*

Virtual databases are used by most large supermarket chains and manufacturing companies. However, such databases are rarely used by government services, or by international organizations or agencies. Instead of being centralized into headquarters or similarly designated "official" computers, databases should be set up so that they can be readily queried by all those needing information.

Some of the databases on zoonotic diseases are likely to be large and the use of multidimensional GIS concepts will be routine. There must be agreement on security (for both transmission and encryption, and

for read and write access), passwords and logging on, and access must be tightly controlled. Ultimately, such databases and related information sources should be transparent both within and between countries. There are many advantages in sharing databases; text, numerical data, images and multidimensional graphics (e.g. holographs) may be included. The software tools to find and assemble the data will have to be efficient; some will have predictive capabilities, or algorithm constructs, based on acquired profiles of individual users.

6.5.4 *Supercomputers*

One of the characteristics of GIS is the very large databases involved. Experience with risk-mapping of diseases has shown that each problem has its optimum set of data for resolution. However, because the necessary databases are so expensive to construct, there is an understandable tendency to make them multipurpose (i.e. to include as many diseases as possible, as well as administrative functions). Therefore, the potential exists over the next decade for such databases to become extremely large as existing datasets are merged. In such cases information may need to be extracted either by analysis of large datasets, or by serial analyses of relatively small datasets extracted from the master database. Whichever technique is used, it is likely that new computers with larger memories will be required to search, sort, analyse and display the data held in them.

6.5.5 *Quality of data and reporting*

All the potential data and its global availability is worthless if the quality and completeness of such data are not assured. The quality of data is paramount to improve health and control disease cost-effectively. Too often there are errors in the design of systems at the national level that minimize or delay reports, discourage data acquisition and generally facilitate the under-reporting of disease outbreaks and pathogenic microorganisms. At the same time large sums of money are being spent internationally and nationally to improve diagnostic laboratory skills and equipment. This is unlikely to be cost-effective unless similar improvements are made in the identification, diagnosis and investigation of outbreaks, and the infrastructure for reporting them, and unless VPH professionals are proactive rather than passive. There must be recognized standards relating to the quality of data, or at least public and international recognition of those countries with high-quality data.

While it would be naive to expect complete transparency in disease reporting by countries, the benefits of rapidly sharing accurate

information, within appropriate security bounds, need to be emphasized. One of the key characteristics of the information age is speed, and one of the best ways of controlling a situation and engendering trust is by providing information accurately and fast.

6.6 The need for risk analysis and human health indicators for VPH

Central to the mission of most VPH organizations and services is the need to assess and manage animal-related public health risks, and to communicate these risks to the parties concerned. These important activities are elements of risk analysis, a discipline that has emerged in recent years in response to an increased need to deal systematically and openly with risk issues. Many animal-related public health risks involve complex life-cycles or multiple routes of transmission from animals to humans through foods or other vehicles. This complexity often makes it unwise or impossible to use an intuitive approach in selecting optimal points of intervention for disease control, and for determining the implications or costs of various risk management options. The difficulty in making sound public health decisions in the face of complexity, uncertainty and varying scientific and public opinion makes a compelling case for a decision-making process that is open and based on scientific evidence, economic analysis and a consideration of societal values.

Risk analysis comprises risk assessment, risk management and risk communication; these terms are briefly defined below.

6.6.1 *Risk assessment*

Risk assessment typically comprises hazard identification, exposure assessment, dose–response assessment and risk characterization. Although these are the four essential components, the nomenclature is in a state of flux and variations are found. In general, risk assessment should be specific to each hazard (e.g. zoonotic agent, veterinary drug residue, foodborne contamination) and frequently must also be specific to the country, animal species or food commodity. In the context of VPH, risk assessment is the process of estimating the probability and impact of adverse health effects attributable to interactions between humans and animals. While quantitative estimates of risk are highly desirable, they are difficult to obtain owing to limitations in expertise, time, data and methodology. A strong research, investigative and surveillance infrastructure is needed to provide the information that underpins the risk assessment process.

Considerable progress has been achieved in assessing risks due to exposure to chemical hazards (e.g. veterinary drug residues), and recent advances in assessing risks from zoonotic diseases and microbial contamination of food show much promise for the future. In many instances, however, only qualitative assessments are possible because of a lack of understanding of the biology of the hazards concerned and exposure. To facilitate, review and enhance the credibility of risk estimates obtained using model structures, it is important to state the assumptions, data sources and uncertainties encountered at all stages of the process. While risk managers often place most emphasis on risk estimates, other outcomes of the risk assessment process may also be beneficial. These include the use of models to identify the potential effectiveness of risk management interventions and research needs. An explicit description of the chain of events leading from the introduction of a hazard into animals to the appearance of a disease in humans will also facilitate an understanding of the process that is modelled.

6.6.2 *Risk management*

Risk management seeks to identify various options for mitigating risk and for selecting the optimal course of action, after considering the benefits and costs, in consultation with interested parties in industry, the government and academia, as well as the general public. Risk management is typically the function of individuals or organizations entrusted with formulating and executing laws and regulations designed to protect public health, and of organizations responsible for the design and implementation of risk reduction programmes (e.g. meat inspection, rabies vaccination of wildlife, zoonoses control). Risk managers should use the outcome of risk assessment to establish priorities for allocating limited resources. Alternative strategies for managing risk should be formulated and, where possible, these should be subjected to cost–benefit analysis.

6.6.3 *Risk communication*

Risk communication is the process of consultation, discussion and review that seeks to enhance the validity, effectiveness and general acceptance of risk assessment and risk management. It should ensure that parties with a stake in the outcome of risk analysis have an opportunity to become informed and provide critical review. In many countries, this is one of the most important and problematic areas of public policy. If done well, risk communication can greatly enhance the quality, acceptance and impact of risk analysis; failure to

follow good risk communication principles can ruin the most well-intentioned and well-crafted policies and programmes. The opinions and values of the public and other stakeholders must be considered when formulating the objectives and scope of risk assessments. During the assessment procedure itself, communication is needed between scientists and risk managers. In selecting optimum strategies for risk reduction, risk managers should weigh input from affected parties, and from risk assessment and cost–benefit analyses, and then effectively communicate the rationale for any decisions taken.

6.6.4 *Health indicators*

Human health indicators are variables that help to measure the changes in public health status, either directly or indirectly, and to assess the extent to which the objectives and targets of a programme are obtained. Objective, verifiable, denominator-based indicators are part of the logical framework for programme planning and they are particularly important as a basis for formulating activities and plans of work. Indicators also aim at monitoring progress; therefore, indicators that permit a quantitative assessment of programme implementation should be chosen.

6.7 Economic implications of VPH programmes

Estimates of the benefits and costs of VPH risk management are important components of the planning phase of VPH programmes. These analyses should include the anticipated economic benefits and their probabilities. The costs of implementing programme options should also be included, as should other costs to industry and the public that could accrue from risk management decisions. At the international level there are many difficulties in employing cost–benefit analyses in VPH. The costs of risk mitigation measures may vary considerably between countries, as will the monetary values placed on adverse effects on public health. Furthermore, trade-offs between benefits and risks are more complex in international trade because the benefits are realized by the exporting country and the health risks are borne by the importing country.

While foodborne pathogens, including bacteria, viruses, parasites and toxins, commonly cause mild and self-limiting gastrointestinal illnesses, severe acute illness and life-threatening complications may occur. For example, approximately 2–3% of people affected by foodborne illnesses develop complications such as arthritis, haemolytic–uraemic syndrome, mental retardation, heart disease or Guillain–Barré syndrome.

According to the Centers for Disease Control and Prevention, foodborne disease affects some 76 million people in the USA each year, of whom 325 000 are hospitalized and 5200 die. The annual cost of foodborne disease in the USA due to the five main pathogens (*Campylobacter* spp. (all serotypes), *Salmonella* spp. (non-typhoidal serotypes only), *E. coli* O157:H7, *Shiga- toxin-producing E. coli* and *Listeria monocytogenes*) is estimated to be US$ 6900 million (*22*). Although the same foodborne pathogens are found in many other countries, the risks are different because of geographical differences in the animal and vector reservoirs and cultural differences in food consumption habits.

However, such estimates undervalue the true costs to society, because they only focus on medical costs and productivity losses and either exclude or underestimate other costs to individuals (such as psychological costs), as well as costs to industry and to the public sector (*23*).

7. Professional development and utilization of VPH staff

7.1 Undergraduate training in VPH

VPH should be taught in all veterinary schools. Courses in food protection, zoonoses and environmental health should be included as VPH will be one of the major activities of the veterinary profession in the forthcoming decades. Training in VPH should be an absolute requirement in training programmes on food hygiene. Veterinary schools in each country should formulate curricula that take into account the current and future needs of VPH in that country. This has been done in some countries, such as India, where courses in milk and meat hygiene, zoonoses and human health, and environmental health have recently been added.

Other subjects that require reinforcement in VPH curricula include epidemiology, microbiology, parasitology, pathology, immunology and biostatistics. In addition, food protection, management and participatory extension methods are important. Community health, including socioeconomic and gender aspects, should be enhanced. Disaster preparedness, for events such as hurricanes, floods, drought and intentionally caused epidemics, should also be covered in VPH curricula.

Training in VPH can be offered at the end of courses in veterinary medicine, after the student has completed training in microbiology,

parasitology and pathology. Practical training in VPH can be accomplished at schools offering such courses.

Undergraduate training should provide a firm basis for the pursuit of postgraduate training in VPH. This can provide a mechanism whereby veterinarians can be more effectively trained in VPH, even where there is no access to graduate education, such as in a school of public health. The continuing collaboration of the veterinary profession with VPH programmes also depends on the general orientation given to veterinary students.

A VPH department should be established in each veterinary school and consist of several faculty members who are well trained in public health. This department should set the standards and coordinate and reinforce the public health aspects of the curriculum. Where schools of veterinary medicine are accredited by an independent agency, VPH should be a required component of the curriculum.

Veterinary schools themselves could complement one another by specializing in particular areas of VPH. This would spread the costs of providing comprehensive research and education programmes, costs which few schools could bear alone.

7.2 Postgraduate training in VPH and continuing professional development

Modern approaches to livestock production have prompted changes in preventive veterinary medicine and certification of herds, and have focused attention at the population level. As a result, veterinarians working in VPH have had to become experts in epidemiology.

Although epidemiology has been introduced into the curriculum of some veterinary schools, teaching and research programmes on food hygiene and other subjects related to VPH have been neglected in many institutions. Most veterinarians lack even the most basic concepts of VPH and consequently have little interest in embarking on a career in this field. A Master's degree or diploma in VPH, as well as continuing education programmes that are recognized by international veterinary associations, are highly desirable.

Postgraduate training in VPH therefore has to be developed to serve the local and regional needs of veterinary and other health professions. The objective should be to provide graduates with the up-to-date knowledge and expertise needed to incorporate the concept of VPH into operational programmes, in which the private sector, health professionals and VPH officers in governmental service can play their complementary roles.

7.2.1 *Disciplines in VPH*

Postgraduate training in VPH should include advanced training in the epidemiology and control of zoonoses and communicable diseases of humans and animals, as well as in biostatistics, environmental health, animal and human nutrition, and food protection. Public health administration, health legislation and economics, occupational health and health education of the public should also be covered. Differences between the individual approach (small-scale husbandry, slaughtering and meat inspection) and the population health approach must also be emphasized. International trade, such as that governed by the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures, requires transparent controls and guarantees for safe and wholesome food of animal origin. The equivalency of quality control systems is also an important issue. Postgraduate programmes in VPH should also include training in risk communication and management.

Postgraduate educational programmes in VPH should be developed for three different target groups:

1. Veterinarians not employed in public health: examples include veterinary practitioners working primarily in food-animal health and production, and those working with companion animals.
2. Veterinarians employed in public health.
3. Other public health personnel, such as sanitation and health inspectors.

In addition, two levels of educational programmes will be required:

1. Courses to enable veterinarians and other health professionals whose VPH education is limited to acquire the necessary knowledge and skills.
2. Courses to update VPH personnel with the latest methods and concepts to improve the delivery of animal and human health services.

7.2.2 *Master's degrees*

At some universities, especially those with a strong emphasis on public health, master's degree programmes lasting 1–2 years should be developed that include epidemiology, zoonosis control and environmental protection. These courses should include both theoretical and practical components. Specialized knowledge in a particular VPH discipline would be recognized by a degree such as a Master of Science or Master of Public Health. WHO and national governments should support the establishment and strengthening of such courses in disciplines relevant to VPH.

7.2.3 *Diploma or board certification*

In several countries, national veterinary societies have a register of veterinary specialists, including specialists in VPH and food hygiene and technology. Since few veterinary faculties in the world can deal with all aspects of VPH, international cooperation is needed among schools, so that education in specific modules may be developed at different faculties. The development of internationally recognized courses will provide an additional educational path for veterinary and other health-related disciplines, and will contribute to the international recognition of expertise in VPH.

7.2.4 *Distance learning and knowledge transfer*

Modern education programmes should be made available on the Internet or on interactive CD-ROMs. This would enable students from all over the world to take advantage of the most current information and to participate in distance learning programmes. Examinations could also be conducted in a similar manner. International courses, master's degree programmes and continuing education courses could also be organized at internationally recognized centres of excellence in VPH and related disciplines. Such courses and programmes should preferably be coordinated by veterinary organizations especially established for this purpose.

7.3 The role of auxiliaries and the community in VPH

7.3.1 *Veterinary and medical personnel*

Veterinarians can be effective communicators of health messages, promote changes of attitudes, and exercise leadership in encouraging the community to organize and to promote public health. They can teach livestock producers about the transmission and prevention of zoonotic diseases, using animal diseases as examples. Veterinary technicians, in addition to their role as veterinary assistants, can communicate their knowledge to the population at risk if they are well trained and understand the principles of VPH. Similarly, physicians can teach their patients about the transmission and prevention of zoonotic diseases. Nurses and other health personnel in close contact with patients also play an important role in health education.

Public health advisers and agricultural extension agents who visit households to give health advice to communities and families, especially in rural areas, play a key role in control programmes. They are in close contact with populations at risk, especially those in remote areas who may have no other source of information about disease

transmission. Health advisers can play a major role in health education and can teach rural communities about the routes of transmission of various diseases and how to prevent infection.

7.3.2 *Community participation and education*

Community participation is generally defined as a process by which individuals and families assume responsibility for their own health and well-being, and in doing so enhance their capacity to contribute to their own, as well as to the community's, economic development.

All sectors of society must have a role in decision-making and in implementing strategies to control or eliminate diseases of animal origin. Specific educational materials should always be matched to the educational level of the particular target group to obtain the best results, and due attention should be paid to different religious beliefs, cultural customs and languages of local inhabitants. Appropriately prepared materials can be used to communicate information on diseases to local communities, and to encourage them to adopt healthy lifestyles. Health educational programmes can be addressed to opinion leaders, schoolteachers, schoolchildren, parents/guardians, livestock producers and rural communities. Indigenous knowledge should be respected and used when effective.

The dissemination of information through the mass media is an essential element in preventing and controlling zoonotic diseases and promoting VPH programmes. Radio and television are valuable means for disseminating health education, but programmes should be clear, concise and designed to appeal to the target audience in order to be effective.

Schoolteachers are potential candidates for delivering health educational lessons, particularly in rural or other areas at high risk of zoonotic diseases. If they are trained in the major VPH hazards they can teach their pupils about basic hygiene and the routes of transmission of, and measures to prevent, zoonotic diseases. VPH educational sessions can be organized in schools, using materials such as slides, overhead transparencies, educational pamphlets, posters, colouring books, comic strips, games and puzzles. Simple illustrated pamphlets and posters are excellent media for teaching information on disease prevention and these can also be distributed to households. In addition to educating schoolchildren, it is also important to reach livestock producers as they are key elements in any programme to control or eliminate zoonotic diseases.

In rural areas the mother routinely acts as the household's primary caregiver, food handler, housekeeper and informal medical consultant. It is especially important that VPH messages reach women, who usually prepare their family's food. However, women in rural areas often have virtually no knowledge of transmissible diseases. Thus, educating them about the importance of hygiene is critical to preventing diseases in the household, because they play a major part in educating young children. Radio announcements, television commercials and informal women's groups should target women and provide avenues to educate them and support their efforts. The use of radio and television is advisable, as many older women are illiterate and constitute a large percentage of radio and television audiences. The messages should be short and appealing, and provide basic information. Video films and television footage are preferable for large-scale educational programmes. Media should emphasize oral communication, such as songs, poems, games and jingles, which can be easily learned and which women can teach to their pre-school children. Informal women's groups should support women in their efforts, provide additional educational opportunities and allow them to share experiences and strengthen their knowledge.

Opinion leaders and individuals with influence among their peers should also be identified and trained so that they can encourage healthy lifestyles. They can then also train others to multiply the benefits within the community. It is crucial to identify an appropriate team that is well aware of the epidemiological and social aspects of the health problem and that has a clear understanding of the objectives, strategies and tasks. To implement and improve current and future plans, this team must continually interrelate and evaluate tactical aspects.

Even with effective dissemination of information, however, the time lag required to decrease infection levels in different hosts is variable and results may not be seen for several years. Therefore, evaluations should be conducted at all stages of the process to analyse the development of the educational process, the changes in knowledge, attitudes and practices, and the degree to which the technical and social goals have been achieved.

7.4 Gender issues in VPH programmes

VPH forms a unique bridge between human and animal health. Women are a key part of this linkage because of their role in maintaining family health and nutrition, and their often invisible role as livestock producers and managers. Women usually prefer to raise

species such as small ruminants, poultry, guinea-pigs and rabbits, because they can control the income generated without inciting male jealousy. Unfortunately, most veterinary and extension programmes exhibit a bias towards cattle and other large animals, which are typically controlled by men. Meanwhile, goats and other small animals, which may contribute more to family food security, receive relatively scant attention (*24*).

In developing countries, women in rural areas are significant food producers; in sub-Saharan Africa, for example, they supply 70–80% of the food consumed. Agricultural development must therefore recognize women's contributions to crop and livestock production, and address the barriers to their success, such as illiteracy, lack of technical training and services, insecure land tenure and low social and legal status. In addition to producing food, women also process food for home use and the market, and prepare food for family meals. Compared to men, women spend a greater portion of their income on food, medicine and other necessities to maintain family health. Expanded support for women's livestock production is thus an effective strategy for improving human nutrition and health (*25*).

The effectiveness of VPH can be increased by incorporating a gender perspective that acknowledges that men and women have different experiences and priorities, different access to and control over resources, and different responsibilities and roles within the family and community. For example, women may have different access to information, credit, technology, markets and services, and may also have different risk levels for zoonotic and other diseases. Moreover, many women's activities are performed within the home and are unpaid: as a result, national statistics usually do not reflect their involvement in livestock production and policies fail to address their needs. Identifying producers or consumers as either men or women can offset some of the biases that exist in public health education or agriculture extension programmes, which assume that all farmers are men, or that only women control food distribution within the family.

Incorporating a gender perspective into VPH would result in greater outreach to women, who have been outside mainstream extension programmes, and would foster better communication and respect between men and women, improving family well-being. With access to VPH information and services targeted to women, livestock production would increase, family nutrition improve, and the incidence of zoonotic diseases and diseases from foods of animal origin would be reduced. Women could inform VPH workers about their current practices, providing valuable guidance for policy and the

development of future services. Women's active participation in all aspects of VPH would lead to greater public recognition of, and support for, their contributions to family and animal health, which in turn would lead to economic and social empowerment, a necessary component for equitable, effective and sustainable development (*26*).

Linking women's knowledge of animal health and hygiene to improving family and community health has profound implications. The need for clean water, adequate diet and hygiene, especially in relation to parturition and the rearing of young, is common to both animals and humans. Areas where women's knowledge of animal management could benefit their families include child rearing, food preservation, hygiene, family planning and identification of health conditions requiring medical attention (*27*). It makes sense to build on women's existing knowledge of human health and nutrition when training for improved animal health. In Honduras, for example, it became obvious that community health care workers and home economists should be trained in animal production and hygiene, because they were the only source of information for women in rural areas, nearly all of whom raised livestock (*28*).

Women can also be recruited and trained as veterinary auxiliaries or technicians in rural areas, which are often poorly served by veterinary services. While women auxiliaries can effectively increase outreach to livestock producers of both sexes, they are not trained as often as men.

Gender is also an issue within the veterinary profession in both the developed and the developing world. Although the United Kingdom, the USA and other developed countries have seen a rapid increase in the number of female veterinarians, gender is still an issue as male veterinarians often earn more than their female counterparts, and there are few women at upper levels of administration or academia. In developing countries, data on female veterinarians are difficult to obtain and are not available in a single database. However, even though the number of female veterinarians is increasing, it is still low. For example, in Peru, the numbers of men and women graduating as veterinarians are nearly equal; however, women experience greater difficulty finding employment. In 1993, only 7% of female veterinary graduates were actually employed as veterinarians.

Strategies to increase opportunities for women in VPH include recruitment and retention goals. "Family-friendly" practices, such as flexible working hours and facilities and allowances for childcare are beneficial to both men and women, but are especially important for

working women with major family responsibilities. A written and enforced policy against sexual harassment is also necessary. In addition, scholarships for advanced training in VPH for female veterinarians can be beneficial because they reduce direct competition between men and women (*29*).

Approaches to strengthen the gender perspective in VPH within the *Health for all in the twenty-first century* strategy (*1*) include:

- Providing training in gender analysis to all VPH staff, including directors and field staff.
- Incorporating training in gender analysis into veterinary curricula, so that all veterinarians have the knowledge, skills and attitudes to meet the needs of all livestock breeders, including women. This should increase VPH services available to women.
- Incorporating a gender perspective in the development of VPH programmes to ensure that they meet the needs of women as well as men. Information should be collected from both women and men to improve the accuracy of data.
- Desegregating all VPH data by gender, where appropriate, to determine whether there are any significant differences in the health of animals belonging to men and women, or in the health of the men and women involved.
- Expanding the use of gender sensitivity and participatory community planning when implementing local health systems and programmes.
- Including gender-sensitive language in all VPH-related documents, for example, replacing “man” with “people” or “humans”.
- Increasing the number of women trained in VPH by:
  - — increasing recruitment and mentoring of qualified women, especially from rural areas;
  - — providing scholarships for women veterinarians, including for advanced training in VPH;
  - — adopting family-friendly policies in employment, and policies prohibiting sexual harassment;
  - — providing opportunities for women’s promotion and increasing their responsibility for, and involvement in, policy-making;
  - — encouraging government ministries, agencies and organizations to adopt and enforce a gender policy, committing them to the goal of gender equality.

8. Conclusions and recommendations

8.1 Surveillance and information exchange

New information and new approaches for the efficient and cost-effective delivery of reliable and accurate information to VPH users in both developed and developing countries are required. Much of this information will arise from ongoing surveillance and research programmes. Such programmes should be designed to enable the collection, analysis, interpretation and timely dissemination of information on VPH issues. In many countries baseline information is often lacking on the burden of zoonoses and other animal-related hazards. Surveillance should enable the assessment and monitoring of these impacts. Accordingly, programmes should include coordination between veterinary and medical surveillance, appropriate information on animal and human populations at risk of disease (e.g. age, location, gender), on animal management (e.g. farm type, feedstuffs) and the environment, as well as the information needed to assess the impact of disease control programmes. The programmes must be sustainable.

While it is important to make the information collected available to as many users as possible, there are important issues of confidentiality and intellectual property that need to be addressed. International organizations such as FAO, OIE and WHO assistance in harmonizing surveillance systems, facilitating agreement on the types of data that should be shared internationally, and assuring quality control for surveillance data. These agencies should also be encouraged to facilitate the timely summarization and dissemination of VPH information to their Member States. Differences between individual countries in their ability to provide and utilize information must be recognized and addressed.

To maintain an effective VPH programme there must also be free and prompt exchange of information between the stakeholders at both the national and international level. In particular, countries must fulfil their international obligations to report the listed zoonotic diseases promptly.

In light of the changes in zoonoses and food safety, WHO should collaborate with OIE to update and review the existing list of reportable diseases to ensure the following:

- Lists of reportable diseases are regularly updated to include emerging diseases.

- Adequate geographical information is provided with notifications of outbreaks.
- All countries meet their existing and future international responsibilities for reporting diseases, and introduce mechanisms to increase the transparency, accuracy and completeness of the data. International organizations should be encouraged to exchange data and develop policies for the global surveillance of zoonotic diseases. Generally, medical and veterinary surveillance programmes should be coordinated at all levels.

8.2 Research

The ability to address new and future trends in VPH will be critically dependent on basic and applied scientific research. FAO, OIE and WHO should continue to play a major role in promoting relevant, cost-effective, problem-oriented research, coordinating international research efforts, and communicating research output to different end-users. Specific research areas that will be increasingly important include the biology of disease, diseases in wildlife and exotic animal species, molecular genetics, epidemiology, sociology, and the development of diagnostic techniques, drugs and vaccines. Research is particularly needed to estimate the burden of zoonotic and foodborne diseases to human populations in terms of mortality and morbidity (incidence and disability) and to study the cost-effectiveness of surveillance and control programmes. Such information will provide a basis for sound decision-making, management and service-delivery practices.

Research must be interdisciplinary, should involve multicentre collaboration, and be sustained and focused. The private sector should play an increasingly prominent role, and this will raise issues of intellectual property that must be addressed. The need for continued research for "public good" must be emphasized. Both differences and similarities in the research needs of individual countries must be recognized. Developing countries should take the lead in prioritizing research relevant to their needs, paying particular attention to small-scale farmers, particularly women in rural areas, and consumers.

8.3 Implementation of programmes

8.3.1 *Adaptation to a changing environment and intersectoral collaboration*

VPH activities and expertise need to be more comprehensive and integrated to address the problems of hazards from animals,

particularly in the case of foodborne diseases. This will require a systems-based quality assurance approach that takes into account the technologies and management systems that are used in the production, slaughter, processing and distribution of food animals. Such an approach will enable hazard-reduction interventions to be made in an integrated, efficient and cost-effective manner. Education outreach should systematically reach food workers and people who handle food within the home, usually women. Similarly, control programmes for non-foodborne hazards should be designed to reduce the risks to humans while taking account of animal welfare and environmental issues.

To be sustainable and efficient, VPH must be flexible and adaptable to changing trends, new challenges and the needs of human populations. This will require enhanced communication between VPH practitioners, national and international agencies, development partners, nongovernmental organizations and the public. Priorities for VPH activities should be reviewed regularly and should be based on sound risk analysis using the available scientific, social and economic information. The VPH infrastructure, administration and expertise will need to respond to changes in priorities by developing mechanisms for timely reorganization and reallocation of resources. Adaptation to change will be enhanced by harmonization of VPH activities at the local, national and international level.

8.3.2 *Community participation*

Community participation plays an integral role in the implementation of VPH programmes; local communities should be empowered by being trained to take ownership of and manage their VPH activities. The following concepts and challenges should be addressed as appropriate:

- Encourage participation by all stakeholders, including women and children and minority groups, in decision-making at the local level, to increase ownership, accountability and sustainability.
- Ensure that social and gender analyses are incorporated into the development of VPH programmes to provide equitable impact and to help achieve the goals of the *Health for all in the twenty-first century* strategy (*1*).
- Involve the private sector and local nongovernmental organizations, with leadership from national and international agencies, to ensure standardization in surveillance information and educational messages to the public.

- Establish multisectoral and interdisciplinary committees at the local level for sustainability and continued disease surveillance.
- Involve and train influential people in the communities (local leaders) so as to build on indigenous knowledge.
- Extend and incorporate VPH activities into existing primary systems and programmes of animal health care.
- Include VPH issues in rural and urban planning decisions.

At the community level the following strategies will increase the effectiveness of VPH programmes:

- Use trained auxiliaries to deliver VPH locally.
- Involve community and women's groups in the development and management of VPH programmes.
- Use participatory field research to identify community priorities, evaluate the impact of VPH programmes and make appropriate adjustments.
- Involve nongovernmental organizations already working in the area in both human and animal health.
- Increase outreach to women in rural areas.
- Coordinate with human health services in the region.

8.3.3 *Role of nongovernmental organizations*

The role of nongovernmental organizations is particularly important. Such organizations should be included as full participants in VPH work, and their activities harmonized with official goals and standards. However, reliance on nongovernmental organizations should not be an excuse for governments to ignore VPH responsibilities, especially in remote or marginalized areas. Experience clearly shows that VPH programmes in developing countries require collaboration that currently either does not exist or is inadequate. Management structures should be established to ensure the participation of all sectors and the appropriate allocation of responsibilities and resources.

8.3.4 *Political commitment*

The political commitment to fund and implement VPH programmes is essential and a number of alternatives must be considered. It is

inappropriate to make specific recommendations as to which government ministry or other administrative structure should be given lead responsibility for VPH, as this is an issue that would vary based on the situation in different countries. However, funding must be approved and committed in advance — many programmes have failed because promised resources were not provided once they began. It is therefore recommended that there be a structure to coordinate activities at the national level, such as an intersectoral committee composed of representatives from national ministries and agencies and other stakeholders, which has both the political authority and funding to design, implement and supervise VPH programmes. To support these intersectoral committees, it is recommended that WHO establish and maintain a VPH focal point at each of its Regional Offices, and that support for these focal points be provided by WHO Headquarters.

8.3.5 *Collaborating centres and reference laboratories*

Because basic data on zoonoses and animal-related hazards are lacking in many parts of the world, collaborating centres and reference laboratories should collaborate with FAO, OIE and WHO to assist participating countries in collecting reliable information on animal-related diseases and hazards and their impact on human health. Collaborating centres should provide technical advice, diagnostic reagents, reference services, training and research. In addition, they should form consortia with other centres addressing public health issues in a broad problem-oriented approach, rather than a narrow disease-oriented approach. This would speed up data collection on the occurrence and distribution of endemic and epidemic diseases and reveal new trends.

Many collaborating centres and reference laboratories are located in developed countries; however, it is developing countries that generally experience the most serious VPH-related disease problems. FAO, OIE and WHO should assist collaborating centres and reference laboratories in their efforts to establish networks in developing countries that are designed to address local problems and/or to enable developing countries to establish their own capacity to address these problems.

8.3.6 *Staff development and utilization*

To prepare future veterinarians more effectively for public health activities and careers, the concept of VPH should be included throughout their undergraduate professional education and training in a consistent format. The veterinary curriculum should be adapted

according to regional or national needs. To be relevant for the needs of a rapidly changing society, training programmes in VPH should reflect changes in public demand. Such programmes should include the latest scientific developments, including recent changes in the knowledge of the epidemiology of zoonoses, and information about other communicable diseases caused by microbial and non-microbial contaminants. The different needs of vulnerable populations, such as those in rural areas, must also be considered. There should be an emphasis on educating students in problem-solving, perhaps through the use of case-studies. Joint training with students in other health disciplines, such as medical, food technology and environmental sciences, can reinforce the VPH holistic approach and build professional relationships. Training and education that interacts with other programmes, such as those in the medical and environmental sciences, should be encouraged. Social and gender analysis should be incorporated into the veterinary curriculum, so that veterinarians have the knowledge, skills and attitudes to meet the needs of all livestock breeders. This should increase services and information available to women. It is highly recommended that a regular audit process be established, to measure the progress and the effectiveness of the VPH curriculum.

A competent authority should be responsible for the establishment of standards for postgraduate and continuing education and training in VPH. In several countries, national veterinary societies have a register of recognized veterinary specialists, including specialists in the field of VPH and in food science and technology. FAO, OIE and WHO should support activities of groups that internationally recognize such specialists. Training programmes and related accreditation standards should be harmonized as soon as possible so that qualifications in VPH are recognized internationally. Since few veterinary faculties can possibly deal with all aspects of VPH in detail, cooperation mechanisms should be established between relevant schools. Education in specific modules can be developed by some faculties, but recognized courses or continuing education programmes can provide the basis for expanded acquisition of knowledge.

Continuing veterinary education and training in VPH has to be addressed at different levels for veterinarians currently employed in public health or in other sectors, and for other health professionals. Academic institutions and veterinary organizations should be encouraged to endorse international standards for advanced training courses in VPH that lead to formal recognition as specialists in the field. Research training in VPH should be promoted and should emphasize the need for high-quality science and recognize the

multidisciplinary nature of VPH research. Efforts in basic research in veterinary medicine are essential. Applied research in VPH should take into account the impact of socioeconomic factors and gender in the community, quantitative risk analysis, mathematics, as well as modelling and cost–benefit and cost-effectiveness analysis.

Career development within VPH should be encouraged by competent authorities to facilitate the recruitment of students. Special attention should be given to under-represented groups, such as women and minority groups, with the expectation that they could effect change among marginalized groups more effectively.

A formalized training programme and continued professional education for auxiliaries in VPH should be established in countries on the basis of need. Gender analysis should be included in the development of VPH programmes, and the use of gender-sensitive and participatory community planning and implementation techniques for local animal and human health systems should be expanded. Nongovernmental organizations and VPH administrations may need to harmonize standards and practices to ensure that educational outreach, disease prevention and surveillance programmes are effective and complementary.

8.3.7 *Collaboration with developing countries*

It is recognized that developing countries may lack the necessary technology, research infrastructure and resources to implement these recommendations. Therefore, it is recommended that international organizations be encouraged to coordinate their collaboration to help promote and build the required capacity. Following a request for assistance, the problem identification phase and the initial planning activities should include networking to ensure the involvement of all stakeholders, including nongovernmental organizations, community groups, women's groups and rural workers' federations. Activities creating a collective ownership and responsibility for the programmes should also be coordinated. In view of the complex nature of the transmission of zoonoses and foodborne diseases from animals, risk analysis should be used where appropriate to design and prioritize VPH policies and programmes.

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Annex 1
VPH programmes and activities at the international and national level

World Health Organization

The founding of the World Health Organization (WHO) programme in VPH dates back to the First World Health Assembly in 1948, at which rabies and brucellosis were discussed and various actions were proposed. In the following years, WHO was requested to assist Member States in combating zoonoses of major public health and economic importance, improving food hygiene practices, and training personnel for VPH work. By its very nature, the VPH programme in WHO has been closely linked with various aspects of the work of the Food and Agriculture Organization of the United Nations (FAO) and the Office International des Epizooties (OIE) in relation to zoonoses, food safety, and the public health aspects of trade in animals and animal products. Collaborative agreements and exchange of information are long established among the relevant staff of these organizations.

VPH activities are currently implemented by WHO Headquarters through the Department of Communicable Disease Surveillance and Control (CSR) in close collaboration with the Food Safety programme. Focal points exist in all WHO Regional Offices. The WHO Regional Office for the Americas/Pan American Health Organization has the largest VPH programme of WHO.

At WHO Headquarters, VPH activities contribute to CSR's global efforts to strengthen the surveillance of and response to all communicable diseases which are or may emerge as public health threats. In collaboration with WHO Regional Offices, CSR supports Member States in the surveillance and containment in humans and animals of zoonoses and foodborne zoonotic diseases of public health importance, and animal diseases with known or potential public health implications; and in the surveillance and containment of resistance to antimicrobial agents in animals, with implications for human medicine. More specifically, major VPH activities include:

- Identifying and evaluating microbiological hazards to human health of animal origin: new, emerging and re-emerging zoonotic diseases, and foodborne diseases, including those due to antimicrobial-resistant bacteria. Examples include rabies, brucellosis, bovine spongiform encephalopathy (BSE)/variant Creutzfeldt–Jakob dis-

ease (vCJD) and foodborne diseases due to enterohaemorrhagic *Escherrchia coli* (O157:H7 and non-O157:H7), *Salmonella enteritidis*, multidrug-resistant *Salmonella typhimurium* and *Campylobacter* spp.
- Developing policies, guidelines, operational research and strategies for the control of zoonotic and foodborne diseases.
- Promoting research on zoonotic and foodborne diseases and their management in humans.
- Strengthening global surveillance of zoonotic diseases and antimicrobial resistance in foodborne pathogens by enhancing the epidemiological capabilities of national laboratories.
- Supervising the work of the Mediterranean Zoonoses Control Programme (see page 62).
- Disseminating relevant information to experts in public health, veterinary science and other scientific disciplines, as well as to consumer groups and the public.
- Contributing to field and laboratory investigations of zoonotic and foodborne diseases.
- Facilitating active contributions to public health by the veterinary services of Member States, an essential requirement for the cost-effective surveillance and control of zoonotic and foodborne diseases in their animal hosts.
- Providing technical and scientific assistance to Member States for their surveillance and control programmes, when requested.

Other diseases and subjects in which VPH professionals are currently involved include anthrax, leptospirosis, echinococcosis and other parasitic zoonoses, zoonotic poxviruses, xenotransplantation and public health consequences of biological weapons.

WHO Regional Office for Africa

In recent years the WHO Regional Office for Africa (AFRO) has been facing outbreaks of emerging and re-emerging diseases, including vector-borne and zoonotic diseases such as viral haemorrhagic fevers and plague, as well as foodborne diseases. Despite this, many zoonotic diseases are often neglected in Africa, even though animal and human health are closely linked, and animals and humans often live together in very poor environmental conditions. This has led to poor or non-existent systems for the surveillance of zoonotic diseases and inappropriate setting of priorities.

Considering the limited resources available in the region, VPH activities should be approached in an integrated and well-coordinated manner, rather than as a vertical or independent programme. As a first

step towards improving disease surveillance, the WHO Regional Office for Africa (AFRO) has developed an integrated strategy for disease surveillance, which was endorsed by the Ministers for Health of the African Region at the forty-eighth meeting of the Regional Committee in September 1998 (resolution AFR/RC48/R2). The strategy focuses on 19 priority diseases, including four epidemiologically significant vector-borne zoonotic diseases: Ebola, Lassa and Rift Valley haemorrhagic fevers and plague. The list of priority diseases should not be considered as fixed; other diseases, including zoonotic diseases, can be added depending on their prevalence.

The overall guiding principle of the integrated strategy is to collect data and information for specific actions. The role of VPH in implementing the strategy is crucial in raising issues related to both zoonotic and foodborne diseases on the priority disease list. The strengthening of laboratory capabilities to confirm the diagnosis of those diseases in humans and animals and the improvement of communication systems are equally important for providing early warning and rapid responses by teams of both medical and veterinary health professionals. In this respect, there is a need to prepare a 5-year plan of action, based on an epidemiological review of zoonotic diseases in the region. The implementation of the plan, as well as monitoring and evaluation, will be a joint effort of VPH and medical health workers at different levels, together with the support of health partners in Member States.

Pan American Health Organization WHO Regional Office for the Americas

The principal role of VPH programmes is to serve as a catalyst for intersectoral action, especially between the health and agriculture sectors, where functions and resources related to zoonoses and food safety are often dispersed and separate. The Member States of the Pan American Health Organization/WHO Regional Office for the Americas (PAHO/AMRO) have long recognized that animal and human health are inextricably linked and that they share the common goal of protecting, promoting and improving the health and well-being of human populations. This intimate relationship stems from the toll that zoonotic and foodborne diseases exact in terms of human health, and the dependence of humans on animals for food and nutrition, socioeconomic development and companionship.

PAHO/AMRO provides political and technical support for Member States to address VPH issues of collective social and economic importance. This is carried out at the political level by ensuring the sustained support of national authorities, and at the operational level

by providing the necessary technical cooperation. It is important that VPH activities and programmes are seen to be relevant, particularly when resources are limited and they have to compete with other health priorities. For example, in Latin America, a vaccination programme directed against dogs, which are the main source of human exposure to rabies, has been shown to be effective in eliminating the disease.

PAHO/AMRO has provided the political and technical framework for the development and strengthening of VPH in the Americas, and for assisting Member States to organize and develop their animal health and VPH programmes and activities. At the request of member governments, PAHO established the Pan American Foot-and-Mouth Disease Centre (PANAFTOSA) in Rio de Janeiro, Brazil in 1950 and the Pan American Zoonoses Centre (CEPANZO) in Buenos Aires, Argentina in 1956, which in 1991 became the Pan American Institute for Food Protection and Zoonoses (INPPAZ). More than 30 years ago, recognizing the importance of intersectoral collaboration between agriculture and health, the Member States mandated PAHO to establish an official forum to implement intersectoral collaboration at the highest political levels. Since 1968, the Inter-American Meeting, at the Ministerial Level, on Animal Health (RIMSA)[1] has been convened by PAHO every 2 years. During RIMSA meetings, the ministers of agriculture and health programmes review the programmes and budgets of the PAHO VPH programme and of PANAFTOSA and INPPAZ. Current issues of mutual interest are discussed, such as food safety during an outbreak of cholera in the region and the problem of emerging zoonoses.

The elements of the VPH programme in the Region include:

- Zoonoses.
- Food safety.
- Foot-and-mouth disease.
- Biomedical models.
- Organization of VPH services.

The VPH programme has concentrated its technical cooperation on the following strategic imperatives:

- Elimination of dog-transmitted human rabies.
- Regional technical cooperation on food safety.
- Regional eradication of foot-and-mouth disease.

[1] Known until 1980 as the Inter-American Meeting for the Control of Foot-and-Mouth Disease and Zoonoses.

- Control/eradication of bovine tuberculosis and brucellosis.
- Surveillance of emerging zoonotic and foodborne diseases.

PAHO/AMRO has a total of 38 Member States, including three European countries that still maintain territories in the Region (France, the Netherlands and the United Kingdom). Its VPH programme comprises a coordination team at the headquarters in Washington, DC, USA, the intercountry and country VPH advisers, INPPAZ and PANAFTOSA. The programme forms part of the Division of Disease Prevention and Control and employs about 50 professionals (mostly public health veterinarians) and more than 100 support staff, most of whom are located at INPPAZ or PANAFTOSA, or in the Member States; only 3% are at the regional office. Almost all professional staff are at the operational level and provide sustained support to national programmes. The staff at the regional office provide technical guidance and orientation to the operational staff in the different countries, or provide technical cooperation to their national counterparts in the implementation of VPH programmes and activities.

Full-time VPH advisers are stationed in Barbados, Bolivia, Brazil, Colombia, Cuba, Ecuador, Mexico, Panama, Paraguay, Peru and Venezuela. In countries where there is no full-time VPH adviser, a staff member of the office of the WHO Representative has been designated to respond to requests from local authorities. The PAHO/AMRO VPH programme is highly decentralized and its work is primarily directed at the country level.

PAHO/AMRO has developed a programme of technical cooperation aimed at facilitating the execution and evaluation of existing programmes. Technical cooperation has been classified into six strategic approaches:

- Resource mobilization.
- Dissemination of information.
- Training.
- Development of standards, policies and plans.
- Research promotion.
- Direct technical consultation.

For 40 years PAHO/AMRO has provided vision and leadership in addressing contemporary issues of animal and human health, such as the problem of emerging zoonoses. Its VPH activities and programmes in the Americas continue to receive strong support from Member States and remain highly relevant to its programme of technical cooperation.

WHO Regional Office for the Eastern Mediterranean

Zoonoses and foodborne diseases present significant public health problems for the Member States of the WHO Eastern Mediterranean Region. The WHO Regional Office for the Eastern Mediterranean (EMRO) recognizes that intersectoral and international cooperation at regional and country levels are needed for the prevention and control of zoonotic diseases.

In addition, EMRO provides advice to Member States for the establishment of VPH technical units in Ministries of Health. These units are responsible for upgrading national systems for case detection and reporting of zoonotic diseases, integrating VPH activities within the existing primary health care system, organizing surveys among specific population groups, promoting training and health education, and coordinating activities for the control and prevention of zoonotic diseases with other sectors, agriculture, municipalities, education, and the environment.

An important function of EMRO is to develop, monitor and evaluate technical guidelines. EMRO also assists in the development of national manuals and guidelines, as well as teaching and health education materials.

The main activities of EMRO include:

- Assisting Ministries of Health to establish surveillance and information systems for major zoonoses such as rabies, brucellosis and salmonellosis.
- Strengthening services for diagnosing and preventing zoonoses in the human population.
- Training medical, veterinary and laboratory personnel in the diagnosis, prevention and control of zoonoses.
- Preparing and adapting legislation for agriculture, the food industry and public health.
- Promoting health education and community participation in the prevention and control of zoonoses.
- Assisting in the development of national strategies to prevent and control zoonoses.

Another important task of EMRO is to assist countries in upgrading their capabilities in surveillance, prevention and control of zoonoses. This is accomplished in several ways:

- EMRO staff and consultants advise national staff during the preparation of comprehensive plans of action that involve activities from different sectors.

- EMRO assists in the organization of national and local joint veterinary/medical training courses and seminars on the prevention and control of zoonoses.
- EMRO provides support for identifying, equipping and training staff at national reference centres on zoonoses. Several national reference centres, research institutes and training centres have become WHO collaborating centres or postgraduate institutions for training physicians in the prevention and control of zoonoses.
- EMRO encourages the establishment of national zoonoses committees, that include representatives from different sectors involved in the surveillance, prevention and control of zoonoses.
- EMRO provides financial and technical support for the organization and implementation of national programmes, including special surveys among population groups at high risk of zoonotic diseases.
- EMRO encourages cooperation between public and private health sectors to identify and report zoonotic diseases. It also promotes cooperation between national programmes and nongovernmental organizations to develop strategies to prevent and control zoonoses.
- EMRO is responsible for upgrading the quality of locally produced vaccines against rabies through technology transfer and staff training in several countries of the Region, including Morocco, Pakistan, the Sudan and Tunisia.
- EMRO coordinates its activities with those of the Mediterranean Zoonoses Control Programme (see page 62).

The major problems experienced by the regional and national zoonoses programmes include inadequate numbers of veterinarians in the Ministries of Health, limited power of national zoonoses committees, insufficient facilities in public health laboratories for identifying and diagnosing zoonotic diseases, inadequate budgetary resources, and weak intersectoral cooperation in the exchange of information on, and coordination of, VPH activities.

Mediterranean Zoonoses Control Programme

Zoonoses and foodborne diseases cause public health and socioeconomic problems of considerable magnitude in most of the Mediterranean, including the Eastern Mediterranean. The main factors responsible for the emergence and re-emergence of zoonotic diseases are the close contact of human populations with animals, the consumption of animal products such as unpasteurized milk and other dairy products, changes in nutritional habits, the continuous intensification of animal production, the increase in international trade in animals and animal products, the rising number of stray dogs and wild

carnivores, and the illegal slaughtering of animals and inappropriate animal waste disposal practices.

Decades ago, the countries of the Mediterranean realized that zoonotic diseases, such as brucellosis, echinococcosis, leishmaniasis, rabies and zoonotic salmonellosis could not be efficiently controlled or eliminated if prevention, surveillance and control activities were carried out in isolation by individual countries. Programmes implemented in individual countries have had only partial success or have failed. Effective surveillance and control of zoonoses require strong regional cooperation, timely exchange between countries of reliable information on disease occurrence, sustained intercountry technical cooperation, and harmonization of surveillance and control strategies and legislation.

This situation was first addressed by Member States of WHO at the Thirty-first World Health Assembly held in 1978, which adopted resolution WHA31.48 on the prevention and control of zoonoses and foodborne diseases due to animal products. Following adoption of this resolution, WHO created the Mediterranean Zoonoses Control Programme (MZCP), and established the Mediterranean Zoonoses Control Centre the following year in Athens to implement the activities of the Programme. The MZCP collaborates closely with the Department of Communicable Diseases Surveillance and Response at WHO Headquarters, Geneva, as well as with EMRO, specialized WHO collaborating centres and the MZCP network of national participating institutions.

The main objectives of MZCP are to foster national and interregional programmes for the prevention, surveillance and control of zoonoses and foodborne diseases as an integral part of national health programmes, to strengthen cooperation between national animal health and public health services, to improve prevention, surveillance and control of these diseases, and to foster collaboration between MZCP Member States, WHO collaborating centres and MZCP national participating institutions. As an international programme, MZCP contributes to the protection of public health and to socioeconomic development in the area.

MZCP depends on the annual contributions of its participating countries and on the contributions in kind from its collaborating institutions. Currently the countries participating in MZCP include Cyprus, Egypt, Greece, Kuwait, Lebanon, Portugal, Saudi Arabia, Spain, Syrian Arab Republic and Turkey; countries associated with MZCP through collaborating institutions include Algeria, Italy, Jordan,

Malta, Morocco, Tunisia and Yemen. Italy is also expected formally to join MZCP in the near future. Representatives of participating countries meet every 2 years in a Joint Coordinating Committee to evaluate the activities implemented during the current biennium and to define the plan of work for the next biennium.

MZCP is currently shifting its main focus and activities from inter-country coordination and collaboration to national human resources development in the participating countries in order to concentrate on those activities of which it has the most experience. Such activities include the training of health officers, veterinary officers and laboratory personnel in areas related to the surveillance, prevention and control of selected zoonoses, hazard analysis critical control point and management of VPH programmes.

One of the main objectives of this plan is to establish MZCP as a leading training programme on zoonoses and VPH activities in the region.

Food and Agriculture Organization of the United Nations

The difficulties of integrating components of human and animal health activities in the surveillance, prevention and control of zoonotic diseases are well known. While the responsibility for prevention, surveillance and control of specific human and animal diseases can easily be established, it has been far more difficult to place responsibility and mobilize resources for controlling zoonotic diseases. This is particularly true for diseases with low prevalence in humans and with limited economic importance for livestock production.

Historically, the Food and Agriculture Organization of the United Nations (FAO) has always recognized the importance of VPH as an integrated component of human health care and animal health services. In international meetings and consultations, FAO has pledged to collaborate in controlling zoonotic diseases and to promote the concept of VPH. Unfortunately, progress in controlling zoonotic diseases is limited in many developing countries. This is despite the accumulated knowledge about their epidemiology, diagnosis and control, the availability of successful models for their control/eradication, and the commitment of international organizations. Furthermore, in some countries, progress has been reversed as a result of economic and structural changes.

FAO has identified two areas that influence the control and prevention of zoonotic diseases: the availability of reliable data and information, and VPH structural administrative changes. These areas are discussed below.

Data on zoonotic diseases

Accurate information about the epidemiology and surveillance of zoonotic diseases is essential for designing, implementing and evaluating control, prevention or eradication programmes. Abattoirs offer an opportunity to obtain reliable data on a number of important animal diseases, including the major zoonoses. For example, it should be possible to trace cases of infected meat back to the production unit, using an animal identification system. However, data collected from the field are only as good as the field veterinarian's ability to recognize diseases, and the postmortem and laboratory facilities for confirming the clinical diagnosis. Unfortunately, field data are often questionable, or are not representative, which hampers the establishment of realistic targets and goals.

There is thus an urgent need for mechanisms and methodologies that generate reliable data. One such initiative is the ongoing Regional Animal Disease Surveillance and Control Network (RADISCON) for North Africa, the Arab Peninsula and the Eastern Mediterranean which has targeted brucellosis and other zoonotic diseases. In addition, high priority should be given to improving the quality of data on zoonotic diseases, including the use of serology and molecular epidemiology for surveillance and monitoring. FAO, OIE and WHO should collaborate further to develop modalities and methodologies for minimum reporting standards for zoonoses. This process has already been initiated through RADISCON, which has developed and distributed model formats for reporting. This reporting needs to be complemented by laboratory facilities for confirming diagnoses.

VPH functions and structures

In the past, it has generally been agreed that a separate national unit needs to be created before VPH programmes can be successfully implemented. This unit should have responsibility for the surveillance, prevention and control of zoonotic diseases, as well as for problems related to food hygiene. To ensure the mobilization of intersectoral resources, and the highest degree of community participation, there should be close collaboration between all the ministries and local authorities, including those for health, agriculture, internal affairs and municipalities (often responsible for meat inspection). The media should actively promote this integrated effort. FAO also collaborates in assessing the risks and socioeconomic impacts of zoonoses, as well as in other VPH responsibilities, such as cost–benefit analyses of control strategies. Furthermore, FAO supports training of personnel in VPH and the development of national infrastructure.

Some of the most serious constraints to establishing and maintaining VPH activities at the country level include the lack of mechanisms for assessing the social and economic consequences of zoonoses, a national infrastructure that is inadequate for programme operations, a lack of professionals with appropriate training, the lack of a mechanism to identify and mobilize resources in different sectors, and insufficient funds for initiating programmes. These constraints have been further complicated by economic reforms and privatization, the move towards which has forced the restructuring of national veterinary services and weakened disease control and animal health issues. In many cases, this has resulted in an almost complete disappearance of VPH activities. Consequently, FAO has embarked on a process to design models for the structure and functions of veterinary services, including VPH.

The following are specific examples of VPH activities that are currently being implemented or are planned:

- Procedures for monitoring VPH should be standardized and should include contacts with ministry of health officials with responsibility for the control and monitoring of zoonoses, and with national/regional WHO representatives.
- Information should be shared with collaborative partners, including WHO/FAO collaborating centres. FAO considers it important to work closely with the collaborating centres and to make the most of their potential ability to attract funding.
- To ensure the involvement of all stakeholders and the coordination of VPH activities, the identification of problems and initial planning activities should include networking. This will create a collective ownership of and responsibility for VPH programmes.
- The importance of community participation for the success of programmes for the control or elimination of zoonoses cannot be overemphasized, and educational programmes for all levels, including primary and secondary schools, should be developed and promoted.
- Primary health care programmes supported by nongovernmental organizations and bilateral international assistance often include components of zoonotic disease control. FAO, in collaboration with WHO, should establish and maintain a database on all activities related to zoonoses control. These programmes should be coordinated to avoid duplication of effort.

Given the complexity of zoonoses and the shortage of resources in developing countries, it is unlikely that many will be able to introduce zoonosis control and other VPH activities. It may be relevant to

evaluate past approaches, where the focus was on single diseases, instead of developing comprehensive pilot programmes for smaller geographical areas with subsequent expansion. To encourage livestock producers, it should be made clear that controlling zoonoses and other diseases will lead to lower animal production losses.

Office International des Epizooties

The Office International des Epizooties (OIE) was created in Paris in 1924 and currently comprises 151 Member Countries. Its three main aims are:

- To provide information on animal health worldwide.
- To coordinate international research on important animal diseases and their control.
- To harmonize trade regulations relating to animals and animal products.

OIE is involved in VPH issues in the context of these three aims and its activities are primarily:

- To survey internationally important animal diseases, including zoonoses.
- To harmonize international efforts to prevent and control animal diseases.
- To publish and disseminate scientific materials.

These activities are discussed below.

International surveillance of animal diseases, including zoonoses

Animal diseases are classified into two lists (A and B), according to their socioeconomic and public health importance and their degree of contagiousness. There are 15 diseases on list A, all of which are of serious socioeconomic or public health importance and are highly contagious. Outbreaks of diseases on this list require immediate reporting to OIE, which in turn informs all countries without delay and provides them with weekly updates of the disease situation. Among the diseases on list A, Rift Valley fever is the only important zoonosis.

Diseases on list B normally do not require immediate international reporting. Member Countries receive annual reports of the occurrence of these diseases and of the measures taken to control them. There are 90 diseases or groups of diseases on list B, about 25% of which are zoonoses and subject to annual reporting to OIE, unless any epidemiologically important changes occur. For example, when rabies occurs in the USA, where the disease is endemic, it is not

subject to immediate reporting. However, if it should occur in the United Kingdom, which is free from rabies, this should be reported to OIE immediately.

In addition, veterinary services in Member Countries are informed of disease outbreaks that are subject to immediate reporting, through the OIE weekly publication, *Disease Information*. This information is also conveyed electronically via the organization's web site (http://www.oie.int). The OIE also publishes bimonthly reports (*Bulletin*) and annual reports (*World Animal Health*) that cover the epidemiology of the diseases on lists A and B and the measures taken by Member Countries for their control. Epidemiological information on these diseases is also available through Handistatus II, a database that can be downloaded from the OIE web site.

International harmonization of disease prevention and control

OIE publishes the *International Animal Health Code*, which harmonizes the import/export requirements for animals and animal products with respect to the diseases on lists A and B, in addition to other disease prevention measures. Several zoonotic diseases are included in this volume, which is periodically updated. The information on risk analysis takes into account the risk to both humans and animals. The International Animal Health Code Commission is now working to include a chapter on zoonoses that are transmissible from non-human primates, and one on quality assurance of veterinary services. The model international health certificates prescribed in the *International Animal Health Code* contribute to safe international trade of animals and animal products, from both animal and public health viewpoints.

OIE also publishes the *Manual of standards for diagnostic tests and vaccines* which describes standards for laboratory diagnostic tests and for the control and production of biological products (principally vaccines) for veterinary use worldwide. The most recent edition includes several chapters on zoonotic diseases (e.g. Rift Valley fever, anthrax, brucellosis, rabies, leptospirosis) and a chapter on human safety in veterinary microbiology laboratories.

Food safety

Since 1930, the OIE International Committee has dealt with questions of food hygiene, devoting some of its work to the scrutiny of health certificates for meat and meat products. The Committee has also formulated recommendations on food poisoning, salmonellosis, trichinellosis, listeriosis, BSE, the veterinary supervision of milk production, inspection of foods of animal origin, food additives, hor-

mones, and residues of veterinary drugs. The interests of OIE in food hygiene were reinforced in the resolution adopted by the International Committee in its Fifty-ninth General Session in May 1991 on chemical residues in animal products. The Nineteenth Conference of the OIE Regional Commission for Asia, the Far East and Oceania held in Penang, Malaysia, in November 1995, recommended that food safety programmes be proactive and dynamic, and focus resources to take into account changes in animal husbandry, animal health, processing technologies and consumer expectations. It also recommended that Member Countries strengthen the collaboration of food safety functions between relevant sectors.

An OIE Working Group on Veterinary Drug Registration was set up in 1985 to deal with issues related to the use of veterinary drugs in food animals, such as the development of resistance to antimicrobial drugs in humans. OIE experts and consultants have also been involved with international issues in transplantation biotechnology, including the use of non-human cells, tissues and organs.

Publications

In addition to its publications on disease surveillance, OIE publishes many books and reports to provide official veterinary services with up-to-date information on animal diseases, including zoonoses, and on VPH. OIE has devoted some issues of its *Scientific and Technical Review*, a periodical directed at public veterinarians, to zoonoses and VPH, as well as regularly publishing papers on these subjects.

OIE and other international organizations play an important role in information exchange, the prevention and control of zoonotic diseases and VPH. OIE addresses zoonoses and VPH issues in close collaboration with WHO, with which it divides responsibilities according to each organization's objectives and resources. Although the aims of OIE remain unchanged, its activities to address these aims reflect the changing responsibilities and activities of official veterinary services.

Nongovernmental organizations

In many developing countries, there are different types of nongovernmental organizations that promote a variety of interests, such as income generation, religion, culture, community health, animal health and production, ecology, advocacy for women, political reform and human rights. Governments and nongovernmental organizations vary in their ability to collaborate effectively, and have often been hampered by mutual distrust and different values and management styles (*1*).

The role of nongovernmental organizations in a "bottom-up" approach

Nongovernmental organizations have the capacity and commitment to make up for the shortcomings of the state and the marketplace in reducing poverty, by making positive contributions to interventions and other grass-roots initiatives. An alternative development model supported by nongovernmental organizations advocated "bottom-up" projects that involved the poor directly in income-generating and social activities. The purpose was to enhance their income-earning capacity and to empower them to develop on their own (*2*).

The collaborative roles of nongovernmental organizations with multilateral and bilateral agencies

The International Bank for Reconstruction and Development (World Bank) and many bilateral development agencies, such as the Canadian International Development Agency (CIDA), the Department for International Development of the United Kingdom (DFID) and the United States Agency for International Development (USAID), advocate increased collaboration with local nongovernmental organizations to advance their goal of reaching marginalized people, such as women and the poor. Nongovernmental organizations tend to have greater local knowledge of the people, and to have their trust, making them valuable and experienced allies in projects of mutual interest (*3*).

The role of nongovernmental organizations in linking human and animal health

Governmental and nongovernmental sectors each have certain strengths and weaknesses in their abilities to link human and animal health. The greatest strength of nongovernmental organizations is their flexibility. For example, they can implement community animal health programmes in areas not reached by trained veterinary personnel.

The role of nongovernmental organizations in conflict zones

Nongovernmental organizations have a particularly important role to play in conflict zones where there is no recognized government, or where the national government is weak. In Somalia, a rinderpest vaccination campaign undertaken by a nongovernmental organization in 1993 achieved a 95% vaccination rate, compared to the 50–80% rate achieved by government veterinary services. Nongovernmental organizations often collaborate with non-veterinary partners, and this should be expanded to include VPH activities where appropriate, without necessarily involving a government agency.

The catalytic role of nongovernmental organizations

Nongovernmental organizations tend to act as catalysts for change and are responsive to the needs and problems of beneficiaries. Given their greater local knowledge and commitment, nongovernmental organizations are more likely than governments to have the interest and skills for adapting development projects and programmes to local conditions. Their small size and proximity to beneficiaries can make them more accountable for results.

The complementary role of nongovernmental organizations

Nongovernmental organizations often complement the government in VPH activities. For example, the Heifer Project International in the United Republic of Tanzania relies primarily on government livestock extension workers and veterinarians, but it also provides additional training and transportation which the government often cannot afford. This raises important questions about the role of government in VPH, and whether reliance on nongovernmental organizations and the private sector is sustainable. The donor community must decide whether working through nongovernmental organizations is an appropriate and long-term solution.

Many local nongovernmental organizations are already working with community health programmes and are accepted at local government level. They are an integral part of the overall national, social and economic development plans. At present some of them have developed and established linkages such as community participation, collaboration between and within sectors, international collaboration, and adaptation of appropriate technologies for use under local conditions.

The contribution of nongovernmental organizations to health for all in the twenty-first century

The goal of health for all in the twenty-first century cannot be achieved without significant contributions from nongovernmental organizations. Stronger partnerships between governments, private organizations, nongovernmental organizations and communities can promote human health and support VPH activities and primary health care. Most of the VPH-oriented nongovernmental organizations aim to provide veterinary research and related scientific findings to governmental, public, VPH and veterinary services, which may lack the managerial experience for adapting technical guidelines and recommendations to national conditions.

The role of nongovernmental organizations at the community level

Nongovernmental organizations can effectively identify community needs and promote community participation. They can contribute

to the development of health policies, especially on environmental issues and VPH. In addition, they can deliver services to vulnerable and inaccessible groups cost-effectively, and facilitate recovery of costs.

Weaknesses of nongovernmental organizations

The greatest weakness of nongovernmental organizations is their small size and scope, and lack of authority. There are also no uniform standards and little systematic documentation of activities and impacts. Nongovernmental organizations are usually dependent on external donors and may collapse if funding is withdrawn. Some local and national nongovernmental organizations, such as the national livestock producers' association in Bolivia (UNAPEGA), are instituting membership fees. The Heifer Project International strengthens its nongovernmental organization partners through early planning for sustainability, including finding alternative funding.

The role of nongovernmental organizations in promoting and implementing VPH

Currently, nongovernmental organizations promote and implement VPH activities by:

- Training researchers in the control and prevention of zoonotic diseases.
- Collecting and analysing data for FAO, OIE, WHO and other donor agencies.
- Supporting WHO Member States in the epidemiological surveillance of zoonotic and foodborne diseases of animal origin, and in measures to control them.
- Providing a forum for the exchange of scientific and technical information on the epidemiology and control of zoonotic diseases, and on other VPH activities.
- Collaborating at all stages of VPH programmes, including planning, execution and evaluation.
- Forming liaisons between public health and agriculture ministries, and between international nongovernmental organizations and donor agencies in WHO Member States or Regions.
- Implementing community action research, using health system methodology, to help solve community VPH-related problems.
- Providing training at the community level in livestock management and in handling food of animal origin.
- Working with women's groups on livestock production and income generation.

Member States[1]

Developed countries

The concept, structure and delivery of VPH services vary considerably from country to country. Among developed countries, responsibility for these activities is usually clearly defined and authorities carry out their duties without major problems. For example, responsibility for VPH activities is shared by four ministries in France, while in Italy the Ministry of Health has sole responsibility. Specific legislation, such as laws and regulations, and enforcement mechanisms also exist to ensure compliance.

Because of growing consumer concerns about food quality and safety over issues such as BSE, salmonellosis, *Escherichia coli* and other infections of animal origin, several countries are in the process of reviewing the framework and scope of their VPH responsibilities. There are plans to integrate VPH units with those responsible for food quality and safety and associated environmental issues. In some European countries, such as France, Italy and the Netherlands, this is partly due to the increasingly centralized regulatory authority of the European Union. To prepare future veterinarians better for the challenges associated with the development of acceptable standards for both producers and consumers, several countries have modified their veterinary curricula to include subjects relevant to future VPH activities.

Developing countries

While the focus of the VPH programmes in Canada, the USA and many European countries has shifted towards food safety and quality, in developing countries the aim of these programmes is to control zoonotic diseases and it will remain so for some time. However, contrary to the situation in developed countries, implementation of VPH in developing countries faces a number of difficulties. These are related to the lack of a clearly defined mandate and associated legislation, and to the fact that no government agency has specific responsibility for VPH. The implementation of VPH programmes has been further hampered by the lack of priority-setting and resources including trained professionals and auxiliary staff, and the lack of reliable data. Where VPH-related programmes have been designed, the approach has often been fragmented; for example, there is often no agreement as to which diseases should be included for consideration by commissions set up to monitor zoonoses.

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[1] Includes reports from Brazil, Cyprus, India, Italy, Malawi, Nepal, the Philippines, the Russian Federation, South Africa, Thailand, Uganda and the USA.

In many countries the situation has been further complicated by forced structural changes in veterinary services brought about by economic reforms. These changes, which include downsizing and privatization, often occur without sufficient analysis of what services need to be retained in the public sector for the "public good". The result has been that VPH services are unable to meet the needs and demands of the public and the livestock industry. In an attempt to counter the negative effect of reduced funding for VPH activities, Brazil has decentralized a number of VPH responsibilities to municipalities. It is in the process of harmonizing VPH functions in different regions, which have very heterogeneous infrastructures, including those for developing mechanisms for monitoring the implementation of regulations.

In Malawi, Nepal, the Philippines and Uganda, one of the main problems has been the shortage of qualified personnel. It is not possible to create comprehensive programmes with limited human and economic resources and VPH activities have therefore focused on one or two of the most important zoonotic diseases. In most developing countries VPH activities may have difficulties in competing for funds with the veterinary services, which give priority to those diseases considered to be of greatest socioeconomic and public health importance.

Trends in VPH

Trends concerning the availability of reliable data

All countries agree that reliable data are necessary for designing, implementing and evaluating VPH programmes. However, field staff often lack the knowledge for diagnosing diseases, and laboratory facilities for confirming diagnoses are often unavailable. Furthermore, the lack of a coordinated programme for ensuring collaboration between all stakeholders impedes efforts to improve diagnosis, and prevents the reporting of data from the field to epidemiological units responsible for VPH-related surveillance.

Trends in VPH education and training

In the past, the veterinary curricula in most developed countries have included subjects related to VPH, with a strong emphasis on meat inspection and food control. As mentioned earlier, the concept and scope of the VPH programmes in some of these countries are being revised to give greater emphasis to food safety and quality, and methodologies are being developed for a "farm-to-table" approach. In other countries, VPH-related subjects have only recently been included in veterinary curricula. Countries with no veterinary faculty

have to accept the curricula of neighbouring countries, which may or may not include VPH-related subjects.

Trends in implementing VPH programmes

Past experiences with implementing VPH programmes should form the basis for designing future programmes. For example, the strategy of creating independent commissions for individual zoonotic diseases should be abandoned, since this has led to duplication of activities and wasted resources. Successful experiences should be studied further. For example, in Cyprus a high-level committee was given the mandate to coordinate control strategies for several zoonotic diseases, which resulted in the control of echinococcosis and the elimination of brucellosis. In Brazil, efforts to engage the private sector in control strategies for zoonotic diseases also deserve further study. In Nepal, a VPH programme was introduced, but was subsequently abolished, partly because the necessary legislation and regulatory guidelines were lacking. The development and introduction of the necessary guidelines and legislation created the environment and momentum for the reintroduction of the VPH programme.

VPH in the Philippines: a specific example

In the Philippines there is no central authority in charge of VPH programmes, and VPH-related activities are fragmented and depend on the different priorities of the agencies concerned. The only programme for the control and prevention of zoonoses that deals with both human and animal aspects is the national rabies control programme. The programme is coordinated by an interagency committee composed of representatives from the departments of agriculture, education and health and local government, and a number of nongovernmental veterinary organizations. Activities have been limited mostly to the implementation of canine rabies control through standard parenteral vaccination in selected communities, prioritized according to the number of human and animal cases recorded. However, this programme only covers 20% of the total target dog population because of financial constraints and competing priorities, such as the campaign to eliminate foot-and-mouth disease.

The Philippine Animal Health Centre and the Bureau of Animal Industry of the Department of Agriculture have specific programmes for livestock and poultry development, the prevention and control of animal diseases, vaccine and drug evaluation and regulations, quarantine, and other activities. The National Meat Inspection Commission is also under the Department of Agriculture and regulates the flow of livestock and meat products, both locally produced and imported,

through various stages of marketing and is responsible for the accreditation of livestock and poultry-processing plants. The Commission also has a national food safety programme.

Veterinarians in the Bureau of Animal Industry and the armed forces of the Philippines have been involved in the Disaster Preparedness Programme. During the 1991 eruption of Mount Pinatubo, these veterinarians were among the first to respond to the situation and relocate animals. Veterinarians in the armed forces are responsible for food hygiene and sanitation and for providing veterinary services within the armed forces.

The Philippine Council for Health Research and Development of the Department of Science and Technology, together with the Philippine Association for Laboratory Animal Science, are leading the programme to promote and standardize the development of laboratory animal resources in the country. Their principal aim is to establish and maintain links with local and international organizations for greater sharing and mobilization of resources to meet local requirements for the production of biologicals, evaluation of foods, drugs and chemicals, animal modelling and biomedical research. The Philippines is a major exporter of laboratory-bred macaque monkeys for biomedical use and considerable information has been generated by Filipino primatologists in the field of primate husbandry and medicine.

The Research Institute for Tropical Medicine, a research agency of the Department of Health, has a veterinary research department that is divided into two units: VPH and laboratory animals. The veterinary research department has been actively involved in national programmes, such as that concerned with rabies, as well as the Department of Science and Technology programme. The veterinary research department also serves as the referral centre for the diagnosis and surveillance of human and animal rabies and of Ebola viruses. Its activities include field operations research, laboratory-, hospital- and community-based studies on disease interventions, and the improved diagnosis and surveillance of rabies, Ebola and certain other emerging zoonoses, such as hantavirus and dengue. The department is the only link to the medical profession in the prevention and control of zoonoses in the country.

The Philippine Society for VPH is a relatively small group of veterinary practitioners from both the private and public sectors, whose primary aim is to establish and promote VPH as a speciality field in veterinary medicine. A Speciality Board administers oral and written examinations and grants candidates a diploma in VPH. All local

veterinary schools have VPH courses included in their undergraduate curriculum, but only the University of the Philippines offers a Master of Science degree in VPH. It is evident that a coordinating unit at least, in either the Health or the Agriculture Department, is necessary to enhance cooperation among the agencies concerned. This will subsequently strengthen and provide direction for VPH programmes in the country. There may also be a need for a regional effort or coalition of VPH programmes, either for Asia or South-east Asia or Asia–Pacific Regions.

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Annex 2

VPH in disasters in developing countries[1]

The two major causes of disasters in developing countries are epizootics and geophysical events. Throughout history, epizootics have killed or reduced the production efficiency of animals. Similarly, geophysical events affect livestock agriculture every year, sometimes exacerbating epizootics, and causing considerable losses of animals and spoilage of food. Epizootics and geophysical events also affect developed countries, but usually with a lower frequency and impact. While developed countries may be able to compensate for any losses incurred by increasing production in other parts of the country. In contrast, disasters in developing countries usually have a long-term impact on animal production and, as a result, on public health and the economy.

Public health is dependent on animal health in developing countries because poor animal health directly affects the human food supply. The livestock industry is the primary source of essential amino acids for the human population. Essential amino acids are necessary for normal growth, immunity and longevity of humans and may not be available in sufficient quantities in vegetarian diets. Many developing countries have limited food reserves and nutritional deficiencies are common in humans. During disasters, the scarcity of food can be further exacerbated by animal deaths and by spoilage of foods.

Following a disaster, developing countries must aim to re-establish their livestock industry as quickly as possible, so as to minimize the losses, such as in the food supply, draught power and personal wealth, and their reliance on disaster relief from other countries. This is only likely to be possible if priority is given to rebuilding livestock agriculture following a disaster.

Examples of disasters involving the livestock industry are discussed below.

Geophysical disasters

In 1970, a cyclone in East Bengal, India, killed approximately 60% of the cattle in a 5000 km^2 area; some 30–80% of farmers lost cattle due

[1] This paper was submitted by Sebastian E. Heath, Assistant Professor, Purdue University, School of Veterinary Medicine, West Lafayette, IN, USA, and was distributed through the pre-Study Group email discussion.

to drowning. Six months later a survey revealed that the proportion of land being cultivated had decreased from over 20% to about 6%. The most common reason given by farmers was the lack of cattle and buffalo to plough the fields. It was estimated that 123000 cattle (31.6 cows per 100 hectares) and 127000 ploughs were needed to return production levels in the area to those before the cyclone. Nearly 90% of all fishermen were unable to fish because they had lost essential equipment.

In 1991, in southern Chile, Mount Hudson erupted sending volcanic ash as far south as the Falkland Islands (Malvinas). Much of this ash settled on land grazed by sheep in Argentina and Chile, thousands of which died due to starvation.

In 1992, droughts in Zimbabwe resulted in a 12% decrease in the national economy, most of which was due to deterioration in the agricultural sector.

In the winter of 1996, in China, 700000 cattle and yak died as a result of the severe weather. Farmers were unable to plough large areas of fields in the following spring.

In floods affecting the Pacific coast of El Salvador in 1996, over 20000 cattle drowned. The damp soil conditions in the many areas affected by the floods favoured the growth of parasites which resulted in increased mortality and morbidity of livestock.

In 1998, an extremely hard winter in northern Tibet, China, resulted in the death of over 10 million buffalo and sheep, most of which belonged to nomads.

Epizootics

In 1991, an outbreak of African swine fever in Haiti necessitated the slaughter of most of the pigs on the island. The indigenous breeds were replaced with "improved" breeds. However, farmers continued to lose income, because the new breeds of pigs were not hardy enough to walk the long distances to market for sale.

In 1998, outbreaks of Rift Valley fever were linked to heavy rains (which were thought to have been associated with an El Niño weather pattern) in north-eastern Kenya, southern Somalia and the United Republic of Tanzania. Several hundreds of thousands of livestock were affected, with mortality rates between 50% and 75% in the early stages of the outbreak. Over 89000 human cases were reported, of which more than 300 were fatal.

Epizootics associated with geophysical events

Between 1950 and 1980 there were three major El Niño events. Between 1984 and 1998 there have been four. A better understanding of weather patterns means that it is now possible to link increases in the incidence of diseases and disease outbreaks with rainfall patterns. For example, El Niño has been linked to outbreaks of foot-and-mouth disease, pneumonic plague, rabies and leptospirosis in the Caribbean and Latin America.

Technological disasters

Ten years after the Chernobyl nuclear disaster in 1986, sheep farmers in parts of Scotland still could not sell any sheep for human consumption because their pastures were highly radioactive.

Many wars and genocidal movements are marked by deliberate attempts to wipe out livestock agriculture in the countries under threat as part of an effort to destroy their national heritage and identity.

Vulnerability of human populations in developing countries to disasters involving animals

Communities in rural areas, including farm labourers and their families, are among the populations most vulnerable to disasters involving animals in developing countries. Most at risk are subsistence farmers and small-scale farmers when animals die, lose weight or become ill, who own their farms and have improved or natural pastures, who may find their livelihoods directly threatened as they usually have few reserves to fall back on. Many of these people also depend on livestock producers as employers for income; if livestock producers suffer economic losses, so do those who depend on him or her.

Impact of disasters on food availability

Food availability is affected by disasters in several ways. Large-scale mortality of livestock following the outbreak of a contagious disease or as a result of a disaster will decrease the number of animals available as a source of food for humans. Decreased food availability also results from weight loss in animals brought to slaughter, and contamination of food and failure of food hygiene practices resulting from disasters can reduce the amount of processed food that is available.

Differences in the sources of food and their respective marketing networks are responsible for creating differential impacts of disasters on both consumers and producers. In developing countries, most people in urban areas buy food of animal origin at markets. Typically, food that is processed and sold in urban areas is supplied by large-

scale producers or is imported. The shortfall in livestock, owing to death and weight loss, that would have been supplied by domestic producers to markets in urban areas forces a country to increase its imports or to request international aid. Unfortunately, neither of these options provides a permanent solution to the problem and both may contribute to a nation's international trade deficit. In rural areas of developing countries, a significant amount of food is grown by the families who consume it. The raising of animal species such as chickens, pigs, turkeys, ducks and guinea-pigs, and in some cases cattle, provides a supplementary source of dietary protein. Consumption of these animals and their products may make up as much as 30% of the protein intake of a subsistence farmer's family. Loss of minor animal species in disasters may result in nutritional deficiencies in subsistence farmers and their families. Children are most likely to suffer the effects of an impaired food supply, as many of them are already on marginal diets.

A role for veterinarians

For many years veterinarians have been the pioneers of animal agriculture throughout the world. The veterinary profession has been responsible for the eradication of many animal diseases, the development of veterinary vaccines, and disease surveillance and control programmes. In many instances, veterinarians have also contributed to the international relief effort in the wake of geophysical disasters. Veterinary involvement in disasters in developing countries has often suffered from the perception that veterinary programmes are exclusively oriented towards the control of epizootics. The disproportionate emphasis on the response to disasters and the lack of an all-hazards approach to disasters involving livestock also adversely affect veterinary involvement, and have alienated other disaster relief agencies and professionals active in developing countries. A regrettable consequence of this alienation is the increasingly common view that veterinarians are merely technicians, rather than professionals able to contribute to societal well-being. All types of disasters affecting animal agriculture in developing countries also affect society as a whole. Veterinarians should participate in emergency management teams and should work in programmes involved in all types of disaster reduction programmes. The role of the veterinarian in this integrated effort of emergency management should be clear, and is no different from other aspects of veterinary management of disasters; caring for animals is an effective method to provide better care for people. In the case of national disasters in developing countries, attention to animal agriculture is an effective method by which to improve public

health, the economy and the environment. Funding for disaster relief may depend on veterinary management of disasters in developing countries being recognized as a form of humanitarian assistance and a contribution to public health.

Annex 3

Contact addresses of selected relevant international institutions

World Health Organization
Avenue Appia 20
CH-1211 Geneva 27
Switzerland
Tel.: +41 22 791 2111
Fax: +41 22 791 3111
Web site: http://www.who.int

WHO Regional Office for Africa (AFRO)[1]
Parirenyatwa Hospital
P.O. Box BE 773
Harare
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Tel.: +1 321 733 9244
Fax: +1 321 733 9020
Email: regafro@whoafr.org
Web site: http://www.whoafr.org

Pan American Health Organization/WHO Regional Office for the Americas (PAHO/AMRO)
525 23rd Street NW
Washington
DC 20037
USA
Tel.: +1 202 974 3000
Fax: +1 202 974 3663
Email: postmaster@paho.org
Web site: http://www.paho.org

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WHO Post Office
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