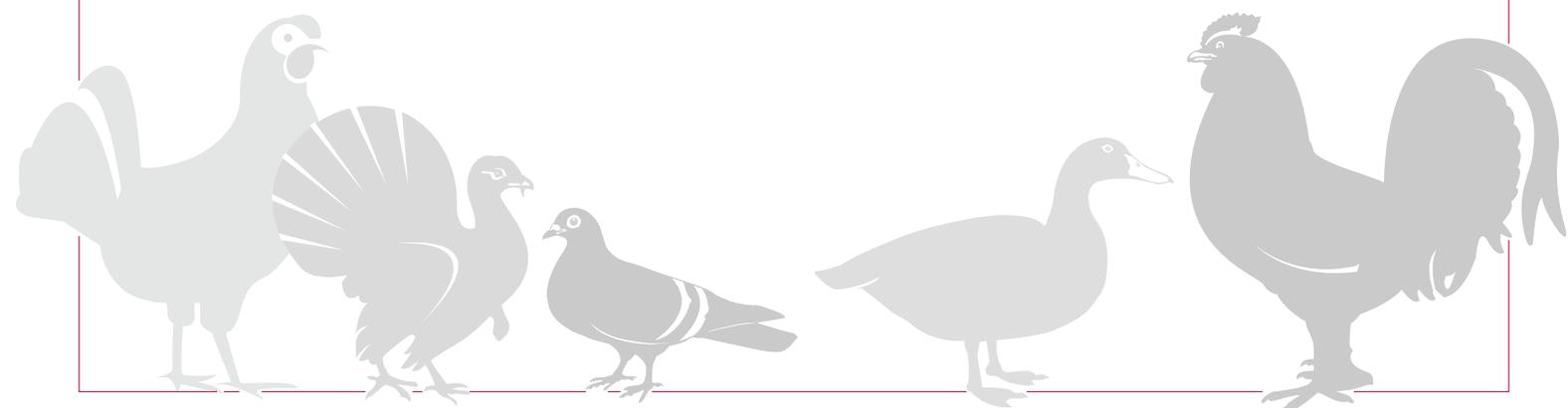


Poultry health and disease control in developing countries



Poultry health and disease control in developing countries

Trevor J. Bagust, Department of Avian Medicine, Faculty of Veterinary Science, University of Melbourne, Australia

INTRODUCTION

In the last half century, significant increases in the productivity of modern poultry stocks have been achieved for both the meat and the egg production sectors of the global poultry industry. Synergies have resulted from advances made in all the major activities of poultry management and housing, nutrition and ration formulation, applying poultry genetics knowledge in commercial breeding programmes and better diagnosis and control of avian diseases. Of all these core elements, poultry health and disease can be the least predictable.

Although poultry diseases from nutritional and metabolic causes can be of concern, the emphasis in this information note is on controlling diseases that are caused by infectious agents, which can exert damaging – and sometimes immediate – negative effects on the profitability of commercial operations. The development of an intensive poultry industry in many of the countries discussed here depends on the growth in number and size of small and medium-sized commercial poultry operations. The emphasis in this review is therefore primarily on optimizing poultry health for this scale of operations. Because of the importance of small-scale village-based production units in many developing countries, however, the poultry health implications for and from such flocks are also included.

POULTRY DISEASES: PATHOGENS AND THEIR COSTS TO PRODUCTION SYSTEMS

- *Pathogens* are disease-causing microorganisms, and include various bacteria, viruses and protozoa.

- A *specific pathogen* is a microbe that is able to cause a specific disease following inoculation of a susceptible host chicken with a purified culture. For example, avian health research has shown that ILT virus is the sole cause of the poultry respiratory disease syndrome recognized in the field as infectious laryngotracheitis (ILT), while the bacterium *Pasteurella multocida* is the specific cause of another respiratory disease known as sub-acute fowl cholera.
- “Although the relative importance of poultry diseases may differ between countries and geographical areas, there are few important diseases that are unique to particular parts of the world” (Biggs, 1982).
- At the global level, however, differences in distribution among regions are now apparent, because genetic variants have emerged within some of the major specific pathogens of chickens. This has become important for attempts to prevent the spread of virulent strains through international movements of poultry products. Table 1 shows the regional distribution of different biotypes of some important pathogens in 2008. ***Inter-regional variation in the distribution of pathogen strains of higher virulence will become more significant in trade, as the poultry industries of developing countries enter export markets.***

Avian pathogens in the future

Emerging pathogens are those for which recognition continues to occur over time (see Information Note on “Emerging Pathogens of Poultry Diseases”). These pathogens arise through various ge-

TABLE 1

Regional distribution of higher-virulence strains of major poultry pathogens in 2008

Pathogen	Africa	Asia	SE Asia	Australasia	Europe	Near East	Americas	
							North	South
Avian leucosis virus (ALV)-J (see Information note 1)	+	+	+	-	-	+	-	+
Avian influenza (HPAI) (high pathogenicity)	+	+	+	-	-/+	+	-	+
Infectious bursal disease virus (IBDV)								
vv strains	+	+	+	-	+	+	-	+
variant strains	+	+	+	-	-	+	+	+
Newcastle disease virus (NDV) high virulence	+	+	+	-	+	+	-	+
<i>Ornithobacterium rhinotracheale</i> (ORT)	+?	+	+	-	+	+	+	+
<i>Salmonella enteritidis</i> PT4	+?	+	+	-	+	+	-?	+
Turkey rhinotracheitis (TRT) virus	+	+	+	-	+	+	+	+

Source: Bagust, 2008, Avian Health Online™.

netic mechanisms, including mutation, recombination or co-evolution with vaccines (e.g., Marek's disease virus) or the medications used (e.g., coccidiostats). **There is a very high probability that several new poultry pathogens will emerge during the next ten to 20 years.** The most likely candidates are pathogenic variants of avian ribonucleic acid (RNA) viruses, specifically those causing infectious bronchitis, Newcastle disease, infectious bursal disease and avian influenza, as well as a hypervirulent form of Marek's disease caused by an avian DNA (herpes-) virus, which is arguably the most challenging disease to control in intensive poultry industries worldwide.

Developed poultry industries are characterized by on-site biosecurity programmes, which are designed to prevent or minimize incursions by known infectious diseases. These programmes are supported by close veterinary and laboratory surveillance for poultry health. A newly emergent disease can therefore most likely be recognized quickly in any developed poultry industry. **However, in countries where poultry production sites still lack adequate biosecurity programmes and access to competent veterinary services with laboratory backup, the economic consequences and time needed to identify, control and resolve the problem are much greater.** The danger is that one or more emerging pathogens become established within a country's poultry populations and then continue to pose a threat as an endemic infection.

The costs of diseases within a country's poultry industry

Using figures from the United States, Biggs (1982) reported that the total economic costs of disease (including vaccines and condemnations) were about 20 percent of the gross value of production (GVP) and about three times the cost of losses from mortality. An analogous 2007 analysis conducted by the University of Georgia, United States, calculated that the GVP of the United States poultry industry in 2005 was US\$28.2 billion, and disease losses were 8.2 percent of this. Both studies showed that for each US\$1 000 loss due to mortalities, another US\$2 000 is lost elsewhere owing to depressed productivity resulting from disease.

There is little information on the economic consequences of poultry diseases in developing countries. Hence one of the future challenges for these industries will be to organize the health infrastructure needed to conduct such analysis. Another will be to move from using frank mortality rates as an economic indicator of losses, to accounting for and then countering the high losses of productivity that result from health-related sub-optimal production.

Infrastructural capacity to diagnose the main causes of disease losses accurately will therefore prove necessary for countries seeking to develop a sustainable poultry industry.

POULTRY PATHOGENS AND THEIR MAJOR MEANS OF TRANSMISSION AMONG POULTRY PRODUCTION SITES

Table 2 lists 25 of the major infectious poultry diseases worldwide. Based on World Organisation for Animal Health listings (OIE, 2000), these are recognized globally as the diseases of most concern, because of their economic effects on commercial poultry production and their potential for negative effects on trade.

The diseases that are of the highest risk of accidental introduction into farms are denoted by ». These pathogens possess inherent properties of high transmissibility, and have enhanced resistance to inactivation (loss of infectivity) due to environmental temperature and sunlight. Such pathogens therefore tend to occur more frequently on poultry sites. Table 2 summarizes the major route(s) of transmission for each of the major pathogens. Knowing the means of spread of any pathogen is fundamental to the development of a plan of action to prevent spread of the pathogen and outbreak of the disease within a production site.

The poultry diseases listed in Table 2 are those likely to be caused by a single specific pathogen. Competent avian veterinarians and the technical personnel who undertake poultry health servicing for farmers in a modern poultry industry must be able to identify or at least suspect these diseases in their classical or relatively uncomplicated forms.

Further disease effects

Respiratory disease complex: Under field conditions, pathogens often interact with not only the host (bird) and its environment, but also one another. For example, day-old chicks arriving infected from the hatchery (vertical transmission) and remaining chronically infected for life are susceptible to other respiratory diseases such as infectious bronchitis or Newcastle disease. Fine dust particles in the poultry house air can then combine with superinfection by *Escherichia coli* bacteria contribute to additional respiratory insults, which will produce the (multiple) lesions that are seen at autopsy for *complex respiratory disease*. Field disease interactions often also involve common immunosuppressive agents, such as infectious bursal disease, Marek's disease or chicken infectious anaemia viruses. These increase the complexity of the disease pictures clinically and the lesions observable at autopsy.

Immunosuppression significantly decreases the ability of young poultry to respond effectively to standard vaccinations, and also predisposes them to infection by other specific pathogens. However, sub-clinical immunosuppression is often not readily apparent to the farmer, and therefore a common "silent" cause of significant economic losses. Pathogens causing such infectious disease conditions are termed "erosive" for site productivity (Shane, 2004). In contrast, major pathogens with high death rates and rapid spread such as NDV, IBDV or HPAI, although generically termed "catastrophic" diseases, cause lower economic losses in the longer term than the lower-level but more pervasive and widespread erosive pathogens do. Immunosuppression results from a range of known infectious and non-infectious causes, as shown in Table 3.

To diagnose the cause(s), competent autopsies combined with systematic on-site investigations of flock production, vaccination history and management practices need to be undertaken. However, results from laboratory examinations will often be needed to confirm a diagnosis. The Information Note on "Poultry Disease Diagnosis: Field Skills and Laboratory Procedures" gives further details.

In the context of poultry health and disease control, **the government of a country that aims to develop a sustainable modern poultry industry MUST THEREFORE also put in place competent field and veterinary laboratory capacity for the diagnosis of poultry diseases.** There is a strong need

TABLE 2

Infectious poultry diseases, pathogens and their routes of transmission among production sites

Poultry disease	Agent	Main signs and lesions produced in diseases in the field	Major route of spread		
			Faeco-oral (and contact)	Aerosols (and contact)	Eggs
Avian mycoplasmosis	Bacterium	Respiratory disease, air-sacculitis (<i>M. gallisepticum</i>) lameness, joint lesions, <i>M. synoviae</i>		+	+
Fowl cholera »	Bacterium	Acute form – septicaemia Chronic infections are associated with respiratory and head lesions	+ (wild birds and vermin)	+	
Highly pathogenic avian influenza	Virus #	Respiratory disease and high levels of deaths: HPAI H5N1 human deaths		+	
Infectious bronchitis »	Virus	Respiratory and kidney disease, egg production drops		+	
Infectious laryngotracheitis	Virus	Respiratory disease (varying severities) and conjunctivitis		+	
Newcastle disease	Virus #	Respiratory and nervous system disease: conjunctivitis (humans)		+	
Turkey rhinotracheitis	Virus	Swollen head, egg production drops, pneumonitis		+	
Infectious bursal disease »	Virus	Illness and losses especially 3–5 weeks old, with immunosuppression related diseases e.g. poor growth, necrosis of wingtips, inclusion body hepatitis	+		
Avian leukosis and reticuloendotheliosis	Virus	Tumours stunted chickens, tumours			+
Mareks disease »	Virus	Paralysis of legs and/or wings, tumours viscera, skin, nerves, eyes		+ contaminated dander and feathers	
Fowl typhoid	Bacterium	Watery diarrhoea, bronze livers	+		+
Pullorum disease	Bacterium	Sick chicks, ovary disease in adults	+		+
Poultry enteritis complex » (turkeys)	Virus (mixed)	Spiking mortalities, diarrhoea, weight loss and depression 1–4 weeks old	+		
Avian adeno Gp1 »	Virus	Inclusion body hepatitis broilers	+		+
Avian adeno Gp3	Virus	Egg drop syndrome in layers	Contact with ducks		+
Avian reovirus	Virus	Lameness, tendosynovitis	+		+
Avian chlamydiosis	Bacterium #	Infections of the spleen, liver and airsacs. Humans – precautions at autopsy!	+ Contaminated dust/aerosol		+
Campylobacter infection »	Bacterium #	Infections but not disease in chickens, Poultry meat serious source for humans	+		+
Paratyphoid Salmonella »	Bacterium #	Enteric infections in chickens and humans	+		+
END OF LISTING OF DISEASES OF TRADE CONCERN (OIE 2000)					
Avian encephalomyelitis »	Virus	Epidemic tremours in chicks, egg production drops in layers		++	
Chick infectious anaemia »	Virus	Anaemia and ill-thrift, then diseases of complex aetiology (causes) which are predisposed to by CIAV immunosuppression		++	
Infectious coryza	Bacterium	Nasal and ocular discharge, facial swelling, drops in egg production	+ (and spread via drinking)		
Fowlpox	Virus	Cutaneous lesions (dry) and wet forms	Transmission by mosquitoes		
Coccidiosis »	Eimeria	Dysentery, soft mucoid faeces. Blood in specific intestinal areas (7 chicken spp.)		+	

» Specific pathogens that are of highest risk of accidental introduction into farms.

Zoonotic poultry pathogen.

TABLE 3

Common causes of immunosuppression in poultry production

Infectious	Non-infectious
Infectious bursal disease	Stress
Marek's disease virus	Poor nutrition
Coccidiosis <i>E. coli</i> bacteria	Mycotoxins, e.g. aflatoxins Ammonia
Newcastle disease virus	Dust
Chicken infectious anaemia virus	Improper use of antibiotics
Fowl cholera <i>Pasteurella multocida</i>	Vitamin deficiency, e.g. A, C, E

Source: Horrox, 2000.

for close collaboration between the public and private sectors in achieving this important goal.

SITE BIOSECURITY: THE PRIMARY KEY TO POULTRY DISEASES CONTROL AND PREVENTION IN COMMERCIAL PRACTICE

Avian pathogens, which comprise disease-causing bacteria, viruses and protozoan parasites, do not recognize national boundaries, only production sites and their disease control circumstances.

The most important measure for sustainable and profitable production on a poultry site is therefore to have forward defences in place – i.e., a biosecurity programme whose components (see

Information Note on “Site Biosecurity and Supporting Strategies for Disease Control and Prevention”) work together to *reduce the risk of introduction of poultry pathogens* into a production site. For further and pathogen-specific protection measures, the farmer will also need to have correctly applied vaccination programmes for the dangerous (catastrophic) poultry pathogens that are known to be active in that region, such as Newcastle disease virus and virulent infectious bursal disease virus strains. Through this, disease outbreaks can largely be prevented, even if such pathogens gain entry to the site. A second tier of vaccinations – such as against some major immunosuppressive and respiratory disease agents (profit-erosive) – is also highly desirable. For poultry disease control, the most common problem on sites in many developing countries is their overreliance on vaccinations, rather than investing to achieve effective site biosecurity. The primary approach to poultry health on a production site should be to attempt to EXCLUDE diseases, rather than allowing relatively ready entry of a pathogen to flocks and then attempting to reduce its effects by immunoprotection, i.e., vaccination.

POULTRY HEALTH: NETWORK BUILDING IN A DEVELOPING COUNTRY.

Why should a network approach be taken to poultry health?

Because the real challenge for a developing country is to build sustainable poultry disease control systems that can focus and integrate their available professional poultry health resources. Although personal and political networks are often strong, professional health networking and the sense that industry personnel are working with the government sector to achieve common agreed aims can be much less evident. Fragmentation and duplication of resources and services, along with disagreements as to which (and how) areas of weakness must be strengthened, can mean that little real improvement of overall poultry health is achieved.

A distinguishing feature of the poultry health services in developed countries is the regular exchange of information among industry veterinarians (although their companies will be commercial competitors), government health services (laboratory and field) and often the universities in a region. Such communication and cooperation occur regularly, for example, quarterly within a soundly developed industry, because it is recognized that the mutual benefits of communicating about poultry health matters far outweigh the collective losses from silence.

How can the government agencies of a developing country position themselves to accelerate the development of a poultry industry?

Experiences gained in developed poultry industries worldwide have demonstrated that investing State resources in a ***central poultry health facility/unit with designated functions*** can provide an integrated special-purpose vehicle for delivering avian health-in-production services, as illustrated in Figure 1.

Government agencies and all industry stakeholders stand to benefit. ***Interaction between government and industry representatives is therefore essential for successful*** design and planning, and also later, when periodically reviewing the unit's performance in health and disease control. Industry might well contribute to financing this, for example, by providing funding for major pieces of laboratory equipment or other infrastructure that

it expects will provide high benefit to itself. However, the guiding principle must be to achieve focused and integrated health functions for the unit to produce the health outputs needed to support sustainable poultry production in the developing country concerned. Avian veterinarians should also have pivotal roles in the poultry industry, through protecting both poultry and human health (see Information Note on “Veterinary Roles in Health and Knowledge Transfer across a Poultry Industry”).

The primary thrust for senior government personnel, in partnership with industry, should be the planning of human resources to strengthen laboratory and extension skills for integrated activities that can deliver appropriate health services across the four sectors of the country's poultry industry. Proof of success will be visible evidence of the private sector choosing to use government services.

Investment in the construction of large purpose-built buildings or a stand-alone new facility should not be seen as the primary aim of this exercise. However, some low-cost special-purpose additions to an existing laboratory may significantly enhance the functional capacity of that unit. Examples could include the strengthening of microbiological health surveillance, or a simple building for secure maintenance of a small specified pathogen-free (SPF) poultry flock. Production of SPF eggs and chickens can then enhance local investigations, including with experimental reproduction of field diseases.

The overriding goal for the central poultry services unit is to be accessible and cost-effective for the veterinary and technical personnel who service commercial poultry production operations, particularly small and medium-sized farming enterprises. The modus operandum should be fee-for-service.

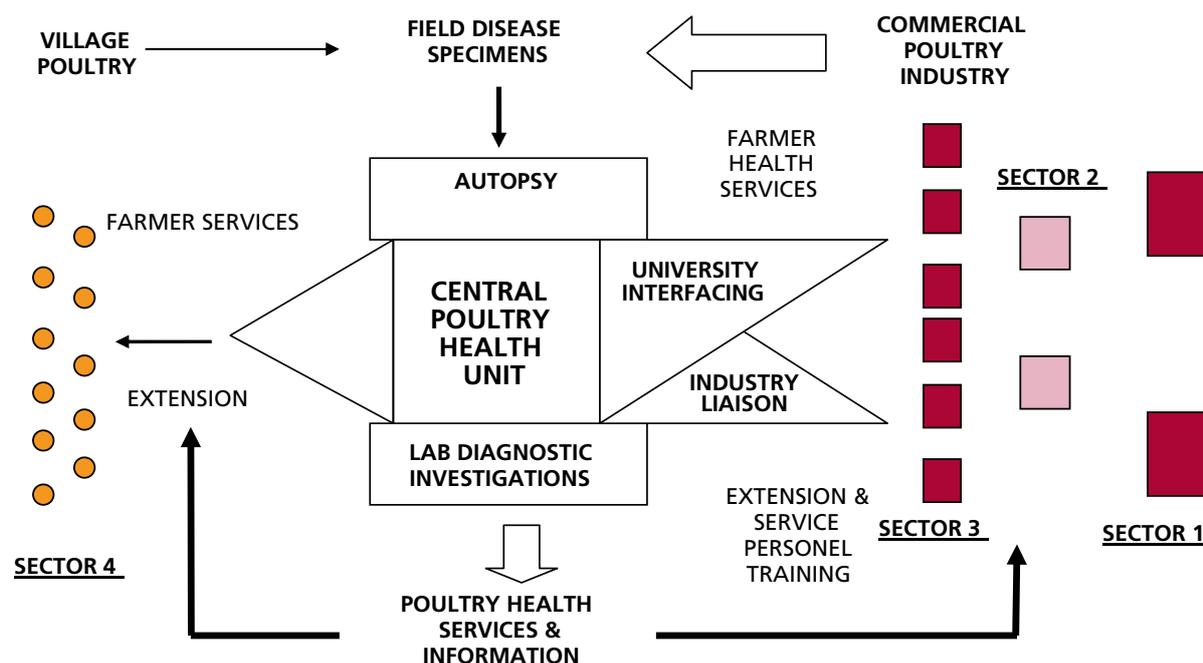
There will however be a clear responsibility for the services provider to direct and develop its staff resources adequately, to ensure that the services offered are relevant to the needs of the developing industry. The interfacing of industry and government poultry health production activities can then help to drive both (Bagust, 1999; Information Note on “Veterinary Roles in Health and Knowledge Transfer across a Poultry Industry”). For developing countries, there is another interesting development prospect: if government laboratory-based services are of sufficient quality, the large-scale intensive industrial operators (Sector 1 in Figure 1) may choose to pay for using those services. This scenario is not a fantasy – in Viet Nam some industrial poultry companies have been submitting samples to a government regional diagnostic laboratory on a fee-for-service basis, thereby gaining access to the expertise of government staff in enzyme-linked immunosorbent assay (ELISA) serological testing.

When quality services are achieved, additional benefits will begin to flow at the national level.

First, the central poultry unit will provide a natural focus for poultry health planning by industry and government, through its functioning in laboratory services, disease intelligence and field extension-outreach. Second, it can also act as a viable interface for health intelligence between commercial industry sectors (Sectors 1, 2 and part of 3 in Figure 1) that have the commercial imperative and economic means to minimize the risk of disease introduction, and the village (family) poultry sector (Sector 4 in Figure 1), which is often viewed as an important reservoir of path-

FIGURE 1

Delivery of the health services needed for support of poultry industry growth in a developing country



ogens of risk to commercial sectors. Although village-based poultry are clearly quite separate from commercial enterprises, it will be vital to include this sector in health services and surveillance. Family-based village poultry production is currently undertaken by a majority of families in rural regions in many developing countries, and contributes very significantly to poverty alleviation and food security.

REFERENCES

- Bagust, T.J.** 1998. Profitable (village) family poultry production – an achievable development vision or a mirage? *Proceedings of the Fourth Asia Pacific Poultry Health Conference*, Melbourne, Australia, November 1998, pp. 43–48. Australian Veterinary Poultry Association.
- Bagust, T.J.** 1999. Poultry health research and education in China for sustainable and profitable production Y2000+. *Proceedings of the First International Conference on Veterinary Poultry*: Beijing, 28–30 July 1999, pp. 61–69. Chinese Animal Husbandry and Veterinary Science Association.
- Biggs, P.M.** 1982. The world of poultry disease. *Avian Pathology*, 11: 281–300.
- Horrox, N.** 2000. Countering immunosuppression. *International Poultry Production*, 8(8): 8–12.
- OIE.** 2000. Diseases of poultry: world trade and public health implications (monograph). *Revue Scientifique et Technique*, 19: 343–665. Paris, OIE.
- Payne, L.N.** 2001. Avian leukosis virus – new mutations: A threat for the upcoming century. *World's Poultry Science Journal*, 57: 265–274.
- Shane, S.** 2004. Global poultry diseases update – avian influenza overshadowing erosive diseases. *World Poultry*, 21: 22–23.

RECOMMENDED TEXT

For a sound overview of poultry diseases in the field, their causes and diagnosis:

- Pattison, M., McMullin, P.F., Bradbury, J.M. & Alexander, D.J.**, eds. 2008. *Poultry diseases*, sixth edition. Philadelphia, Pennsylvania, USA, Saunders Elsevier. 611 pp. ISBN: 978-0-7020-2862-5.

Emerging pathogens of poultry diseases

Trevor J. Bagust, Department of Avian Medicine, Faculty of Veterinary Science, University of Melbourne, Australia

WHAT IS AN EMERGING PATHOGEN AND HOW IS IT RECOGNIZED?

Emerge = "to come forth into view from concealment or obscurity in background". (Macquarie Dictionary, Macmillan publishers)

As opposed to a specific pathogen that is known to be present as the cause of a recognizable poultry disease, an emerging pathogen is a specific microbe that can be shown to be the causative agent of a disease that:

- i. has been recognized previously, but the cause has remained unclear; or
- ii. is a new disease syndrome that has not appeared previously.

The usual sequence of events in the emergence of a disease generally starts with a novel disease becoming apparent to industry veterinarians and supporting diagnostic laboratories in a country, or sometimes simultaneously in several countries. Serological and virological investigations will often exclude the obvious involvement of currently known poultry pathogens. If the disease losses caused by this new pathogen are likely to be significant, further investigations will be undertaken in the research laboratory to clarify the pathogenesis of infection, means of transmission, immunity mechanism, and potential for vaccine development or eradication, depending on which is the most appropriate approach.

Cultivation of the microbial agent outside the host will usually permit serological screening to establish the prevalence of infection in flocks. Diagnostic investigations may include retrospective studies of previously unresolvable field disease problems, such as avian leukosis (subgroup-J) (Example 1).

The nature and intensification of the poultry industry make it seem likely that high numbers of specific pathogens will have to be excluded or prevented by vaccination at production sites, and that many pathogens will have arisen or been recognized as emerging in recent decades.

The industry is not unique in this regard among the intensive animal industries (pigs, poultry and fish), but pathogen-host dynamic interactions occur on a huge scale and are frequent within the poultry industry globally. Among production animal species, poultry have a uniquely short generation interval and must be reproduced continually, with probably about 100 million individual animals a day across the world's poultry industries. Vaccination is an essential measure for protecting poultry stocks against a range of dangerous pathogens, and during this protection process, the host's immunity continually exerts selection pressure on these poultry pathogens.

Viral pathogens, particularly those with ribonucleic acid (RNA) genomes (e.g., infectious bronchitis, Newcastle disease, infec-

tious bursal disease viruses, and avian retroviruses such as avian leukosis virus), are all susceptible to the development of point mutations during replication of the genome. These viruses appear to lack effective proof-reading mechanisms for control of viral translation and repair of mutations during replication. Payne (2001) estimates that the rate of point mutations in avian retroviruses is as high as one per million virions, occurring within just one twelve-hour cycle of replication.

As viruses are continually mutating, so it must be accepted that new virus strains and disease problems will emerge in the future.

Several examples of poultry pathogens that have emerged in the last decade or so are given in the following, along with a brief explanation of the mechanism(s) involved in their emergence.

Example 1: Avian leukosis (subgroup-J) virus

This pathogen developed by genetic recombination in the field between two avian retroviruses. Between 1995 and 1998, neoplasms were observed in young breeders, leading to major losses of broiler breeders worldwide. This was due to primary breeding companies having genetic stock contaminated with ALV-J, the progeny from which were then exported to more than 50 countries. Retrospective virological and serological examinations by Payne (2001) and his laboratory group showed that this virus was circulating in the United Kingdom as early as 1989, with infections in some flocks sporadically producing tumours then in broiler breeding stocks.

Example 2: Newcastle disease.

The emergence of virulent NDV from lentogenic strains of Newcastle disease in Australia from 1999 to 2001 has been closely investigated and scientifically proven using molecular epidemiology.

Example 3: Highly pathogenic avian influenza.

Because of its zoonotic potential, the emerging poultry disease of greatest concern worldwide has been avian influenza, whether HPAI H5N2 (China, Hong Kong Special Administrative Region in 1999 and 2001) or HPAI H5N1 (in Asia from 2003 onwards, spreading to some 60 countries worldwide). This pathogen has subsequently been eradicated from all developed poultry industries, but is persisting as an endemic infection of poultry in several continents.

THE MECHANISMS FOR A POULTRY PATHOGEN'S EMERGENCE

Genetic changes

These can occur in a pathogen through accumulation of point mutations in the genome or even recombination and reassortment of gene sequences. These changes sometimes result in an altered pathogen with the ability to multiply more effectively in the host. Initially these changes may not be recognized, but as the mutant strain of the pathogen multiplies, becomes better adapted to the host, and spreads within flocks and among production sites, disease problems can become apparent – emerge – against the background of normal expected levels of losses during production activities.

The co-evolution of viral pathogens with their vaccines and medications

As do any other organisms, poultry pathogens tend to change and evolve. Antigenic change results from genetic control, and can be accelerated under immune pressure. Immune responses are geared to controlling pathogens, and include antibody production and T-cell activation against pathogen-specific protein structures, which are those most likely to change over time. Medication with antibacterial or anticoccidial drugs exerts similar effects over time. Continued treatment against coccidiosis or bacteria with the same unchanging drugs, especially with sub-therapeutic doses, tends to promote the emergence of resistance to those antimicrobial or anticoccidial drugs.

REFERENCES

Payne, L.N. 2001. Avian leukosis virus – new mutations: A threat for the upcoming century. *World's Poultry Science Journal*, 57: 265–274.

Poultry disease diagnosis: field skills and laboratory procedures

Trevor J. Bagust, Department of Avian Medicine, Faculty of Veterinary Science, University of Melbourne, Australia

FIELD SKILLS

It is extremely important to apply a *systematic* approach when conducting field investigations. An autopsy (necropsy) is essential for avian veterinarians or technical services personnel seeking to establish a preliminary diagnosis. The autopsy also allows samples to be collected and submitted to a diagnostic laboratory for confirmatory testing. Samples collected may include blood, serum, plasma, swabs, feathers, tissues, scrapings or smears, as needed for confirmation or exclusion of the potential causative pathogens. Excellent video-based information on practical procedures for clinical examination and sample collection can be accessed at <http://partnersah.vet.cornell.edu/>.

Two of the best general-audience articles available on flock health and poultry diseases diagnosis were published in the international poultry industry technical periodical *World Poultry* (Yegani, Butcher and Nilipour, 2005a; 2005b). These articles can be accessed directly by using the hyperlinks shown for each.

LABORATORY PROCEDURES

The following comments confirm and extend the key information in these two articles.

Serology is the most frequently used of the three diagnostic approaches. However, it should be noted that detection of antibody can only be an indicator of previous exposure to a pathogen. Serology is nearly ideal for application in flock health surveillance, as laboratory testing can be conducted quite readily, for both the collection and the examination of large numbers of samples from multiple flocks. Serological activities in flock health surveillance may also include monitoring the effectiveness of vaccination programmes.

Microbiological investigations – bacteriology and virology: Yegani, Butcher and Nilipour (2005b) explain briefly where these tests are used in the modern industry. The following are their main advantages and disadvantages:

Histopathology is relatively economical, quick and useful for obtaining results, and the samples are easy to collect, store, transport and process. The downside of histopathology is that once a set of samples has been placed in fixative, the culture and typing of a pathogen is usually not possible.

Microbiology, whether bacterial or viral, it is invaluable for the isolation and culture of pathogens. However, the practitioner must exercise care to avoid cross-contamination when collecting the samples, and to prevent inactivation of infectivity during transport to the laboratory.

Routine aerobic bacterial culture is not expensive, other types of culture and typing usually are.

Culture of avian viruses is sometimes required, especially when field disease presentations are atypical or the emergence of a variant form of a viral pathogen (e.g., infectious bronchitis virus) is a possibility. The disadvantages of virus culture are that it requires time – often about a week – and using culture systems is moderately expensive.

PCR (polymerase chain reaction): This test system is highly sensitive and specific, which can be a problem. If the reagents (e.g., the primers) used are not an exact match with the pathogen in question, false negatives will occur. False positives, through contamination while a test is in progress in the laboratory can also be a problem.

Note: No laboratory test can return perfect results every time, and laboratories are not infallible. Veterinarians and technicians should always keep in mind the point made by Yegani, Butcher and Nilipour:

“It is important, when investigating poultry production-health problems, that you do NOT rely SOLELY on the results of diagnostic tests”.

REFERENCES

- Morrow, C.** 2008. Laboratory investigation to support health programmes and diseases diagnosis. In M. Pattison, P.F. McMullin, J.M. Bradbury and D.J. Alexander, eds. *Poultry diseases*, 6th edition, pp. 39–47. Philadelphia, Pennsylvania, USA, Saunders Elsevier. ISBN: 978-0-7020-2862-5.
- Yegani, M., Butcher, G.D. & Nilipour, A.H.** 2005a. Monitoring flock health: an absolute necessity – Part 1. *World Poultry*, 21(6): 40–41. www.avianhealthonline.vet.unimelb.edu.au/fao/world_poultry_reading_a.pdf
- Yegani, M., Butcher, G.D. & Nilipour, A.H.** 2005b. Monitoring flock health: laboratory approaches – Part 2. *World Poultry*, 21(7): 32–33. www.avianhealthonline.vet.unimelb.edu.au/fao/world_poultry_reading_b.pdf

Site biosecurity and supporting strategies for disease control and prevention

Trevor J. Bagust, Department of Avian Medicine, Faculty of Veterinary Science, University of Melbourne, Australia

BIOSECURITY PROGRAMME FOR COMMERCIAL POULTRY PRODUCTION SITES

- Keep poultry in a fully enclosed area, to which entry by other people is physically restricted by having only one point of access. This access point should be enterable only through a foot-bath containing disinfectant.

In general, casual visitors to a poultry production site should be discouraged. Records should be kept of all visits.

THE MOST COMMON BREAKS IN BIOSECURITY OCCUR WHEN INFECTIOUS POULTRY DISEASES ARE INTRODUCED BY THE MOVEMENTS OF PEOPLE.

- Prevent contact with wild birds and vermin by physically excluding them from the site, for example, with bird netting.
- The poultry keeping area and equipment within it must be kept clean, and be disinfected every few months. Cleaning followed by disinfection is essential between batches of poultry. Concrete rather than earth flooring in poultry production areas greatly increases the effectiveness of cleaning and disinfection.
- Equipment should NOT be shared among poultry sites. If it is absolutely necessary to share items, the equipment must be thoroughly cleaned AND disinfected before and after entering any poultry production site.
- Contamination of food and water by faeces should be strictly avoided.
- Feed should be stored in secure, lidded containers; the water supply should be decontaminated, for example, by a standard chlorination treatment.

Birds and health:

- Birds should be sourced from a breeder whose bird health status is known to be good, and should be of healthy appearance on arrival at the site. The new birds being introduced should be kept separate and be the last fed every day for an initial quarantine and observation period of one month.
- Potential signs of diseases, which should be known by the farmer, can include:
 - dullness, reluctance to drink or eat;
 - diarrhoea, respiratory distress, a sudden drop in egg production;
 - inability to walk or stand, abnormal position of head, neck or wings;
 - sudden illness and/or death of several of the birds in a group.

BIOSECURITY PROGRAMMES ARE BASED PRIMARILY ON QUARANTINE OF A SITE COMBINED WITH MEASURES FOR STRINGENT HYGIENE AND DISINFECTION.

The strength of this approach is that it can be applied generally to exclude from a site ALL important diseases (see Table 2 in "Poultry Health and Disease Control in Developing Countries") apart from those that are egg-transmitted.

More specialized disease prevention and control measures to support biosecurity on a site include:

Vaccination and medication: Diseases for which these may be applied include almost all the ones listed. However in every case, the vaccine being used will be effective for the prevention of ONLY that specific disease.

Eradication can be applied for egg-transmitted pathogens ONLY. The pathogens for which commercial eradication programmes have been successfully applied are avian mycoplasmosis, avian leukosis and reticuloendotheliosis viruses; fowl typhoid; and *Salmonella pullorum*.

Immunogenetic resistance to disease is promising for Marek's disease, but is not yet commercially available.

BIOSECURITY FOR VILLAGE PRODUCTION – SMALL-SCALE SEMI-SCAVENGING POULTRY FLOCKS (NON-COMMERCIAL)

Although it is not possible to apply full site biosecurity where numerous small poultry flocks are moving about in or around common areas in a village during daylight hours, modified elements of biosecurity can be applied.

As a minimum, housing should be provided to shelter and protect birds from predators at night time.

Improved poultry health can also be achieved by combining two other general approaches:

- *The development of central higher-quality hatchery-based services for the supply of day-old chicks*

Irrespective of whether the poultry stocks being supplied to farmers in a country are of an indigenous or a commercial genotype, the laboratory screening of breeding stocks for freedom from infection, followed by the application of enhanced hatchery hygiene programmes should enable freedom to be assured from at least pullorum disease and fowl typhoid. Chicks supplied can also be protected early in their life against catastrophic diseases such as Newcastle disease and infectious bursal disease virus before leaving the hatchery (Bagust, 1998), by

having high levels of maternal antibody, which can be assured by undertaking vaccination of the parents.

- *Strengthening extension services for training farmers in health and production*

Poultry health and production extension services can quite quickly be systematically upgraded by applying information from other developing countries, such as Bangladesh, on strategies/ programmes that have proven successful in practice.

SUPPORTING STRATEGIES FOR CONTROL AND PREVENTION OF POULTRY DISEASES

The illustration of a classical building below shows that the columns (the pillars) are needed to support the roof, while the roof both holds the pillars together and protects the integrity of the building. The whole building represents the production site, and the pillars are the individual supporting activities that are integrated into an overall biosecurity programme.

The pillars represent the major technology-based approaches currently available for the control and prevention of infectious diseases of poultry. From left to right, the order of the pillars represents how widespread their use should be, starting with approaches that are suitable for widespread application, and moving towards those that are suitable only for specific uses. Thus, while quarantine, hygiene and disinfection are universally applicable against poultry pathogens, vaccination can be widely, but not always, used and eradication is currently feasible only for a few pathogens.

Pillar 1 – QUARANTINE: Currently, genetically based disease resistance is rarely of practical use in the field. This means that isolation is the only option. This is the oldest of the approaches, and dates back to Roman times (*quaranta* is Latin for 40), when a 40-day isolation period was enforced before a plague ship crew could enter a harbour or town.

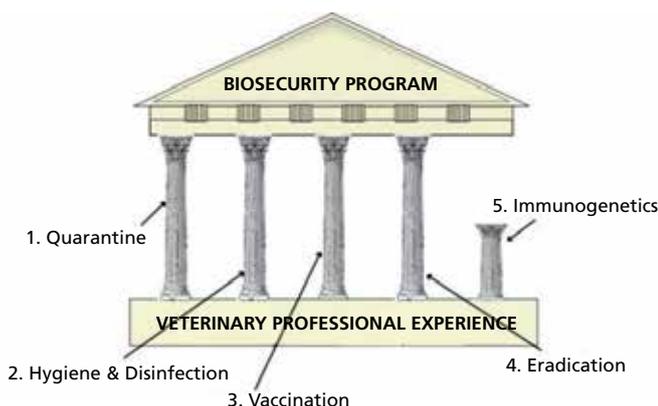
Pillar 2 – HYGIENE AND DISINFECTION – complements quarantine. When flocks are being isolated from the entry of microbes, hygiene and cleaning are the first measures used. These **must result in the removal of organic material from the surfaces to be decontaminated**, for example, in poultry houses or the hatchery, if antimicrobial disinfection treatment is to be effective.

Pillar 3 – VACCINATION is probably the easiest and most economical group of methodologies used for the control and preven-

tion of poultry diseases in poultry production. However, it should NOT be used as the sole measure on a flock.

Pillar 4 – ERADICATION is a feasible disease control option for only some specific poultry pathogens. The criteria to be met are usually that the major mode of transmission is via the egg and that relatively accurate and inexpensive lab tests have already been developed for detection of infection. Although a successful eradication programme requires major investments of resources, significant benefits can flow back to industry over the longer term.

Pillar 5 – IMMUNOGENETIC RESISTANCE to disease is not yet complete, but – as the case of Marek's disease virus demonstrates – it may soon become so. The solution may lie in the hands of commercial primary breeding companies, because genetic selection could be applied to disease resistance, should a commercial need create pressure for this. At present, however, this is not seen as a high priority relative to other growth and production parameters. In addition, there is a lack of effective tools for selecting for specific resistance to many major infectious poultry diseases.



Veterinary roles in health and knowledge transfer across a poultry industry

Trevor J. Bagust, Department of Avian Medicine, Faculty of Veterinary Science, University of Melbourne, Australia

VETERINARY ROLES IN HEALTH (POULTRY AND HUMAN HEALTH)

As shown in Figure 1, the supply-and-demand forces within the market place provide the major driving force for development of modern poultry production. Any commercial enterprise seeking continuing success in the marketplace must therefore:

1. minimize its costs of production;
2. ensure that its products are safe for human consumption.

Veterinarians also have to fulfil these dual responsibilities in a modern intensive poultry industry by:

- **Achieving the most economical poultry production**

The veterinarian’s role in poultry health involves close collaboration with several other professionals working in key roles in the poultry production operation.

- **Achieving product quality for protection of public health**

The veterinarian also has a role in ensuring that poultry prod-

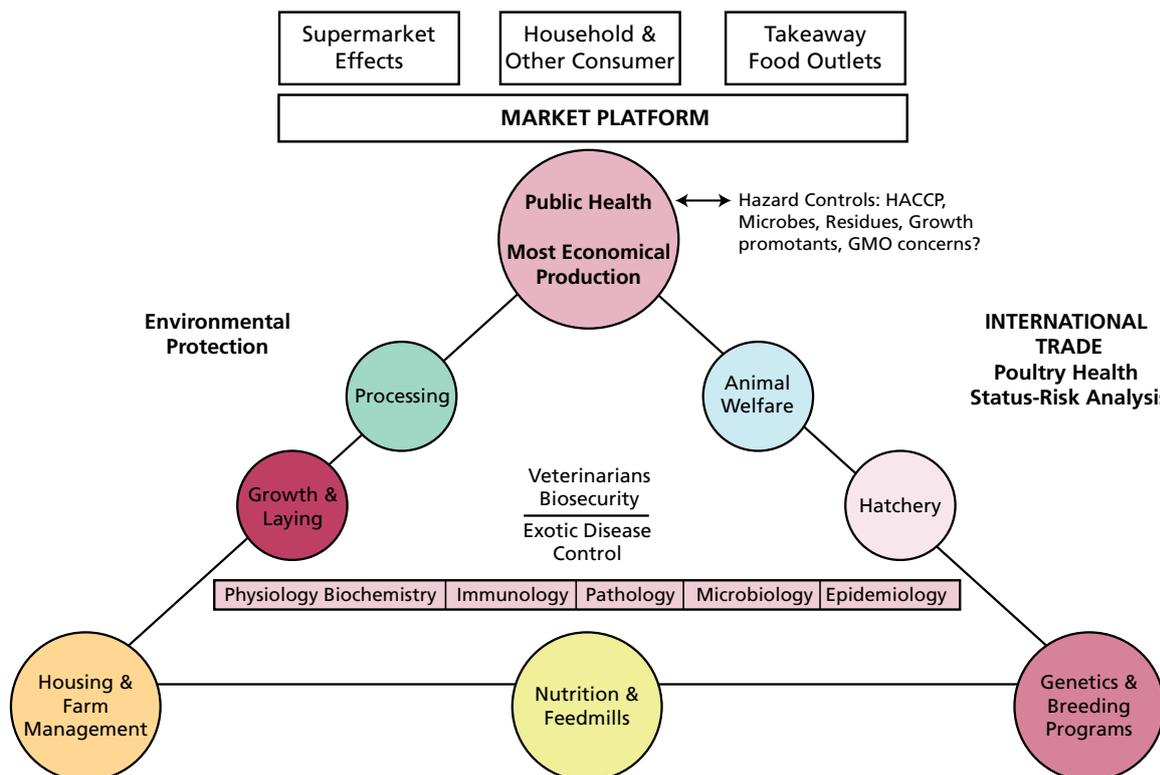
ucts are free from zoonoses (infectious diseases transmissible from animals to humans, such as Campylobacter, Salmonella and listeriosis) and that they are microbiologically safe and free from environmental residues. Experience proves that the profitability of a food industry or commercial organization is very quickly undermined by problems with unsafe poultry products.

AVIAN HEALTH-IN-PRODUCTION: PROFESSIONAL DEVELOPMENT AND KNOWLEDGE TRANSFER

Veterinarians are trained to develop their capabilities for understanding animal diseases, as well as the causes, prevention and control of a range of pathogens. To this end, veterinary undergraduate education includes the scientific disciplines of *physiology and biochemistry, immunology, pathology, microbiology* (including serology) and *epidemiology* – the science of the transmission of infectious diseases. Veterinarians need formal knowledge and

FIGURE 1

The roles and important interaction points (---) with other production professionals for poultry veterinarians operating in a modern intensive poultry industry



Source: Bagust, 2006; Avian Health Online™.

training in these disciplines so that they can understand and investigate problems in avian health. Avian veterinarians are also responsible for ensuring that appropriate *poultry health knowledge* is transferred to the technical personnel who share responsibilities in poultry production.

Avian veterinarians and other technical services personnel working in developing countries may wish to achieve higher levels of expertise in the performance of their commercial activities. Advice and guidance on undertaking professional development to internationally accepted standards of competency is available from relevant professional international bodies, such as the World's Poultry Science Association (www.wpsa.com) or the World Veterinary Poultry Association (www.wvpa.net).

Figure 2 illustrates how all the activities undertaken in poultry production can work together to achieve sustainable progress in an industry.

The wheels of knowledge transfer shown in Figure 2 are lubricated by communication and interfacing among the personnel involved, so in a country seeking to develop an effective and efficient poultry industry, it is essential that personnel learn to operate in this cooperative manner. A national networking structure is the logical starting point for achieving sustainable poultry health in production, particularly through strengthened control of infectious poultry diseases.

FIGURE 2

The wheels of knowledge transfer in a poultry industry

