CSIRO's Australian animal health laboratory

Martyn Jeggo outlines the five national priorities of the Australian Animal Health Laboratory

Abstract

CSIRO's Division of Livestock Industries' Australian Animal Health Laboratory (AAHL) is a national centre of excellence in disease diagnosis, research and policy advice in animal health. There are five national responsibilities of this facility and it plays a vital role in maintaining Australia's capability to quickly diagnose exotic (foreign) and emerging animal diseases.

AAHL opened in 1985 at a cost of over $150 million, and is one of the most sophisticated laboratories in the world for the safe handling and containment of animal diseases.

AAHL is funded by the Australian Federal Government, via CSIRO and the Department of Agriculture, Fisheries and Forestry, and also by industry organisations and commercial companies. AAHL has a number of external oversight committees to ensure compliance with good microbiological management, OHSE issues and general governance. The most important of these is the AAHL Advisory Council which is Chaired by DAFF and has representatives from States, industry and other key stake-holders, meets twice a year and provides strategic direction and broad prioritisation of activities at AAHL.

Responsibilities

AAHL has five national responsibilities:

1. Diagnosis of infectious exotic diseases;
2. Developing new vaccines and therapeutics;
3. Provision of advice and reagents;
4. Training and education; and
5. Biocontainment.

Diagnosis of infectious disease

Prior to the opening of AAHL, most specimens for exotic disease exclusion needed to be sent overseas to a reference laboratory for a specific diagnosis. This placed Australia in a difficult situation because of a loss of control over important information related to trade and because of the considerable time it took for a result to be obtained from the overseas laboratory. Samples also could be damaged in transport and hence a definitive diagnosis would not be possible. Given the significant value of Australian export of animal products and live animals, AAHL was established to carry out exotic disease diagnostics and to underpin Australia's trade in this area.

In the last 19 years, AAHL has supported State veterinary laboratories by providing exotic disease diagnostic services. Thousands of samples have been tested for disease exclusion, providing continuing evidence of freedom from diseases such as foot-and-mouth disease (FMD), bovine spongiform encephalopathy (BSE), scrapie and a range of fish diseases. A small number of outbreaks have been confirmed—such as the poultry diseases, avian influenza and Newcastle disease. In 1998, the importance of AAHL was highlighted when testing at AAHL showed that FMD was not present in the Toowoomba saleyards, enabling quarantine bans to be lifted within 24 hours. If specimens from Toowoomba had to be flown to the World Reference Laboratory for FMD at Pirbright, United Kingdom, at least three days would have been required for diagnosis and this would have resulted in significant disruption to Australia's export trade.

AAHL has played a major role in detecting and characterising new viral diseases of animals.

In the last 10 years the facility demonstrated that Hendra virus (previously know as equine morbillivirus) was the cause of the unusual disease in horses

and humans that occurred in Queensland in 1994/95. The laboratory also showed that an orbivirus called Wallal was the cause of kangaroo blindness and that flying foxes and insectivorous bats throughout Australia were infected with a dangerous rabies-like virus called Australian bat lyssavirus. In 1997 another virus, called Menangle virus was isolated in New South Wales and was shown to cause serious reproductive disease in pregnant sows and a 'flu like' illness in piggery workers. AAHL characterised the virus and showed it to be novel. In 1999, AAHL worked with key international research organisations investigating another new virus in Malaysia. Now called Nipah virus, the previously unrecorded viral disease killed more than 100 people and thousands of pigs. This paramyxovirus is closely related to Hendra virus. In 2003, AAHL joined investigations in the animal reservoir of SARS. As part of the development of disease control strategies, research is continuing on the viruses in an attempt to better understand the diseases they cause.

AAHL is recognised by the world animal health organisation – *the Office International des Epizooties* (OIE) – as a regional reference laboratory for Newcastle disease, avian influenza, bluetongue and rabies.

The importance of the OIE reference laboratory role was exemplified during the recent avian influenza emergency in South East Asia. Initially a staff member was seconded to the UN Food and Agriculture Organization (FAO) to provide a mix of expertise in laboratory diagnosis, emergency response and animal disease control. This mission involved work at FAO headquarters and with the animal health authorities in Thailand, China and Vietnam. Follow up activities by AAHL included training of veterinary laboratory staff from Vietnam and then Indonesia, Myanmar and the Philippines, and production and distribution of laboratory reagents to a number of countries in the region. AAHL has also recently been designated as an OIE Collaborating Centre for New and Emerging diseases giving it a crucial global role in the risk management of diseases.

Collaborative disease investigations help to reduce the threat of disease incursion by first assisting disease control and secondly by establishing productive working relationships with animal health authorities in Australia's immediate neighbourhood.

Developing new vaccines and therapeutics

AAHL undertakes research to develop new diagnostic tests, vaccines and therapeutics for endemic animal diseases of national importance. This research helps improve animal welfare and industry efficiency. Research focuses on diseases such as Johne's disease (a wasting disease of ruminants) and developing alternatives for antibiotics for intensive animal industries like pigs and poultry.

AAHL recently extended these efforts into a number of exotic diseases through collaboration with a range of national and international partners.

Provision of advice

AAHL provides expert advice to the Australian Government and State governments on exotic and endemic disease management issues. It also provides advice to government, industry bodies and the private sector on issues such as disease risk and disease research solutions. AAHL also assists in overseas development projects in the animal health area. Key staff from AAHL travelled to Malaysia during the 1999 Nipah virus outbreak and to China in 2003 to co-ordinate investigations into the animal reservoir of SARS.

Training and education

AAHL has provided exotic disease training to more than 400 Australian and New Zealand veterinarians. In 1999, with funding from the Northern Australia Quarantine Strategy (NAQS), this training was extended to other veterinarians in the region, with a group from Indonesia visiting AAHL. A further group of veterinarians from Indonesia and Papua New Guinea attended training at AAHL in 2002.

In the early 1990s, AAHL produced a series of exotic disease training videos and slide sets. These resources help educate farmers, vets and others about exotic disease. Three series of videos are available—covering rural awareness, vet training and training for control workers.

AAHL is active in transferring technology to Australian States and overseas. For example, the AAHL Plant Toxins Unit has transferred tests to detect low

levels of corynetoxins (the cause of Annual Ryegrass Toxicity) to State laboratories, allowing inter-laboratory validation.

AAHL has an ongoing collaboration with Vietnam's Veterinary Company/ Veterinary Research Centre (NAVETCO) and the Department of Animal Health (DAH). AAHL staff have provided training in disease investigation and diagnosis for animal diseases such as classical swine fever, avian influenza and duck virus enteritis to their Vietnamese colleagues. Staff from NAVETCO and DAH have also attended training workshops at AAHL.

Biocontainment

AAHL includes a high-biocontainment facility, to safely fulfil its major role of diagnosing emergency animal disease outbreaks.

In addition to use in emergency disease diagnosis, exotic disease agents are also used in evaluating vaccines and related control options, and in training veterinarians to recognise diseases they would not normally see. Some of these exotic diseases pose major economic threats to the nation's animal industries, so they must be securely kept and handled safely inside the laboratory.

Procedures and containment facilities at AAHL conform with or exceed the requirements defined in the *Australian/New Zealand Standard, Safety in Laboratories, Part 3; Microbiological safety and containment facilities.*

AAHL has the capacity to operate at biosecurity level four (BSL4), the highest available. Such facilities are necessary to handle safely zoonotic pathogens that pose a high risk to humans as well as animals.

AAHL's main building has five levels, of which four are inside the secure barrier, a thick concrete wall that forms an airtight 'box' around the secure area. All of this area is held at a lower air pressure than the outside world, to keep any airborne infectious agent inside the laboratory.

Within the secure box are a series of smaller secure boxes, each with a drop in air pressure. A guiding principle in the design of AAHL was that biocontainment should never get by a single barrier. If one containment system or barrier fails, then at least one other barrier is in place to protect Australia's livestock.

All physical containment systems are duplicated, and all essential systems, such as electricity generators, steam and compressed air plants, are triplicated. Biocontainment would not be at risk from a computer or power failure, for example.

Anything leaving the secure area must first be treated. The air is routinely filtered to remove infectious aerosols. All the sewage is heat-treated and solid waste is incinerated. Equipment leaving the secure area is sterilised by autoclave or gas decontamination. Information must be transmitted to the outside by fax or computer network, as books and papers cannot be removed once inside the secure area.

Special biocontainment cabinets are used for laboratory bench work. When working with infected animals that may be excreting viruses potentially fatal to humans, staff work in special plastic suits that cover the whole body and isolate them from the disease hazard. When working with agents such as Newcastle disease virus, which can be carried in the respiratory tract or the eyes, staff wear breathing-air hoods. Access to such agents is strictly limited to trained staff who use a range of measures to contain the disease agents.

The personal containment procedures are backed up by compulsory showering out of infected animal rooms and out of the secure area. As an added precaution, once outside the secure area, staff must not have contact with livestock animals for seven days. In addition, a quarantine suite is maintained on site in the event of a laboratory accident that exposes a staff member to an exotic infectious agent. Staff would then stay on site in the quarantine suite until cleared to leave.

The BSL 4 facilities at AAHL are viewed as best practice by many in the world. In 2002, the National Center for Foreign Animal Disease, part of the Canadian Science Center for Human and Animal Health, commissioned their BSL4 facility in Winnipeg. Prior to commission, a virologist, veterinary scientist and biosecurity officer from the Canadian facility visited AAHL, gaining skills and knowledge on the best practice for operating at BSL4.

Summary

AAHL remains today what it was 19 years ago, one of the world's leading high security biocontainment laboratories, demonstrating best practice and utilising cutting-edge diagnostic technologies to maintain an effective national, regional and global role. As globalisation proceeds the risk from new and emerging disease undoubtedly grows and with the added dimension of bio-terrorism, AAHL continues to be a relevant and critical infrastructure for both Australia and the world.

Author
Dr Martyn Jeggo is the Director of CSIRO Livestock Industries' Australian Animal Health Laboratory (AAHL). He has headed AAHL since September 2002. Dr Jeggo's career has included stints at the United Kingdom's Institute of Animal Health Pirbright Laboratories, the Veterinary Diagnostic Laboratories in Yemen Arab Republic and the Joint FAO/IAEA Division of Agriculture (Food and Agricultural Organisation/International Atomic Energy Agency), in Vienna, Austria. For more than 15 years he has been involved in the management of laboratory networks dealing with rinderpest and contagious bovine pleuropneumonia in Africa, Foot-and-Mouth Disease in Asia, and brucellosis worldwide.