27. Bishop, S., *et al*. (2010) The first report of ovine cerebral neosporosis and evaluation of *Neospora caninum* prevalence in sheep in New South Wales. *Vet. Parasitol.* **170**, 137–142. doi:10.1016/j.vetpar.2010.01.030

28. Sangster, C., *et al*. (2010) Neosporosis in an aborted Southern White Rhinoceros (*Ceratotherium simum simum*) foetus. *J. Wildlife Zoo Med.* **41**, 725–728. doi:10.1638/2009-0250.1

29. King, J.S., *et al*. (2011) Extensive production of *Neospora caninum* tissue cysts in a carnivorous marsupial succumbing to experimental neosporosis. *Vet. Res.* **42**, 75. doi:10.1186/1297-9716-42-75

Biographies

Richard Malik is a consultant in small animal medicine that has a special interest in infectious diseases of companion animals. He is particularly interested in viral diseases of cats, fungal diseases especially those caused by *Cryptococcus* species, mycobacteria, saprophytic pathogens such as *Burholderia*, *Prototheca* and *Pythium* and most recently parasitic diseases because of the influence of Jan Slapeta! Richard works for the Centre for Veterinary Education where he facilitates feline distance education programs, and develops life-long learning strategies for vets in practice.

Derek Spielman is a Lecturer in Veterinary Pathology at the University of Sydney. He has worked as a companion animal clinician, zoo and wildlife veterinarian and has a PhD in conservation genetics. His special interests are in wildlife pathology and the ecology and epidemiology of wildlife diseases. He is also interested in the pharmacokinetics of antibiotics in Australian marsupials. He is especially interested in the effects of neural angiostronglyosis on tawny frogmouths and possums.

Jan Šlapeta joined the Parasitology team in the Faculty of Veterinary science at the University of Sydney in 2007. He has a broad understanding of the biology of parasites of both medical and veterinary importance, as well as the diseases caused by them. He has experience in several research laboratories, including the NIH in the USA, the CNRS in France and the University of Technology in Sydney. Jan specialises in the molecular identification and the evolution of protozoan parasites. His diagnostic techniques and biodiversity studies have received worldwide interest. He has a particular interest in applications of molecular biology towards elucidating the unique properties of parasites of medical and veterinary importance.

The changing roles of veterinary laboratories in Australia

Rob Rahaley

Biosecurity SA
Primary Industries and Regions
South Australia
Tel: +61 8 8207 7970
Email: rob.rahaley@sa.gov.au

Over the past 30 years there has been a major restructure of government veterinary laboratory services in Australia coinciding with, but not directly related to, the proliferation of private veterinary laboratories. State and territory government services have been increasingly centralised with greater focus on surveillance for exotic and emerging animal diseases and a shift away from animal health research. Private pathology services have flourished as veterinary practitioners increasingly value laboratory support for their clinical assessments and animal owners are prepared to spend more for the care of their pets. Future challenges and opportunities exist for governments to maximise return on investment in laboratories through minimising duplication of services, leveraging the academic and infrastructure resources of university veterinary schools and better utilising the efficiencies of the private sector.

Government laboratories

The need for laboratory support for government animal health programs was recognised early in Australia's colonial history. Laboratory-based veterinary diagnosis was recorded as early as 1890[1] and the first dedicated veterinary diagnostic and research facility, the Queensland Stock Institute, was established 1893[2]. Other government funded, veterinary-specific laboratories began to appear in the early 1900s and by 1925 all states had at least a basic veterinary laboratory service with one or more pathologists[3].

The laboratories played an important role in disease control and research and greatly assisted the development of Australia's

Figure 1. Mobile laboratory used during pleuropneumonia eradication campaign in the Northern Territory.

livestock industries as producers adapted to the many animal health challenges of managing livestock in an often harsh environment. Anthrax, clostridial diseases, tick fever, brucellosis, tuberculosis and internal parasites were just a few of these challenges. Laboratory diagnostic support was an essential part of the fight against bovine pleuropneumonia which had ravaged Australian cattle herds until its eventual eradication in 1968[4].

The commencement of the bovine brucellosis and tuberculosis eradication campaigns (BTEC) in 1970[5] heralded a period of unprecedented expansion of government laboratories. Brucellosis eradication required testing of millions of blood samples and regional laboratories complemented the work done in central laboratories. In both the pleuropneumonia and BTEC programs, caravans converted to mobile laboratories were also used to handle the large number of samples in remote areas (Fig. 1).

By the mid-1980s Australia had 23 "bricks and mortar" veterinary laboratories scattered throughout the country (Table 1). In addition to the BTEC work, these laboratories also performed general diagnostic pathology and were an important part of the overall national animal disease surveillance system.

Happy days

The early 1980s are often viewed by aging veterinary diagnosticians as the halcyon days of veterinary laboratories in Australia. In addition to the massive activity generated by the BTEC governments generally accepted a role in supporting livestock production through extension activities, control of endemic diseases and a significant level of research. Access to diagnostic services was free and laboratories were well staffed.

Surveillance for diseases was also a key priority. Information on what diseases are, or are not, present in Australia is essential to underpin our interstate and overseas market access and for protection of public health. Australia is free from many of the serious infectious diseases affecting livestock in other parts of the world and, in particular, the absence of foot and mouth disease (FMD) is critical to our overseas trade access. FMD surveillance has always been a major focus for government laboratories.

A critical step in early detection of exotic and emerging diseases is farmer reporting of abnormalities in their stock. The provision of free laboratory services was a major incentive for reporting and the regional location of many of the laboratories facilitated submission of whole animals for post-mortem examination. Most regional laboratories had a healthy caseload and this provided an excellent training ground for laboratory diagnosticians.

Despite this extensive national laboratory network, Australia still lacked the capability to actually diagnose many exotic diseases. Without a high security laboratory, live viruses required for many diagnostic assays could not be held in the country and suspect samples had to be sent overseas to laboratories such as Pirbright in the UK.

Following considerable lobbying from industry and the veterinary profession, the Australian Animal Health Laboratory (AAHL), a world class, high security biocontainment laboratory was commissioned

Table 1. Australia's network of veterinary laboratories in 1990.

Jurisdiction	Location of laboratories
Victoria	Parkville, Attwood, Hamilton, Benalla, Bairnsdale, Bendigo
NSW	Menangle, Wagga Wagga, Wollongbar, Armidale, Orange
WA	South Perth, Albany, Bunbury
NT	Darwin, Alice Springs
SA	Adelaide, Struan
Queensland	Brisbane, Rockhampton, Townsville, Toowoomba
Tasmania	Mt Pleasant

and opened in 1985 at a cost of more than $185 million[6]. AAHL continues to play a pivotal role in Australia's defence against the incursion of exotic animal disease and is at the forefront of research into both exotic diseases and emerging animal diseases such as Hendra virus and bat lyssavirus. In recent years, AAHL has adopted a strong "One Health" focus to leverage the value of cooperation between medical and veterinary investigators.

The emergence of AAHL was not without controversy however, and an acrimonious, and ultimately successful, campaign was mounted to prohibit the laboratory housing live FMD virus for fear of its escape from the facility. This ban remains in place today, severely impeding AAHL in achieving its mission. The development of molecular diagnostics and antigen capture techniques now enables the diagnosis of clinical FMD at AAHL but research into this important disease remains confined to off-shore laboratories at considerably greater cost.

The wheels start to wobble...and fall off

Australia was declared provisionally free of bovine brucellosis in 1986 and provisionally free of bovine tuberculosis in 1992[5]. The BTEC work and associated industry funding that underpinned many of the regional laboratories evaporated and, in the late 1980s, governments were faced with an increasing financial burden to maintain the laboratories. New terms like "cost recovery", "beneficiary pays" and "rationalisation" started to creep into conversations.

South Australia was the first state to move on the cost of their laboratory network closing the Struan laboratory in 1991 and, in the same year, the Arid Zone Research Laboratory in Alice Springs closed. In 1994, the Victorian government negotiated with a private consortium to outsource the management of all of their 4 regional laboratories. The Hamilton, Benalla, Bendigo and Bairnsdale laboratory buildings were leased to the consortium but the Department of Agriculture retained control of the Victorian Institute of Animal Science at Attwood. This was fortunate because the outsourcing was a disaster. In 1996, the Department initiated another tender process for provision of diagnostics services, with the successful tenderer operating from their own central pathology laboratory. Consequently, the consortium ceased operations and dismissed all staff at the regional laboratories[7].

NSW also reduced their number of laboratories closing the Wagga and Armidale laboratories in 1996. Wollongbar and Orange closed in 2009. In 1997, the South Australian government outsourced its sole remaining state laboratory to a private company. Bunbury in WA closed in 1999.

Closures continue, with the Queensland government recently announcing the closure of their Toowoomba and Townsville laboratories and centralisation of all testing in Brisbane. If these closures proceed, only 7 of the 23 laboratories will remain.

A new paradigm

Despite the drastic reduction in regional laboratories, the value of veterinary diagnostics has not been lost on government and investment in central laboratories continues. The Berrimah laboratory in Darwin was rebuilt in 1998 and a new laboratory was constructed at Coopers Plains in Brisbane in 2010. In NSW, a $57 million upgrade of the Elizabeth McArthur Institute of Agriculture was opened in 2012. A more ambitious investment is the recently completed Centre for Agribioscience in Victoria (Fig. 2). A joint venture between the Victorian government and Latrobe University, this $288 million

Figure 2. Victoria's new Centre for Agribioscience.

complex now houses Victoria's veterinary diagnostic laboratory (formerly at Attwood) alongside other bioscience activities[8]. The WA government has proposed to rebuild the South Perth veterinary laboratory in 2014–16[9].

Another positive in the reduction of the number of laboratories is that all government laboratories are now NATA-accredited, providing an external assessment of quality assurance. Maintenance of quality assurance systems is very resource demanding and it's doubtful that many of the regional government laboratories could have undertaken this within existing budgets.

Concurrent with the centralisation of laboratory services there has been a significant shift in government policy regarding the application of public funds to support livestock industries. State government funding for endemic disease control programs has all but ceased and there is little state government money allocated to animal health research. Instead, laboratories are more focused on surveillance for emerging and exotic diseases with other work usually done on a user-pays basis. For the most part, with the exception of AAHL, research has either disappeared or gravitated away from government laboratories to universities. Not only has this reduced the overall amount of animal health research being undertaken in Australia, it has also fractured the important link that existed between contemporary diagnostic activity and applied research into diseases of production animals.

Follow the LEADDR

A recent initiative for state laboratories is the Laboratory Emergency Animal Disease Diagnosis and Response program (LEADDR). The 2007/8 incursion of equine influenza virus into Australia and subsequent successful eradication campaign demonstrated the value of a distributed capacity for diagnosis of an exotic animal disease, particularly during the proof of freedom phase which may involve testing many thousands of animals. The LEADDR program involves transfer of non-agent replication technology such as PCR and ELISA from AAHL to the state laboratories under an umbrella of strict quality assurance.

Private laboratories

Private veterinary laboratories have a much more recent history in Australia. Medical laboratories have dabbled in veterinary diagnostics in the past, particularly in regional centres, but this has been more of a service to the local veterinarians rather than a bona fide business venture.

The first private veterinary laboratory owned and operated by a qualified veterinary pathologist opened in Melbourne in 1979. A second, unrelated business commenced in Brisbane in 1985. These laboratories focused on the pet animal and racehorse markets and both of the pathologists had strong personal following. Business growth was initially slow but increased as veterinarians' appreciation and reliance on laboratory support for their diagnostic work-up increased and the public became more willing to spend on their pets. Similar enterprises were soon established in Sydney, Adelaide and Perth.

Today there are about 20 private laboratories servicing the Australian veterinary industry, primarily in capital cities but a few are in regional centres. They may offer a full range of diagnostic services or specialise in disciplines like parasitology or trace mineral analyses. In some cases they are associated with medical laboratories, leveraging the existing infrastructure. While sharing couriers, buildings and some analytical equipment is a logical and very successful business model, animal pathology and microbiology are often very different from their human counterparts and dedicated staff and equipment are often required.

The primary objective of a private laboratory is generating profit. As a result, both the caseload and the work environment are very different from their government counterparts. In most private laboratories, samples from companion animals and the racing industry predominate with the bulk of revenue generated from haematology, biochemistry, histopathology and cytology. Most operate or access courier services and there is generally a greater urgency to get results out to appease very demanding veterinary clients. High volume throughput is the key to success and automation is a priority to minimise labour costs. Post-mortem examinations are expensive if they are charged at true cost-recovery and are therefore uncommon.

There have been a few instances where private sector laboratories have encroached on the traditional business of government laboratories. The private business environment is generally more flexible and can allow a more responsive approach to labour requirements through better utilisation of casual staff. This, combined with better adoption of automation, makes them a financially attractive option for high volume testing such as serology and they have competed successfully for export testing of farm animals and testing for disease control programs such as ovine brucellosis, enzootic bovine leucosis and Johne's disease.

The profit motive does not mean that private sector laboratories compromise on quality or service. In fact it's quite the opposite. The business is highly competitive and provision of a high quality service is essential for survival. Most large private veterinary laboratories are NATA-accredited and the private sector employs more specialist veterinary pathologists than the public sector.

Unlike their medical colleagues, many veterinary practitioners also have quite sophisticated in-clinic laboratories. Bench-top analysers allow on-site haematology, biochemistry and endocrinology. These units have become increasingly sophisticated and accurate over the past 15 years and they have been widely adopted as part of routine clinical work-ups. The uptake of these analysers by veterinarians was once viewed as a threat by private laboratory operators; however, they have also led to an increased awareness and appreciation of clinical pathology by both veterinarians and animal owners so a peaceful coexistence has developed. One major provider of referral veterinary laboratory services in Australia is also the major vendor of in-clinic analysers and their business model is to view the options as complementary rather than competitive.

Private versus public – cooperation or competition?

The advent of private veterinary laboratories was viewed with both cynicism and concern by many government laboratory personnel. The profit motive was seen by some as compromising science. At the time, a significant number of government laboratories also provided some level of service for small animal veterinary practitioners to bolster their own budgets and they did not appreciate this new competition. Conversely, the private sector viewed the government laboratories as unfairly competing in the market place with marginal costing policies resulting in less than commercial fee structures. They argued that the government had no role in servicing the pet and pleasure animal markets.

Fortunately, today the public and private sector have a much more comfortable relationship as they have realised that their roles are different. Government laboratories have essentially exited the companion animal market but there are still occasional grumblings about private laboratories "cherry picking" profitable farm animal services. Nonetheless, each sector appears to have found its niche and now realise that they can coexist. Competition for qualified staff from the private sector has had some positive impact on salaries for government laboratory workers.

In a few cases, private laboratories have replaced government operated services. Victoria continues to outsource some testing (primarily serology) to a private laboratory but retains a central government laboratory for core diagnostic work. They have persisted with this model since 1996. In South Australia, the private sector has provided all laboratory services to government for the past 15 years. This model is not without its challenges as the work environment of a commercial fee-for-service laboratory does not afford pathologists and other laboratory diagnosticians much reflection time. When a diagnostic sample is sent to a laboratory, government's requirement is that the case is examined as a whole and the implications of the findings for the state or territory's animal health, trade, public health and environment are all considered. In a commercial environment, the diagnostician has little time for such thinking before moving on to the next case. One solution is to build this "thinking time" into the negotiated fee structure but this tends to negate the assumed cost-savings of privatisation.

Universities

There are now 7 veterinary schools in Australia and all must have access to laboratories to support their clinics and for teaching. All have highly credentialed laboratory diagnosticians and all struggle to maintain an appropriate caseload of farm animal species.

To leverage both expertise and case material, there have been several attempts to co-locate government laboratories with university veterinary schools. This is a common model for service delivery in the Unites States where state-funded diagnosticians operate side-by-side with university teaching and research staff. To date, all proposals in Australia have been abandoned before their implementation. Perhaps this reflects the difficulty in aligning the teaching and research functions of a university with the surveillance and response functions of government but this can be overcome by resourcing appropriately to the diagnostic caseload. It would be prudent for further attempts to be made to make it work here. Universities benefit from the added caseload (and therefore teaching material) that government laboratories attract and government benefits from both the expanded expertise found in an academic institution and the recognition of "teaching value" that universities apply in setting cost-recovery models. Both benefit from the efficiency of shared facilities and a more robust scientific environment. The joint venture between the Victorian government and Latrobe University may provide further insight into how this might work in the Australia. Although Latrobe does not have a veterinary school they do offer an undergraduate degree in animal and veterinary bioscience.

Challenges for the future

The reduction in government veterinary laboratories is an irreversible trend and further rationalisation of services is likely as governments continue to scrutinise their expenditure of public funds. However, this process needs to be better coordinated. While jurisdictions have taken steps to maximise the efficiency of services within their boundaries, there is still significant duplication of resources and services across jurisdictions. If all state and territory laboratories were under a single controlling agency, the optimal national network of laboratories to support government

surveillance and disease control programs would look quite different to what we have today.

Rationalisation comes at some cost however. Training opportunities for veterinary laboratory diagnosticians have been reduced and there are concerns about the future availability of a qualified workforce. The closure of regional laboratories and the fee structure of the private laboratories have resulted in a dramatic reduction the number of post-mortem examinations undertaken by trained pathologists in Australia. Most are now done in the field by veterinary clinicians who submit tissue samples to the laboratories. No doubt disease diagnoses are delayed or missed because of this.

There is a need to improve information exchange between all laboratory sectors. Governments need diagnostic information to build an overall disease surveillance profile for the country. This information is fed into a national animal health surveillance database and used to underpin trade negotiations. For the most part, university and private laboratory data is lost to this system. Conversely, private and university laboratory diagnosticians would benefit from more information about what is being seen by their government colleagues.

Another key challenge for both government and private laboratories is how to better integrate their services. Private sector (and university) laboratories are now represented on the Subcommittee on Animal Health Laboratory Standards reporting to Animal Health Committee but there needs to be more consideration of how governments might tap into the potential of the private sector, for example in provision of high volume testing during an emergency animal disease response. Developing competitive tender contracts for provision of services before an emergency would most likely be very cost-effective in a national animal disease emergency.

The National Animal Health Laboratory Strategy (NAHLS)

To address many of these issues, Animal Health Australia (AHA) was requested by governments to convene a strategic advisory group in 2006 to develop a national strategy to rationalise laboratory service delivery in Australia. The mission of the NAHLS was the development and delivery of a national animal health laboratory service capability for the effective control of animal diseases of major importance to Australia. The strategy was to look at strengthening diagnostic capability through adequate resourcing, staff training, enhanced diagnostic technology and improved information technology. The advisory group included government, university and private sector representation.

Unfortunately, despite considerable effort by AHA, little progress has been made. Some laboratory personnel viewed the strategy as a threat and it was difficult to drive strategic change in a system without control of the sources of existing funding or any significant additional funds. The strategy did not engage senior decision makers and many state governments continued to make major investments in laboratories without national consultation or coordination.

Perhaps a different approach is needed; instead of paradigms like rationalisation and efficiency the answer may be to work towards expanded centres of excellence where the focus could be technologies, species or diseases. Such a system need not preclude wider service delivery to fulfil surveillance needs but would focus significant government expenditure on key national priorities and minimise duplication of effort. A shared vision between governments and universities and better information flow to reignite the synergy between diagnostic pathology and research is probably more important than shared infrastructure. Both need to recognise the strength of the private sector in the cost-effective provision of high throughput services.

Government, private and university laboratories all have different drivers, skills and strengths but if a truly national animal health laboratory strategy is to work, what better than centres of excellent embracing private, pubic and university laboratories, each doing what they do best?

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The views expressed in this article are those of the author.

References

1. Mylrea, P.J. (1989) The laboratory diagnosis of diseases in livestock in New South Wales: 1890 to 1947. *Aust. Vet. J.* **66**, 114–117. doi:10.1111/j.1751-0813.1989.tb09762.x
2. Angus, B.M. *et al*. (2007) Parasitology and the Queensland Museum, with biographical notes on collectors. *Memoirs of the Queensland Museum* (Brisbane: Queensland Museum) **53**, ISSN 0079-8835
3. Vallis, R. (2011) A Veterinary Awakening: The History of Government Veterinarians in Australia. Dept. of Agriculture, Fisheries and Forestry Canberra.
4. Newton, L.G. and Norris, R. (2000) Clearing a continent: The eradication of bovine pleuropneumonia from Australia CSIRO Publishing ISBN 0 643 06562 8.
5. Lehane, R. (1996) Beating the odds in a big country: The eradication of bovine brucellosis and tuberculosis in Australia. CSIRO Publishing ISBN 0 643 05814 1.
6. www.csiro.au/en/Organisation-Structure/National-Facilities/Australian-Animal-Health-Laboratory/AAHL-Profile/History-highlights.aspx

7. Anon. (2003) Inquiry into veterinary pathology services report. Parliament of Victoria Environment and Natural Resources Committee. p15
8. www.agribio.com.au
9. www.agric.wa.gov.au/objtwr/imported_assets/aboutus/corp/renewal_faqs_external_final.pdf

Biography

Dr Rob Rahaley is South Australia's Chief Veterinary Officer. He is also a specialist veterinary pathologist and worked for 15 years in the Victorian veterinary laboratory system before becoming a partner in Veterinary Pathology Services, Australia's largest private veterinary laboratory, and managing their Adelaide laboratory for 12 years. During this time his company was awarded the inaugural contract to provide veterinary laboratory services to the South Australian Department of Primary Industries. The company was sold to IDEXX Laboratories in 2000 and in 2002 he moved to the UK as manager of the IDEXX laboratory at Wetherby. He returned to Australia in 2005 as the Australian and New Zealand Country Manager for IDEXX. Dr Rahaley was appointed the South Australian Chief Veterinary Officer in 2007. He is a member of the Australian Animal Health Laboratory Strategic Policy Group and is an Affiliate Professor within the School of Animal and Veterinary Science at Adelaide University.

Foot-and-mouth disease: a persistent threat

Wilna Vosloo

Australian Animal Health Laboratory
Private Bag 24, Geelong East
Vic. 3220, Australia
Tel: +61 3 5227 5015
Fax: +61 3 4227 5555
Email: Wilna.vosloo@csiro.au

Foot-and-mouth disease (FMD) is a viral infection of cloven-hoofed animals. It is considered one of the most infectious viral diseases known and is feared for its ability to spread rapidly and cause widespread outbreaks in domestic livestock under intensive farming conditions. Remarkably, it does not cause high mortality, but morbidity can reach 100%. The disease has been eradicated from large parts of the world, and countries that are free of FMD take extreme precautions to prevent its reintroduction. For this reason FMD has been called an economic disease due to resultant trade restrictions and subsequent losses in income that have been estimated to reach between $7.1–16 billion for Australia depending on the size and duration of the outbreak[1].

Foot-and-mouth disease virus belongs to the genus *Aphthovirus* in the family *Picornaviridae* and exists as seven distinct serotypes (O, A, C, Asia-1 and South African Territories (SAT) 1, 2 and 3) with the latter 3 belonging to a different lineage. There is little to no cross-protection between virus isolates belonging to the different serotypes, complicating control of the disease when using vaccines. It is a single-stranded RNA virus with a small genome (~8.5 kb) that lacks proofreading ability[2] and each serotype therefore exists as numerous genetic and antigenic variants that have been classified into topotypes, i.e. geographically linked viruses with limited genetic variation[3]. The geographic distribution of the serotypes varies and different regions have their particular pools of viruses for which specific vaccine strains are needed. So far, seven pools of viruses have been identified to assist with control plans[4] (Fig. 1).

The disease has a very wide host range and most cloven-hoofed species are susceptible, although at varying levels[5]. However, their importance in the maintenance and spread of the infection varies depending on various factors such as the species of animal involved, the virus isolate, the infectious dose and the immune status of the animals. For example, there are FMD virus isolates that are highly infectious to pigs, but not cattle[6], while sheep and goats rarely show overt clinical signs[7]. Impala (*Aepyceros melampus*) that are found in sub-Saharan Africa are sometimes referred to as indicator species due to their high susceptibility to infection. During infection, that could also be sub-clinical, they can transmit the disease to other susceptible species, but factors such as animal density and contact rates determine that impala do not play an equally important role in the epidemiology of the disease in all regions where the species occur[8]. The African buffalo (*Syncerus caffer*), that is limited to sub-Saharan Africa, mostly suffer sub-clinical infection. It is the only species that has been shown to maintain the three SAT serotypes of FMD for long periods of time probably due to co-evolution of host and virus. The virus is present in cells obtained from oro-pharyngeal scrapings more than 28 days after the clinical phase of the disease has ended[9]. Although it is not clear how buffalo can transmit the disease, there is sufficient evidence that they can act as a source of infection for other domestic and wildlife species[10,11].