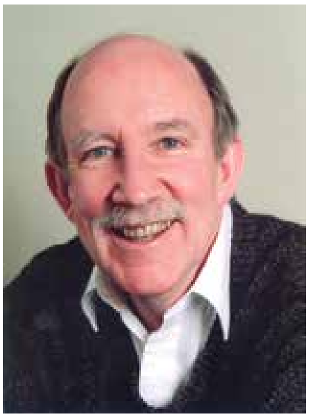
Leptospirosis – importance of a One Health approach



Roderick J Chappel
NRL, 4th Floor, Healy Building
41 Victoria Parade, Fitzroy
Vic 3065, Australia
Tel +61 3 9418 1115
Email roderick@nrl.gov.au

Lee D Smythe
WHO/FAO/FAO Collaborating Center for Reference and Research on Leptospirosis, Communicable Disease, Forensic and Scientific Services, Health Services and Support Agency, Queensland Health PO Box 594, Archerfield, Qld 4108, Australia
Tel +61 7 3274 9064
Email
Lee_Smythe@health.qld.gov.au

The term leptospirosis represents a spectrum of human and veterinary diseases caused by pathogenic serovars of the spirochaete genus *Leptospira*. It is of global significance as a cause of human mortality and morbidity, and of disease in domestic and production animals and in wildlife. A One Health approach to leptospirosis control is essential because human infection almost invariably results either from direct animal exposure or from exposure to environments contaminated by infected animals. The relationships between human and veterinary leptospirosis are illustrated by Australian experience. A major factor limiting control of the disease is poor communication and cooperation between those working from medical and veterinary perspectives. *Leptospira* shows great antigenic and genetic diversity, and so international leptospirosis reference laboratories are a vital but fragile resource. There is a compelling need to maximise cooperation between all professions with an interest in leptospirosis, to create outcomes, to communicate with governments and to ensure essential resources.

Leptospira currently includes species recognised as pathogenic for animals, free-living saprophytic species, and species that are genetically intermediate between these two groups[1]. The pathogenic species include the well recognised *L. borgpetersenii*, *L. kirschneri and L. interrogans,* and the genetically intermediate species such as *L. fainei*[2] are also sometimes reported as pathogenic[3]. Any mammal can potentially be infected[4], with effects from subclinical to fatal.

Leptospiral infection can be host-maintained, if transmitted readily within the host species, or incidental when such transmission does not occur. Infection of pigs with *L. interrogans* serovar Pomona[5] is an example of the former. Human leptospirosis is always incidental, and almost always results from direct or indirect exposure to the urine of infected animals[4].

Incidental infections are usually more severe than infection in maintenance hosts. Annual global incidence of severe or fatal human leptospirosis has previously been estimated as 500,000, but is probably much higher[6,7]. Flooding often leads to outbreaks with many fatalities. Survival of leptospires shed in animal urine is favoured by warm, wet conditions in tropical environments[4]. In temperate countries, most human infection relates to occupational exposure, water sports, or overseas travel. In Australia, it is predominantly occupational; affected groups include dairy farmers, abattoir workers, meat inspectors and agricultural workers[8]. However, surveillance between 1998 and 2004 showed a shift of 18% from occupational to recreational epidemiology[9].

Leptospirosis in Australia has been reported in many domestic animals such as pigs, cattle, sheep, horses and dogs, and in a number of wildlife species[9]. Such animal infection is often asymptomatic, but can cause reproductive losses in cattle and pigs, and atypical mastitis in dairy cattle. Leptospirosis has been shown to reduce growth rate in farmed deer in New Zealand[10]. No human vaccines are available in Australia, but animal vaccination helps prevent human infection as well as controlling veterinary disease.

Australian experience exemplifies the relationships between animal and human leptospirosis. Human incidence is highest in Queensland, because of its tropical and subtropical climate. The recently emerged *L. borgpetersenii* serovar Arborea[8] now causes the majority of human cases in Queensland (Figure 1), often with occupational exposure to infected rodents. The major Queensland floods of 2010–2011 led to an increase in human infections, as wet conditions allowed leptospires to survive longer in the environment.

Resources, recognition, challenges, interdependence

Although leptospirosis is of global significance, several factors make control difficult. The human disease is under-diagnosed and under-reported. Lack of recognition leads to inadequate resources, which in turn leads to under-diagnosis: a vicious circle. Government interest in leptospirosis is often lacking. Because it is of greatest importance in resource-poor tropical countries, human leptospirosis competes for resources with greater problems such as malaria and HIV/AIDS. Resourcing for veterinary leptospirosis is an even greater problem. Global understanding of veterinary leptospirosis is very inadequate, and in-depth veterinary expertise is poor and decreasing, yet protecting people largely depends on control in animals. Leptospirosis is expected to increase in the future as a result of climate change[11].

Leptospirosis is a complicated and moving target[12], and it is only through animal infection that we have some understanding of this. *Leptospira* is a most unusual genus, as is becoming understood through sequencing and genomic studies[4,13]. Patterns of infection in different animal species change over time, as illustrated by the emergence of serovar Arborea in Australia, and serovars wax and wane in importance. A species may change from an incidental to a maintenance host over time (McCaughan, C.J., personal communication) and a serovar can show different infection characteristics or different pathogenicity in different parts of the world[14]. Detecting and understanding these changes is beyond our present capacity. The situation is complicated by the fact that serological diagnosis depends on previous isolation of leptospires from human or animal sources. Our knowledge of leptospiral diversity is certainly incomplete; new serovars, and less frequently new species, are periodically discovered. Culture media suitable for growing one serovar may be unsuitable for growing another. We know most about the culture requirements of serovars that we have already isolated.

The traditional professional separation of the medical and veterinary perspectives is a major problem, and the medical

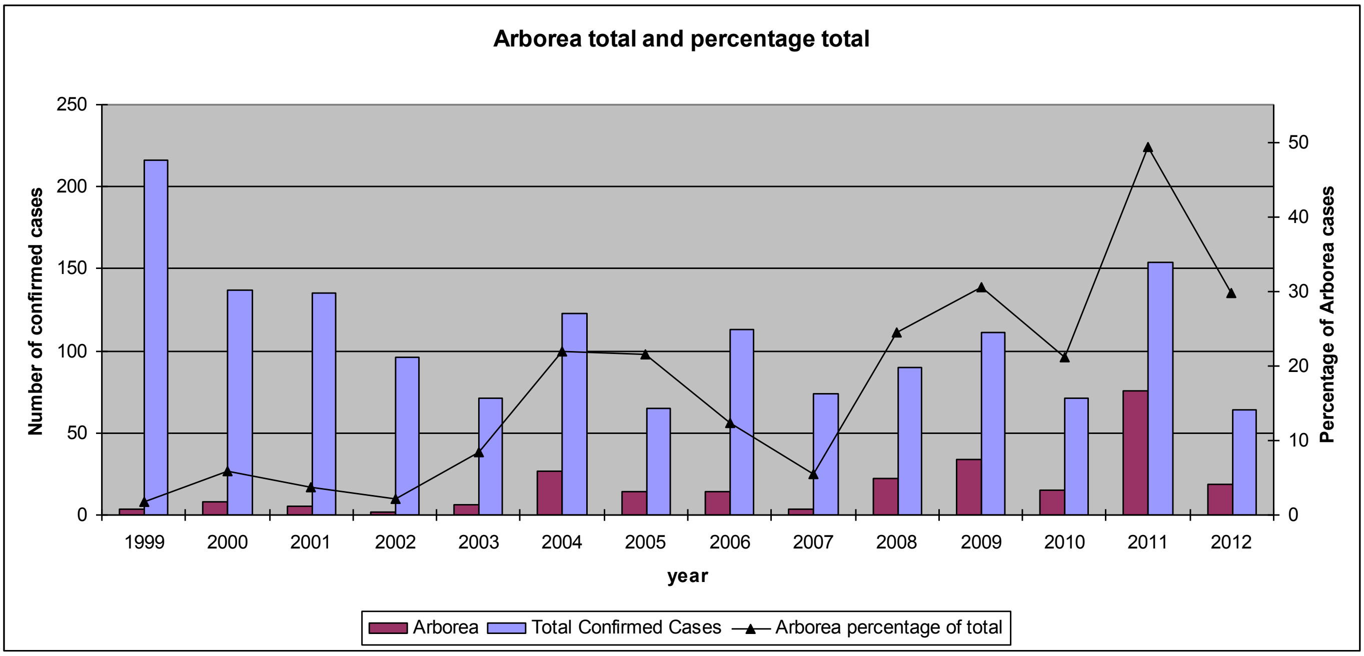


Figure 1. Trend in confirmed cases of human leptospirosis in Queensland caused by *Leptospira borgpetersenii* serovar Arborea, 1999–2012. Figures were compiled by the WHO/FAO/OIE Collaborating Centre for Reference and Research on Leptospirosis in Brisbane.

profession must learn from the broader understanding of those working on the veterinary side. Furthermore, although human leptospirosis surveillance is important, surveillance in animals is vital – for human as much as for veterinary considerations. Yet veterinary leptospirosis surveillance is extremely limited.

An international resource for workers in the field is the International Leptospirosis Society (ILS) which was founded in 1994 and incorporated in Victoria in 2011. Its objectives are promoting awareness of leptospirosis, facilitating communication, and providing information and support. It provides low-cost proficiency testing to about 100 laboratories performing the leptospirosis microscopic agglutination test worldwide[15]. Both medical and veterinary testing laboratories participate, and their results can be compared globally. In contrast, many other available proficiency testing schemes are restricted to either medical or veterinary testing.

Reference laboratories

Leptospirosis reference laboratories are a vital resource. Each has to try to maintain a full collection of the known leptospiral serovars, and to maintain and develop expertise in techniques for leptospirosis diagnosis and bacteriological and molecular characterisation. They provide both veterinary and medical testing laboratories with leptospiral cultures and with antisera for quality control. They also characterise new isolates, confirm new serovars, and assemble human and animal incidence data.

Several reference laboratories operate around the world. Cooperation between reference laboratories is essential, because of the diversity of leptospires, and the risk that a particular strain maintained in one laboratory may differ from the same strain in another laboratory. Exchange of cultures between reference laboratories is important, but is restricted by resources, and by the increasing cost and regulatory difficulty of shipping live cultures internationally. Much of the international burden is carried by two leptospirosis reference laboratories: the WHO/FAO/OIE Collaborating Centre for Reference and Research on Leptospirosis in Brisbane and the National Reference Laboratory for Leptospirosis at the Royal Tropical Institute, Amsterdam. An indication of the fragility of available resources is that both of these are in countries where human leptospirosis is fairly infrequent.

Future imperatives

Cooperation and cross-fertilisation between those with medical and veterinary perspectives on leptospirosis is needed to make effective use of scarce resources, to share knowledge, and to develop integrated control strategies. Cooperation with those involved in wildlife and natural resource management is similarly important. Key objectives must be improved veterinary surveillance, enhanced research at all levels, and support for the vital infrastructure of international leptospirosis reference laboratories.

References

1. Brenner, D.J. *et al.* (1999) Further determination of DNA relatedness between serogroups and serovars in the family Leptospiraceae with a proposal for *Leptospira alexanderi* sp. nov. and four new *Leptospira* genomospecies. *Int. J. Syst. Evol. Bact.* 49, 839–858.
2. Pérolat, P. *et al.* (1998) *Leptospira fainei* sp. nov. isolated from pigs in Australia. *Int. J. Syst. Bact.* 48, 851–858.
3. Arzouni, J.P. *et al.* (2002) Human infection caused by *Leptospira fainei*. *Emerg. Infect. Dis*. 8, 865–868.
4. Adler, B. and de la Peña Moctezuma, A. (2010) *Leptospira* and leptospirosis. *Vet. Microbiol.* 140, 287–296.
5. Chappel, R.J. *et al.* (1998) Prevalence and geographic origin of pigs with serological evidence of infection with *Leptospira interrogans* serovar pomona slaughtered in abattoirs in Victoria, Australia. *Vet. Microbiol.* 62, 235–242.
6. Hartskeerl, R.A. *et al.* (2011) Emergence, control and re-emerging leptospirosis: dynamics of infection in the changing world. *Clin. Micro. Infect.* 17, 494–501.
7. Anon. (2011) Report of the Second Meeting of the Leptospirosis Burden Epidemiology Reference Group. World Health Organization.
8. Slack, A.T. *et al.* (2006) The epidemiology of leptospirosis and the emergence of *Leptospira borgpetersenii* serovar Arborea in Queensland, Australia, 1998–2004. *Epidemiol. Infect.* 134, 1217–1225.
9. Lau, C. *et al.* (2010) Leptospirosis: an emerging disease in travellers. *Travel Med. Infect. Dis.* 8, 33–39.
10. Subharat, S. *et al.* (2012) Growth response and shedding of *Leptospira* spp. in urine following vaccination for leptospirosis in young farmed deer. *N.Z. Vet. J.* 60, 14–20.
11. Lau, C *et al.* (2010) Climate change, flooding, urbanisation and leptospirosis: fuelling the fire? *Trans. R. Soc. Trop. Med. Hyg.* 104, 631–638.
12. Thornley, C.N. *et al.* (2002) Changing epidemiology of human leptospirosis in New Zealand. *Epidemiol. Infect.* 128, 29–36.
13. Adler, B. *et al.* (2011) Pathogenesis of leptospirosis: The influence of genomics. *Vet. Microbiol.* 153, 73–81.
14. Faine, S. *et al.* (1999) *Leptospira* and Leptospirosis (2nd edn), p. 114, MediSci Melbourne.
15. Chappel, R.J. *et al.* (2004) Impact of proficiency testing on results of the microscopic agglutination test for diagnosis of leptospirosis. *J. Clin. Microbiol.* 42, 5484–5488.

Biographies

Roderick Chappel is the Quality Manager at NRL in Fitzroy, Victoria, and was formerly a research scientist specialising in leptospirosis at the Victorian Institute for Animal Science. He is the current President of the International Leptospirosis Society (ILS), and coordinates an international collaboration delivering the ILS proficiency testing scheme for the leptospirosis microscopic agglutination test.

Lee Smythe is Director of the WHO/FAO/OIE Collaborating Centre for Reference and Research on Leptospirosis, Australia and Western Pacific Region, and a former President of ILS.