

Department of Labour
TE TARI MAHI



Leptospirosis

Reducing the impact on New Zealand
workplaces

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Disclaimer

The Report summarises written material primarily generated and published since the release of the "Guidelines for the Control of Occupationally Acquired Leptospirosis" by the Department of Labour in June 2001, and information gained from people interviewed and contacted in the course of the project.

Every care has been taken to accurately reflect the material of the resources reviewed and the statements and views of people consulted. However the views and interpretations expressed are those of the author and not necessarily those of the Department of Labour or other organisations or institutions of the individuals consulted.

Barrie R Keenan

Wellington
August 2007

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EXECUTIVE SUMMARY

It is extremely unlikely that Leptospirosis will be eliminated entirely from the New Zealand environment. There is no human vaccine. Therefore the emphasis must be to isolate and minimise the hazard. There is no human to human transmission.

Key stakeholders are the Department of Labour (DOL), the Accident Compensation Corporation (ACC), Ministry of Health (MoH), meat industry, meat workers unions, farmers and their families, general practitioners, animal researchers, public health researchers, veterinarians, and animal vaccine manufacturers.

Following the publication of the "Guidelines" in 2001 there have been a range of initiatives taken by each of the main stakeholder groups as they have striven to meet their respective responsibilities. While this review has identified a number of specific areas requiring further research the key issue is how the contributions of the stakeholders can be brought together demonstrating the extent to which the industry has assumed responsibility for reducing the incidence and severity of occupationally acquired Leptospirosis in New Zealand, and how this leadership can be enhanced in the future.

The specific areas requiring further research are:

1. Definitive data on the occurrence of Leptospirosis in the community, especially the rural community.
2. Development of one comprehensive dataset rather than having to rely on the five different systems as at present.
3. Development of "easier-to-use" personal protective equipment of proven efficacy particularly for use in "high-at-risk" areas of meat processing plants.
4. The efficacy of vaccines for sheep and deer and hence the economics of use with these species.
5. Improvements in diagnostic tests for humans and the possibility of tests for animals before they are offered for sale or slaughter and processing.
6. Identification of sources of funding for related research initiatives.

In support of these areas and issues:

Occurrence of Leptospirosis in the community

Notified cases of leptospirosis in New Zealand increased in the period 1999 – 2002 in which year 140 cases were notified, and then have trended down with 86 and 89 notified cases in the years ended June 2005 and 2006 respectively.

Accurate information must be collected on the actual incidence of leptospirosis in rural and urban communities, the serovars involved, and the linking of this to exposures of people to various animal species, rodents and recreational waterways. Case report forms and procedures need to be amended accordingly. The absence of comprehensive and accurate data significantly inhibits the

calculation of the total costs of leptospirosis and the hence the benefits and return on various preventive strategies.

It is widely believed that there is considerable underreporting of the disease. A comprehensive study in Hawaii indicated a 600% increase in actual incidence over reported "sickness". It is hoped that a study of seroconversion of meat workers to be conducted by Katie Owens of MAF and Massey University staff will be able to commence soon. A key feature will be the reporting of leptospirosis on the basis of antibodies in the blood rather than people being diagnosed as being "sick".

Cross sectional studies would provide very valuable information on levels of infection and the impacts in people, animals, and wildlife. The Hawkes Bay has been identified as an area where this type of research could take place, for a number of reasons.

Development of one comprehensive dataset

There are considerable differences in recording systems and processes. For ESR - laboratory confirmed tests greatly exceed the number of notifications through related health systems. There is a different number in the Notifiable Occupational Disease System (NODS) and the ACC and the meat industry databases. The Public Health Bill to be introduced sometime in the future might offer scope for rationalisation and a new start with one integrated and comprehensive system. It is recommended that this opportunity be pursued.

Development of "easier-to-use" personal protective equipment (PPE)

Most, if not all, meat processing companies have developed appropriate health and safety documentation and consulted with staff about its implementation and observance.

Adaptation of PPE to the particular circumstances of various workstations within the meat industry is ongoing. Operators report that with some equipment they experience significant limitations in comfort, visibility, and ease of use when worn for extended periods. Automation of the most "at risk" processes is highly unlikely.

Positive initiatives within meat processing plants include the wearing of cut-resistant gloves, the wearing of water proof gloves, the wearing of special protective glasses, the use of "Stonepine" cream, and the use of some face shields. Following the implementation of the Smokefree Act the limitation of smoking to specific designated areas is a positive move.

Efficacy of vaccines for sheep and deer

Since 2001 there has been an increase in workers in lamb only plants and deer slaughter premises contracting leptospirosis. It is noted that some works drawing stock from particular regions will have very little occurrence of leptospirosis while other plants drawing stock from the same areas can have a much higher incidence – this is an area warranting further study.

Staff at Massey University are seeking funding to research the production effect of leptospirosis in lambs, and older sheep, and the efficacy of vaccination in controlling leptospirosis at the sheep farm level. Alternatively will vaccination of all cattle and deer on the property significantly reduce the infection in sheep on that farm? All young animals are born seronegative therefore any seropositive animals have become infected during their lifetime.

Research reported in 2005 by staff from Massey University and Invermay indicates some 80% of deer herds have a high proportion of stock infected. Vaccination, by definition is meant to be the elimination of shedding in those animals not infected at the time of vaccination. Some productivity gains after vaccination have been reported in deer.

Improvements in diagnostic tests for humans and for animals before slaughter

Two blood tests, some 4 to 6 weeks apart, and using the microscopic agglutination test (MAT) are the primary method of diagnosing leptospirosis in humans. A 4 fold increase in titre is required to provide confirmation of a positive diagnosis. A polymerase chain reaction (PCR) test is available - the analysis of one sample providing a definitive diagnosis of the presence or absence of leptospirosis, but not of the serovar causing the infection.

There are numerous accounts of delays by both GPs and hospital clinicians in ordering tests, and also in employers being reluctant to meet the cost of either the MAT or the PCR tests. Simplified testing for humans would be particularly advantageous.

There is a need to develop simple, rapid tests to identify infected herds and flocks so that staff at the meat plants can be warned in advance.

Identification of sources of funding

While the DOL has actively initiated, facilitated and participated in meetings identifying research priorities and prevention strategies it does not have any appropriation to fund the research initiatives identified. Animal industry funding has supported projects carried out by Massey University veterinarians. Some funding for the research of the kind suggested might be possible from the joint Occupational Health Research Fund - now administered jointly by ACC and the Health Research Council and this and other possibilities need to be explored.

Other institutional and industry initiatives

Since the publication of the "Guidelines" the DOL has demonstrated a commitment to proactive intervention and enforcement commensurate with the severity of the other workplace health and safety matters it deals with. Some 210 improvement notices relating to leptospirosis and employees were issued between December 1999 and September 2005. Two prosecutions were taken before December 1999 and one is currently pending (2006).

The "Guidelines" published by the DOL in 2001 were reasonably well received - relevant parts were extracted by meat works, regional DOL offices, and industry

groups and communicated to various audiences and target groups. Some updating and amendment, to correct current ambiguities, is required. It is recommended that the sections of the Guidelines which need change are identified and an updated version generated.

Although Leptospirosis was added to ACC's Schedule 2 in 1998 the percentage of "lodged claims" that have become "covered claims" has declined. It is hoped that the reasons for these trends can be explored.

Training of staff of the various stakeholders is ongoing. In a number of regions there has been good information for employees to share with doctors, information made available to GPs, and to farmers, their families, and people handling livestock. Additional strategies for communication to interested parties should be developed when the Guidelines are updated.

Progress with other species – cattle and pigs

Estimates are that some 90% of dairy cattle are vaccinated on an ongoing basis. The Westland Dairy Co has paid for the vaccination of dairy cattle owned and farmed by its suppliers since 1984. The NZVA wants to extend its prevention programme (called Leptosure TM) to 8000 dairy farms within 5 years. Very little data is available on the incidence of leptospirosis in dairy herds.

Previous work by Roger Marshall indicates a similar proportion (80%) of beef cattle herds are infected with leptospirosis.

Vaccination of all pigs for leptospirosis is encouraged and definitely improves productivity in sows, baconers, and porkers. Major pig processing companies will not accept stock from properties which cannot produce a vaccination certificate.

RECOMMENDATIONS

That the Department of Labour convene a meeting of key industry stakeholders at which participants will report on initiatives they are taking to address particular problems with leptospirosis and then explore means through which efforts might be coordinated and the industry exercise combined and effective leadership in combating leptospirosis.

That the Department of Labour facilitate a meeting between various agencies (especially meeting with the Ministry of Health, District Health Boards, ESR and other testing laboratories, ACC, and medical researchers) to improve the accuracy and completeness of data recorded on the incidence of leptospirosis and how initiatives for improved data flows between the agencies can be commenced.

Look at the efficacy of representatives of the key stakeholders (Executive Summary paragraph two) forming a project team to plan and undertake a project to obtain comprehensive information on the incidence of leptospirosis (including serovar type) in a rural community such as the Hawkes Bay. The anticipated outcomes of the project would include the raising of awareness of the disease among affected people in the farming, professional and urban communities, and the evaluation of different strategies for control in the various animal species, farming systems, and work environments.

BACKGROUND

Reason for this study at this time

In June 2001 the "Guidelines for the Control of Occupationally Acquired Leptospirosis" were published as a joint project between the Department of Labour and the Injury Prevention Division of the Accident Compensation Corporation and the Meat Industry Association. The aim of the Guidelines was to provide practical suggestions for the management of the workplace health hazard presented by the bacteria which can cause leptospirosis in humans.

It was emphasised at that stage that the prevention of leptospirosis called for a partnership between many different parties and a combined and concerted effort. With this in mind the Accident Compensation Commission (ACC) and the Department of Labour (DOL) undertook to take the lead in a collective approach to managing a disease which it was acknowledged could be costly in terms of human health and economic output.

In the period between 2001 and 2006 there were a number of reports that indicated the incidence of leptospirosis in humans could be back on the increase after a steady decline from the 1970's and that more cases were coming from the South Island. Current data capture relies on information coming from the Institute of Environmental Science and Research (ESR) and the Notifiable Occupational Disease System (NODS) but it appeared that less than 5% of reports come through these avenues and of those at least 50% arise from a combination of the meat processing and dairy industries.

Two new features were the incidence of leptospirosis being contracted by employees in "sheep only" processing plants and indications of high rates of positive tests in some deer herds. There were perceptions supporting the notion that vaccination of sheep is not cost-effective and there had been a number of the initiatives proposing research into relevant avenues of human and animal health relating to leptospirosis. However it has proved very difficult to identify sources of funding to enable these integrated research projects to be commenced.

Scope of this study – Terms of Reference

The scope of this study was as follows:

1. To undertake a review of written work since 2000 on occupationally acquired leptospirosis and of current trends in the incidence of the disease and the success of present prevention methods - with the view to providing written advice to assist in identifying one or more avenues to which the Department of Labour could direct resources in order to reduce the incidence and severity of occupationally acquired leptospirosis in New Zealand.
2. Separate, brief, written advice about the feasibility of delivering a one-day workshop at which the report would be presented and discussed and, if considered feasible to deliver such a workshop, advice of whom to be

invited to attend and suggestions for topics to be covered at the workshop.

The research has been carried out within a framework developed by the Department of Labour's Health Advisors Team as the preferred strategy for research projects. The report endeavours to address the key research topics that are relevant for this issue.

During discussions during the final stages of drafting the report it was emphasised that the DOL was not funded to facilitate the research in the areas identified and therefore attention should be given to how initiatives being taken by the industry stakeholders could be coordinated and extended to address these needs. Accordingly this dimension is now addressed in the report.

Additionally it was suggested that the most appropriate timing for a possible workshop was after industry stakeholders had had the opportunity to study the report and time to consider possible responses and contributions to the challenges and possibilities identified for further work.

What is Leptospirosis?

Leptospirosis is an acute generalised infectious disease characterised by extensive vasculitis, caused by *Leptospira* species. It is primarily a disease of wild and domestic animals, and humans are infected through direct or indirect contact with infected urine. Human to human transmission is extremely rare and has not been recorded in New Zealand. Leptospirosis is the World's most common Zoonotic Disease, New Zealand's most common occupationally acquired infectious disease and its incidence in New Zealand is high in comparison with other temperate developed countries (Thornley et al 2002).

Leptospirosis is a notifiable disease in New Zealand. Public health services obtain additional case demographic and risk factor data from the notifying doctor and this information is entered into the surveillance database (EpiSurv). The disease is also under laboratory surveillance. Specimens from cases are referred for additional serological testing using the microscopic agglutination test (MAT).

This testing is carried out at ESR and a small number of other diagnostic laboratories. These laboratory and notification data are collated nationally by ESR for the New Zealand Ministry of Health (Baker et al 2004).

Leptospira spp. have been ranked as one of the most successful of vertebrate pathogens and is nominated as the world's most widespread zoonosis (Plank and Dean 2000). Leptospire possesses an impressive array of strategies which enable it to elude control, including wide antigenic variation, the ability to infect a broad range of species, sophisticated mechanisms of host-adaption including the ability to remain in hosts for long periods and continue shedding in the urine. Additionally they exhibit the capacity to survive for long periods in temperate and moist environments, and have multiple modes of transmission and entry into hosts (Davies 2003).

There are over 200 *Leptospira* serovars classified into 23 serogroups (Bolin 2004). A new and alternative scheme based on genomic considerations classifies the pathogenic organism into several species. While this has interesting implications for future research for the purpose of this report serovars are written as if they were a single species e.g. *Leptospira hardjo* and *Leptospira pomona*. As recorded by Worthington in 1982, over the years since *Leptospira* were first identified in New Zealand in 1951 the following species have been isolated from animals in this country *Leptospira borgpetersenii* sv. *hardjo*, *Leptospira interrogans* sv. *pomona*, *Leptospira balcanica*, *Leptospira copenhageni*, *Leptospira borgpetersenii ballum*, and *Leptospira tarrasovi*. There is one report (Thompson 1980) of *Leptospira australis* being isolated from a human.

In humans serological diagnosis indicates that five of the species endemic in farm animals infect humans with the most common being *L. hardjo*, *L. pomona*, and *L. ballum* – and the other two being *L.tarrasovi* and *L. copenhageni*.

L. balcanica which is associated with possums in New Zealand has not been reported in humans. *Leptospira spp* other than the above are classified by the Ministry of Agriculture and Forestry as “other exotic organisms” (MAF 2004).

Many of the *Leptospira spp* are adapted to a particular host species (known as the maintenance host), in which an almost symbiotic relationship has been formed. Species other than the maintenance host may be more resistant to infection but if infected are more susceptible to disease. *L. hardjo* for example infects most cattle in an endemic situation that only causes occasional cases of disease in cattle. However it has been recorded as being responsible for the majority of cases of this disease in humans (accidental hosts). In maintenance hosts post mortem examination shows that the *Leptospira* may localise in the kidneys. In the farm situation the animals may continue to excrete the organism in their urine for many months, if not years.

The disease is spread in water and mud contaminated with infected urine. Flooding, or irrigating, can be a significant means of spreading infected material in the pastoral situation. Infection can occur by mouth or through the skin, particularly through abrasions and wounds. It is understood that diseased animals shed more organisms and are more important sources of infection than chronic carriers of infection. In accidental hosts the incubation period may be from 2 –16 days and is followed by a period when the bacteria are present in the blood and hence able to spread to other organs in the body.

The Ministry of Agriculture and Forestry has reported that at the 2004 general session of the World Organisation for Animal Health (OIE) members voted to remove the leptospirosis chapter from the OIE Terrestrial Animal Health Code because of the ubiquity of the organism and the absence of meaningful control programmes and effective treatments in live animals (Pharo 2005)

What does it do to people?

Clinically in humans, leptospirosis ranges in severity from a mild sub-clinical illness to either a self-limited systemic illness (some 90% of cases) with most

patients fully recovering within three – four months, or a severe potentially fatal condition accompanied by multi-organ failure.

The incubation period is commonly 5 – 14 days, but ranges from 2 –30 days. The onset, and the way the condition presents clinically is often of two phases, with the first acute phase lasting about a week followed by an immune phase characterised by the shedding of leptospires in the urine. Most complications are associated with the build-up of leptospires within the tissues during the immune phase and are most likely to manifest in the second week of illness.

The main organs likely to be affected are the kidneys, lungs, and liver. The predominant early clinical features are the sudden onset of headache, muscle pain and tenderness, fever, rigors, nausea, conjunctival suffusion or redness, transient skin and mucosal rash, photophobia, and other signs in which the symptoms simulate a meningitis, but in which no actual inflammation of these membranes is present. i.e. meningism. Severe cases may progress to renal and respiratory failure, as well as pulmonary complications.

Illness caused by the serovars present in New Zealand is seldom fatal, although some deaths have been recorded. Illness caused by some serovars present in other countries can result in fatalities of between 10 and 20% of those infected.

ACC's current New Zealand case definition is:

"An illness characterised by fever, headaches, chills, myalgia, conjunctival suffusion, and less frequently meningitis, jaundice, or renal insufficiency. Because the presentation of illness in anicteric (i.e. not associated with jaundice) cases is non-specific it is important to correlate the illness with exposure." (ACC Review: Leptospirosis in New Zealand July 2004)

What have been the trends in New Zealand since 1990 and since 2001?

The annual number of cases in New Zealand peaked at 875 in 1971. The annual incidence of human leptospirosis in New Zealand declined from 5.7 per 100,000 of population in 1990-92 to 2.9 per 100,000 in 1996-98 (Thornley 2002) but over the period 2001 – 03 there was an average of 118 notifications (3.2 per 100,000) and 148 laboratory identified cases (4.0 per 100,00) per year. The incidence in this period was significantly higher than in the previous three year period reversing a long-term decline in rates of this disease in New Zealand (Baker and Lopez 2004).

It would appear that this was a short term trend as in 2004 there were 102 cases (2.7 per 100,000) and this declined further in 2005 when there were 86 cases notified (2.3 per 100,000) and this increased only slightly in 2006 when 89 cases were notified.

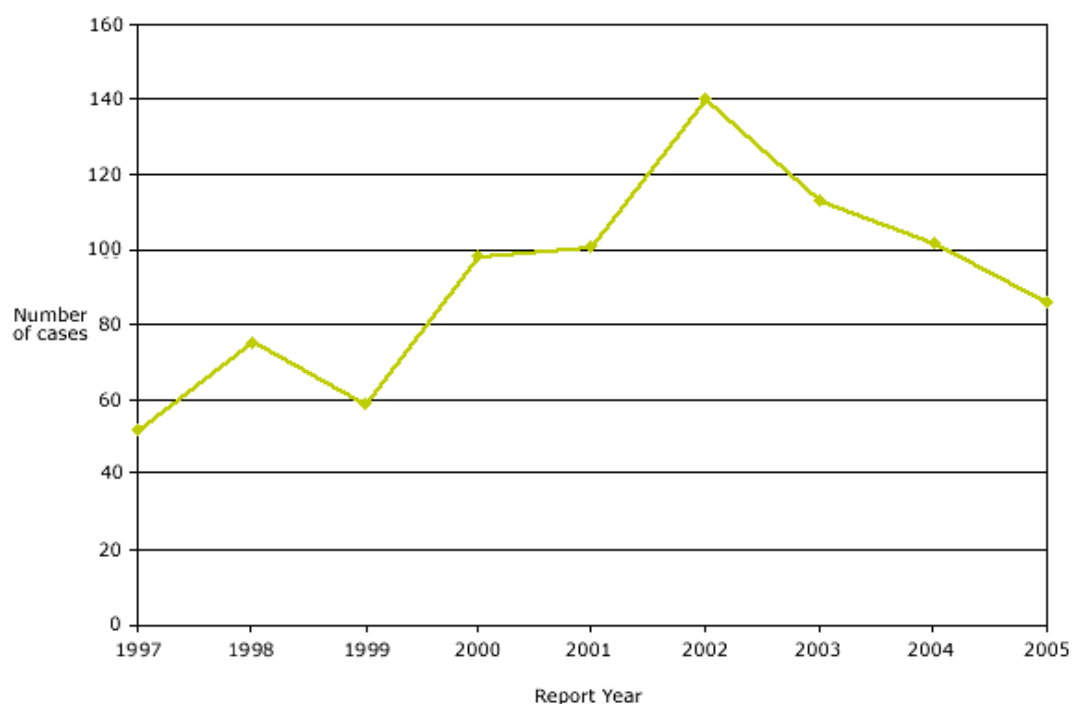
Of the 86 notified cases in 2005, 67 were laboratory confirmed and in addition there were a further 42 cases which were laboratory reported but not notified (ESR Annual Report 2005).

No leptospirosis related deaths were reported in 2005. Of the 80 cases for which hospitalisation status was recorded, 36 (45%) were hospitalised.

- One death has been attributed to Leptospirosis – after a fisherman handling nets was exposed to rat urine.

The trends of Leptospirosis notifications in New Zealand from 1997 – 2005 are shown in Figure 1 below.

Figure 1: Leptospirosis notifications in New Zealand 1997 - 2005



Source: New Zealand Public Health Observatory – data reported by ESR as at 16 February 2006

Occupation was recorded for 82 (95.3%) of the 86 notified cases. Of these, 75 cases (91.4%) were recorded as engaged in occupations previously identified as high risk for exposure to *Leptospira* spp in New Zealand and the proportion in high-risk occupations has changed little over the last two years being 93.1% in 2004 and 86.3% in 2003.

Of the 82 cases in 2005 with recorded occupation, 39 (47.6%) worked in the meat processing industry (as either freezing workers, butchers, meat inspectors, meat processing managers, and meat processing cleaning supervisors) and 36 (43.9%) were farmers, farm workers, or stock truck drivers. Cases in the 2005 year also included one possum hunter, one market gardener, one contractor (engaged in stock/effluent pond cleaning), one furniture manufacturer (who also had contact with animal manure), one coalmine supervisor (who also had a hobby farm) one concrete cutter, and one plumber. (ESR Annual Report 2005).

The highest age specific rates were reported in the 40 – 49 years with 30 cases (5.6 per 100,000 population) and there were 21 cases in the 50 – 59 years (5.0 per 100,000 population). Males comprised 93.0% of the cases and ethnicity was recorded for 74 of the 86 cases. Of these rates were highest for the Maori ethnic group with 16 cases or 3.0 per 100,000 population.

On the ESR's EpiSurv database serovar data was recorded for 67 of the 86 cases in 2005 with *L. hardjo* 46 cases (69%), *L. pomona* 13 cases (19%), *L. ballum* 6 cases (9%), and *L. tarassovi* 2 cases (3%).

Table 1 shows cases by District Health Board for the period 1997-98 through June 2005. Over the whole period 1997 – 2005 the District Health Boards recording the highest percentage of cases were Waikato, Hawkes Bay, Canterbury, Northland, and MidCentral.

In the period from 2000 – 2005, compared with the total period 1997 – 2005, increases in the percentage of cases have been recorded by Waikato, Hawkes Bay, MidCentral, Bay of Plenty and Southland. Decreases in this period have been recorded by Canterbury, Northland, and Taranaki.

Table 1: Leptospirosis cases notified by District Health Board 1997-98 through 2004-05

DHB	1997-98*	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Total	%
Auckland				2		1		1	4	0.5
Bay of Plenty	1	3	3	7	8	6	2	7	37	4.9
Canterbury	7	5	14	6	8	9	12	4	65	8.6
Capital and Coast		2		2	2			2	8	1.1
Counties Manukau		3	1	2	1	4	3	1	15	2.0
Hawke's Bay	13	7	7	10	23	20	12	16	108	14.2
Hutt	1								1	0.1
Lakes	2	2	1	2	1		4	1	13	1.7
Mid-Central	5	4	4	5	10	9	11	9	57	7.5
Nelson/Marlborough	4	4	5	5	6	13	8	5	50	6.6
Northland	8	6	11	8	13	8	6	2	62	8.2
Otago	1	1	4	2	3	7	1	3	22	2.9
South Canterbury	1	1	4	7	7	4	1	1	26	3.4
Southland	1		3	3	1	2	15	5	30	4.0
Tairāwhiti	4	1	2	8	7	4	6	3	35	4.6
Taranaki	3	2	7	4	2	5	6	3	32	4.2
Waikato	9	13	11	22	20	18	25	11	129	17.0
Wairarapa		3		1	1	1	1	2	9	1.2
Waitemata	2		3	2	8	4		1	20	2.6
West Coast	1	2	4	1	2		5	4	19	2.5
Whanganui	1	2	2	1	1	5	1	3	16	2.1
Total for year	64	61	86	100	124	120	119	84	758	100

*Year runs from 1 July to 30 June. Data extracted from ESR's EpiSurv on 5 May 2006

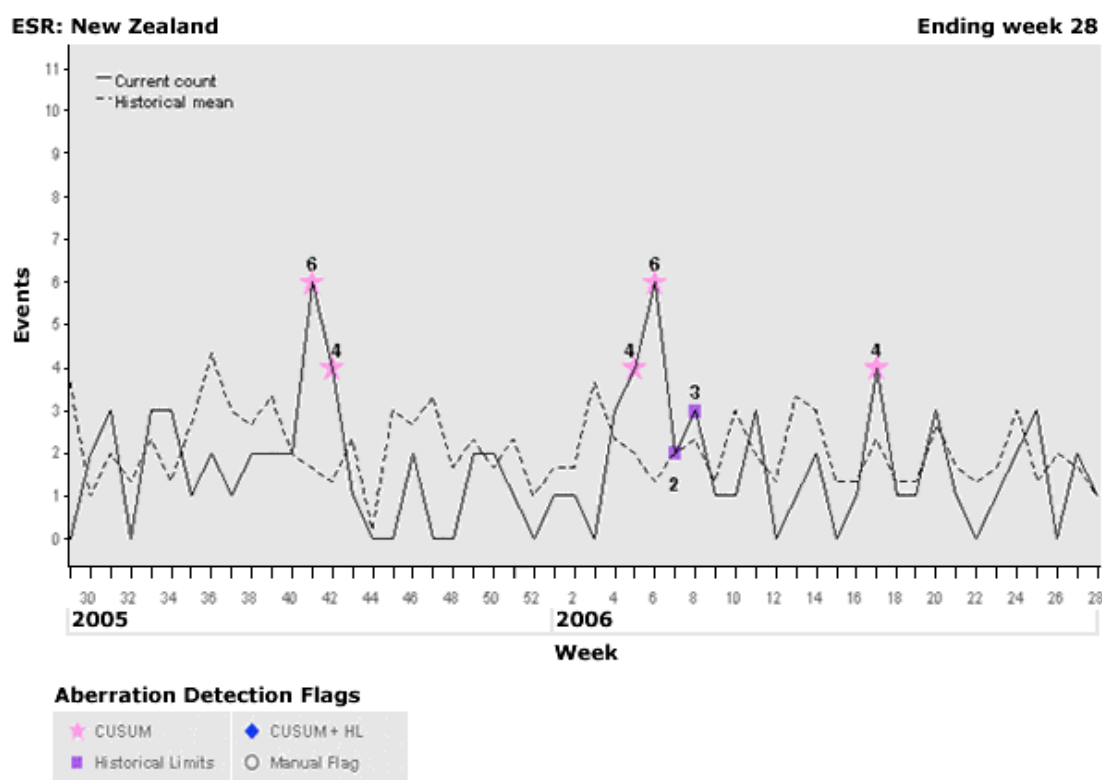
Data from ESR in Table 2 shows that the two most dominant occupational groupings are meat processing and farmers (including those involved with farming operations).

Table 2: Leptospirosis cases by occupational grouping 1997-98 through 2004-05

Occupational Group	1997-98*	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Total	%
Meat Processing	22	20	21	37	51	55	59	51	316	41.7
Farmer & related	22	22	38	38	51	40	43	23	277	36.5
Contractor/Tradesman	3	2	3	2	3	0	2	2	17	2.2
Forestry	0	2	1	2	2	1	2	1	11	1.5
Professional/Office	4	1	7	2	2	2	3	1	22	2.9
Not Employed	4	4	1	4	5	5	2	0	25	3.3
Other	2	1	2	4	0	3	2	2	16	2.1
Unknown	7	9	13	11	10	14	6	4	74	9.8
Total	64	61	86	100	124	120	119	84	758	100

*Year runs from 1 July to 30 June. Data extracted from ESR's EpiSurv on 8 May 2006. Preliminary data (R Pirie pers comm.) indicates that in the year to 30 June 2006 there were 89 cases – 3 more than the previous year with the distribution throughout the year being shown in Figure 2.

Figure 2: Leptospirosis cases notified July 2005 – June 2006



Source: ESR via R Pirie pers comm. July 2006

Extract EpiSurv reports accessed through www.nzpho.org.nz state that apart from two peaks in October 2005 and in February 2006 the number of cases is in line with the 3 year average.

However in October 2005 14 leptospirosis cases were notified compared to six cases notified in the same month the previous year. The cases were notified from MidCentral (4 cases), South Canterbury (3), Northland (2), and one each from Counties Manukau, Bay of Plenty, West Coast, Canterbury, and Otago DHBs. Among the 13 cases for whom occupation was recorded, six were farmers, five worked in the meat processing industry, one was a possum hunter, and one was a furniture manufacturer. The serovar was identified for eight cases as *L. hardjo* (7 cases), and *L. ballum* (1 case).

In February 2006 13 cases of leptospirosis were notified compared to 7 notified cases in the same month of the previous year. Four (30.8%) of the cases were notified from the Hawke’s Bay DHB. Occupation was recorded for 12 cases, 10 were farmers, one was a meat worker, and one was an investor. The *Leptospira* species and serovar was recorded for 12 of the 13 notified cases: *L. pomona* (7 cases), *L. hardjo* (3), *L. ballum* (1), and *L. tarassovi* (1).

Acceptance of claims by ACC

Data obtained from ACC on the number of claims made in the years since 1991-92 and the number of claims accepted is shown in Table 3. There are areas for further research to ascertain why such a low percentage of claims notified to ESR come through as claims to ACC and secondly why the percentage of claims

lodged claims that have been accepted/covered by ACC has declined since 1998 when leptospirosis was included in ACC's Schedule 2

Figure 3: Claims made, and accepted/covered, by ACC from persons with Leptospirosis

Year	ACC claims lodged	ACC claims accepted	Percentage ACC claims accepted	ESR statistics	Percentage of ESR cases lodged ACC	Percentage of ESR cases accepted ACC
1991-92	133	92	69.2			
1992-93	105	79	75.2			
1993-94	68	43	63.2			
1994-95	83	60	72.3			
1995-96	67	49	73.1			
1996-97	49	36	73.5			
1997-98	33	23	69.7	64	51.6	35.9
1998-99	13	12	92.3	61	21.3	19.7
1999-2000	4	4	100.0	86	4.7	4.7
2000-01	40	23	57.5	100	40.0	23.0
2001-02	69	48	69.6	124	55.6	38.7
2002-03	88	53	60.2	120	73.3	44.2
2003-04	95	56	58.9	119	79.8	47.1
2004-05	101	54	53.5	84	120.2	64.3
2005-06 **	63	27	42.9			

Notes:

Year is the financial year beginning 1 July and ending 30 June

* These are all notifications – from both employees and members of the public.

** 2005-06 is partial year commencing 1 July 2005 ending 13 May 2006

Source of ACC data is Incite 03055 Leptospirosis stats

Produced by Data Warehousing & Business Intelligence Unit

Data Warehouse load date is 13May2006

ESR data extracted from ESR's EpiSurv on 5 May 2006

Some idea of the cost to the individual and the nation

A range of difficulties are encountered when estimating the cost of leptospirosis to the individual and the nation. Some of these include:

- The perceived degree of under-reporting of the illness. This can be the result of the variety of severity of symptoms, the reluctance of the person to go to a doctor, whether or not the doctor recognises the risk of leptospirosis and asks for a blood test for leptospirosis, the accuracy of the blood tests when taken, the reluctance of the person to take time off work because of the impact of extra work load for fellow workers, or because not wanting to forego income. Estimates of the degree of under-reporting vary from a factor of 2 to a factor of 8 to 10 to "all you see is the tip of the iceberg". Implementation of an active surveillance programme in Hawaii resulted in an approximately six-fold increase in reported leptospirosis infections (Sasaki et al., 1993).
- The variability of time required to recover from the disease can be from 3 – 4 weeks away from work up to a period of 6 – 8 months. Longer periods have been recorded, in some cases.

- The percentage of people requiring hospital treatment and for different durations.
- The varying percentage of lodged claims that are accepted by the ACC for compensation.

Since the release of the Guidelines in 2001 there have been on average some 112 cases reported each year.

Data from the meat industry indicates that on average each case results in 6 weeks away from work, excluding time on alternate duties – thus 40 hours/week x \$25/hour = \$6,000 per person affected.

It is estimated that on average each case costs some \$1,500 in direct medical costs when hospitalisation is taken into account with some 45% of those whose affected requiring hospital treatment.

There is no comprehensive data on the actual cost to those engaged in the farming sector or other occupational groupings. More details of the costs to farmers and other self-employed persons needs to be obtained. However, it can be implied that on a conservative basis the cost per person is \$7,500 (\$6,000 + \$1,500) and hence an annual direct cost for 112 persons is of the order of \$840,000 per year. The absence of comprehensive and accurate data significantly inhibits the calculation of the total costs of leptospirosis and the hence the benefits and return on various preventive strategies. Note that it is normal to regard the indirect costs of workplace injuries, illness and absence as being 4 to 8 times the direct costs.

Changes in species and/or serovars and routes of transmission.

A major development in the period 2001 to the present has been the research into the epidemiology and control of leptospirosis in New Zealand farmed deer conducted by Professor Peter Wilson and colleagues at Massey University and Colin Mackintosh at AgResearch, Invermay (Wilson et al 2005). This was one of a number of papers on this topic presented to the conference of the Deer Branch of the New Zealand Veterinary Association in 2005.

By taking some 20 blood samples from each of 113 farms in different areas throughout New Zealand the researchers established that *L. hardjo* was present in 65% of the herds, *L. pomona* in 4% and a further 14% of herds had both *L. hardjo* and *L. pomona*, - with no evidence of infection being observed on 17% of the farms. No serological evidence of serovar *L. copenhageni* was observed on any farm. In an earlier study in 1992-1993 the prevalence of the different serovars was 70% *L. hardjo*, 10% *L. pomona*, and 1% *L. copenhageni*.

As far as is known there have been no recent comprehensive surveys of the occurrence of leptospirosis in dairy cattle. Discussions with the veterinarians practising in the Waikato indicate that some 90% of their clients vaccinate their

dairy cattle. Since the middle 1980s the Westland Dairy Company has paid for the vaccination of dairy cattle owned and farmed by its suppliers.

The New Zealand Veterinary Association's product Leptospure™ is a farm specific risk management plan which incorporates the vaccination of all classes of stock at the appropriate times together with effective strategies for hygiene and personal care, rodent control, and waterways and effluent management. A business plan has been developed and resourced by the NZVA with the objective of expanding the uptake of the programme from the current level of some 500 farms to having 8000 dairy farms enrolled in the programme within five years. While the concept of programme is equally applicable to beef cattle, and there was an initiative to apply it to properties in the Taupo area, there has been minimal uptake by beef cattle farmers of either the Leptospure™ or any other leptospirosis vaccination programme.

Vaccination of all pigs for leptospirosis is encouraged as this has been shown to improve productivity by preventing abortion in the sows and to enhance growth rates in baconers, and porkers. Most major pig processing companies will not accept stock from properties which cannot produce a vaccination certificate.

Understanding of the proportion of sheep flocks that are infected with leptospirosis, the degree of infection, and the regional distribution of infected flocks is severely limited by the absence of any comprehensive data. Staff at Massey University are seeking funding to research the production effect of leptospirosis in lambs, and older sheep, and the efficacy of vaccination in controlling leptospirosis at the sheep farm level.

Another aspect of the proposed research initiative is to see if vaccination of all cattle and deer on the property will significantly reduce the infection in sheep on that farm? Preliminary research has confirmed that all young animals are born seronegative therefore any seropositive animals have become infected during their lifetime. While the level of infection in lambs is relatively low the degree of infection can increase very significantly with hoggets and some categories of older sheep (C Heuer pers. comm.).

Thornley observed that in the period 1996-1998 infections caused by *L. ballum* had overtaken those caused by *L. pomona* as the second most commonly recognised serovar. As *L. ballum*, which is maintained in rodents and occurs secondarily among livestock animals, had been tested for in New Zealand for a long period the point was made that the observed increase was not because of a change in testing schedules. Therefore the emergence of it as a more frequent cause of human infection suggested a change in the prevalence of *L. ballum* and the increasing exposure of people to this serovar by direct animal contact or through contaminated surface waters (Thornley 2002).

However it would appear that this was a temporary shift as the predominant serovars among laboratory reported leptospira over the 2001 – 2003 period were *L. hardjo* (42.7%), *L. pomona* (33.5%) and *L. ballum* (10.7%) with smaller contributions from *L.tarrassovi* (7.9%) and *L.copenhageni* (2.4%) (Baker 2004).

There is no consolidated information available on the degree of leptospira contamination of rivers and streams used for recreational purposes by kayakers, trampers, and other users. Although it has been suggested that this might be an increasingly important source of infection the information collected in the various systems lacks the specificity to justify or refute this claim.

UPDATE ON RESEARCH

The changing epidemiology of human leptospirosis in New Zealand

The objective of the work published by Thornley and his co-authors (Thornley 2002) was to describe the current epidemiology and trends in New Zealand human leptospirosis using descriptive epidemiology of laboratory surveillance and disease notification data for the period 1990 –1998. During this period the annual incidence of human leptospirosis in New Zealand was 4.4 per 100,000. Incidence was highest amongst meat processing workers (163.5/100,000), livestock farm workers (91.7), and forestry-related workers (24.1).

The most commonly detected serovars in this period were *L. hardjo* (46.1%), *L. pomona* (24.4%), and *L. ballum* (11.9%). Although the annual incidence of leptospirosis declined from 5.7 per 100,000 in 1990 –1992 to 2.9 per 100,000 in 1996 –1998 the authors concluded that the incidence of human leptospirosis in New Zealand remains high for a temperate developed country and that targeted and evaluated disease control programmes should be renewed.

Recommendations made in the paper (Thornley 2002) include:

1. The leptospirosis disease notification dataset collected on the case report form would benefit from ongoing improvement and a particular aspect would be the collection of accurate information on exposures to potential sources of infection.
2. Future reviews of leptospirosis epidemiology should make use of exposure data and a study of cases matched for geographic area of residence would be necessary to determine the proportion of cases attributable to recreational exposure.
3. The overall decline, and the decline in cases among livestock farmers, is likely to be the result of improved prevention of the disease in livestock.
4. Several health districts have not followed the overall trend but there is insufficient data to provide explanations for the failure of these health districts to maintain the declining rates of leptospirosis.
5. Valuable information would be gained from the inclusion of data comparing vaccination rates between health districts but this information was not currently available.

The paper published by Michael Baker and Liza Lopez (Baker 2004) updates the Thornley analysis of the period 1990 –1998, by describing the epidemiology over the most recent three-year period to 2003.

During 2001 to 2003 there were 355 notified cases of leptospirosis, an average annual total of 118 cases being a rate of 3.2 per 100,000 and for laboratory-identified cases a rate of 4.0 per 100,000, based on 2001 population census data. The average rates in this period were significantly higher than the preceding three years when notifications were 2.1 per 100,000 and laboratory identified cases were 2.8 per 100,000.

Occupation was recorded in 91.5% of the 355 cases notified in 2001 –2003. In this period there were virtually equal proportions of meat workers (37.5%) and farmers (37.4%) with a smaller group (7.0%) engaged in a wide range of occupations which potentially involve contact with animals or environments contaminated by animals. By comparison the occupational distribution of the 399 cases in 1990 –1992 included a higher proportion of livestock farm workers (57.0%) compared with meat processing workers (29.6%).

The predominant serovars among laboratory-reported leptospira in the 2001-2003 period were *L. hardjo* (42.7%), *L. pomona* (33.5%), and *L. ballum* (10.7%) with smaller contributions from *L. tarrasovi* (7.9%) and *L. copenhageni* (2.4%).

An analysis was made of the 90.4% of cases (321/355) in which information was reported on contact with animals or animal products prior to the illness. Of these, 47.0% reported unspecified contact with a farm. Many cases also reported contact with more than one animal species. Contact with cattle alone was reported by 23.4%, cattle in combination with other animals 9.3%, sheep on their own 5.9%, sheep in combination with other animals 4.4%, pigs on their own 2.5% and rodents on their own 1.2%. (It is interesting to note, in view of data reported elsewhere in this Report, that no cases of contact with deer were identified).

The conclusion is drawn that most infections are associated with contact with cattle, either on their own or with other animals. Such infections may be caused by any of the important serovars in New Zealand, although *L. hardjo* and *L. ballum* predominate. Sheep appear to be the second most important reservoir, on their own or in combination with other animals. Here *L. hardjo* and *L. pomona* occur in similar proportions. Cases with a history of contact with pigs are most commonly infected with *L. pomona*.

The authors make the point that the rise in incidence marks the end of a steady decline in incidence that had been identified over the previous two or more decades and while leptospirosis remains overwhelmingly an occupational disease of livestock farm workers and meat processing workers, as observed previously, there are marked differences in incidences occurring between different district health board areas.

District Health Boards with consistently high rates are Tairāwhiti (14.4 per 100,000), Hawkes Bay (11.6), South Canterbury (7.6) Northland (7.4), Nelson Marlborough (7.3), Waikato (6.8), MidCentral (5.8), West Coast (5.5), Taranaki (4.5), Bay of Plenty (3.7), Wanganui (3.7), and Southland (2.9)

Particular mention is made of several potential sources of bias which need to be considered when interpreting the surveillance data – these include:

1. Many individuals with leptospirosis will not seek medical attention either because the symptoms are mild and short-lived, or due to difficulties accessing medical services. This may result in a lowering of the reported rates especially of those living in rural areas.

2. Recognition of leptospirosis by doctors was regarded by many of the people interviewed during the joint Department of Labour – ACC 'Aftermath' project as poor. The reasons for this are that the symptoms of Leptospirosis are not clear cut, that Leptospirosis is relatively rare (especially for urban GP's) and the need to test is not always recognised, even after admission to hospital. (Aftermath 2002.) Unrecognised cases will not receive laboratory testing and therefore are not included in the data set. Doctors may also be less likely to suspect the diagnosis in cases lacking a history of exposure to a well-known source of infection, creating a bias against detecting atypical or emerging modes of transmission.
3. The ESR *Leptospira* Reference Laboratory does not receive all records from regional laboratories, and the laboratory surveillance database therefore may not represent a true count of all laboratory identified cases in New Zealand.

The conclusion is drawn that the analysis of trends over this 2001 – 2003 period provide some evidence that the epidemiology of leptospirosis in New Zealand is changing. The proportion of cases among meat workers now equals that among farmers. There is evidence that sheep are emerging as a more important reservoir than previously.

Ongoing disease surveillance would provide more sensitive and complete information if laboratory and notification data were fully integrated. More intensive epidemiological study would enable better definition of the risk factors of the disease on the farm and in the meat processing environments which in turn would help identify effective interventions.

Leptospirosis in sheep and deer

When the Guidelines were published in June 2001 it was acknowledged that knowledge of the role of all the individual livestock species as sources of human exposure to *Leptospira* pathogens was incomplete. In a paper to the New Zealand Veterinary Association meeting in May 2005 Dorjee et al (Dorjee 2005) reported preliminary results of work undertaken in response to the incidence of leptospirosis in meat workers in sheep only plants.

The study was conducted between May 2004 and June 2005 with a total of 1966 sera from 68 lines of sheep comprising at least 65 different properties from various areas around New Zealand being collected by systematic random sampling of 30 carcasses from each of 3 – 5 randomly selected lines (i.e. farms) per week. The results were that 33 of 68 (48.5%) lines had one or more carcasses with titres of either *L. hardjo* or *L. pomona* or both. The prevalence of positive lines to both serovars was significantly higher for hogget lines (85.7% and 28.6%) than for lamb lines (23.4% and 10.6%) for *L. hardjo* and *L. pomona* respectively.

A strong positive association was observed with the kidneys lesions (i.e. distinct white spots) and seroprevalence for both serovars. Carcasses with at least one distinct white spot on one or both kidneys were 4.6 times and 15.1 times more likely to test positive to *L. hardjo* and *L. pomona* respectively, than those without

white spots. However the prediction of the sero-status of a carcass based on kidney lesions is low with positive predictive values of 16.7% and 9.2% for *L. hardjo* and *L. pomona* respectively.

In a second study, sheep from five farms with reported clinical outbreaks of leptospirosis attributable to *L. pomona* were investigated and sampled for serology. The outbreaks presented as a weakness, lethargy, and death of either 1 – 4 week old lambs or 6 – 9 month old lambs with up to 5 – 15% of the lambs in the affected groups dying. Severe jaundice was a feature of all cases. Three cases were associated with periods of high rainfall that caused surface flooding or poor drainage. In two cases a worker became ill and leptospirosis was suspected. On another farm where an outbreak of leptospirosis was suspected 14 successful isolations of *L. pomona* were made from 16 lambs (13 seropositive and 3 seronegative) sent for slaughter.

The third study followed cohorts of lambs, hoggets, and mixed age ewes by serology and culture on a commercial farm on which a clinical outbreak of leptospirosis had occurred in the previous season. Results indicate that the seroprevalences in lambs up to eight months of age was low, while it was high in hoggets and ewes exposed to the outbreak in the previous year.

The authors conclude that this study indicates *L. pomona* can cause significant economic losses on affected properties and at the same time that lambs affected with this serovar can be clinically normal. The on-farm case study data shows that although the clinical outbreaks were related to *L. pomona*, the prevalence of *L. hardjo* was equally or widely prevalent in both affected and unaffected mobs on the same farm. This is probably because the risk factors for transmission between species, and between sheep, are the same for both serovars. It also indicates that subclinical infection with both of these serovars was very common, again highlighting the higher levels of leptospirosis circulating on these properties.

While the evidence available to date indicates that meat workers have a higher risk of exposure to live leptospire during the processing of sheep carcasses coming from farms where there were recent clinical or unrecognised outbreaks of leptospirosis, the risk of exposure from lamb carcasses appears to be lower than that for older sheep. The authors comment that more work is needed to understand the risk to meat processing workers and other persons working with sheep and that the additional information gained from this further work will be important to contribute to the development of measures to address the risks faced by these workers.

In his paper “Leptospirosis in sheep – a call to action?” Dr Peter Davies (Davies 2003) stresses the necessity to understand which serovars predominate among human cases of leptospirosis that have been attributed to exposure to sheep and more information is required of the prevalence of the relevant serovars in different classes of stock and regionally. The importance of interspecies transmission of leptospirosis to sheep (e.g. from cattle, deer or pigs) requires clarification, as does the ability of sheep to act as maintenance hosts and the dynamics of transmission in flocks.

In the period since the publication of the "Guidelines" there has been discussion on the merits of vaccination of all livestock (dairy, beef, deer, and sheep) destined for slaughter and whether vaccination is a "viable option". Peter Davies makes the point in the paper that this suggestion is premature as clinical leptospirosis has only been sporadically reported and at the time of writing there were no vaccines registered for use with sheep. Even though, since the work reported in the paper, there are now two vaccines registered for use with sheep, little research has been done to establish the effectiveness of them in all age classes of sheep. More research needs to be done on the range of serovars that needs to be covered in any effective vaccination programme, gathering proof of the adequacy of cover (i.e. that the vaccines will reliably prevent urinary shedding), and how vaccination programmes should be designed for commercial flocks.

Dr Cord Heuer in his paper "Human Health and Leptospirosis", presented to Sheep and Beef Cattle Veterinarians (Heuer 2006) made the point that cattle were maintenance hosts for *L. hardjo*, farmed deer for *L. hardjo* and *L. pomona*, and pigs for *L. pomona* and *L. tarassovi*. While sheep could be readily infected with *L. hardjo* and renal infection could persist for at least 13 weeks, shedding by infected cattle could occur intermittently for up to 18 months.

Cattle may remain serologically positive to leptospirosis for up to seven years. Infection with *L. hardjo* usually causes a sudden decrease in milk production and flaccid or atypical mastitis in cows. Where large outbreaks of leptospirosis due to serovar *L. hardjo* occurred, the number of herds becoming infected without clinical signs increased as the outbreak spread.

One longitudinal study of sheep in 2005 suggested that seroconversion occurred throughout the year in ewes, hoggets and lambs and that at slaughter, lambs had a lower seroprevalence than older animals because of their shorter time at risk from birth to slaughter.

Beef Cattle

Some research on leptospirosis in beef cattle was carried out in Hawkes Bay in 1998 in 1999 and reported by Matthews et al in 1999. Titres to *L. hardjo* were detected in all herds and 44% of all the animals tested had titres of 1:384 or greater indicating these animals had recent or current infections (Matthews 1999).

During the next year two herds were examined in more detail with the view to ascertaining at what time of year, and at what age, infection was occurring. The results indicated that infection with *L. hardjo* occurs after the first year of life in both sheep and cattle and that infection is probably present in all stock types.

There was a difference in the time of infection of cattle on the two farms and because young and old stock were not mixed on either farm, the reason could possibly be that one farm has lower rainfall compared with the other farm that was monitored.

The authors concluded that the data in the survey suggests that by vaccinating young stock they would be protected from contracting leptospirosis, the risk of which increases after their first year. This would also allow for the possibility of control, if not eradication, on these farms.

Deer

In 2003-2004 the number of human leptospirosis cases in Southland increased to more than double the previous rates and there were seven cases in deer slaughtermen from venison processing plants, all of whom had no other animal exposure. This indicated that deer are an important vector for the disease (Bell 2005).

Research projects commissioned by industry and conducted by researchers from Massey University and AgResearch Invermay investigated the epidemiology of leptospirosis infections in the deer herds, its national distribution, and the potential for vaccination strategies to reduce the risk to animals and humans and were reported (Wilson 2005), and Ayanegui-Alcerreca 2005). The survey included 113 non-vaccinated farms from both islands with 2,165 animals being sampled. Use was made of a questionnaire where data for a risk factor analysis was requested, such as herd composition, herd size, type of production, demographic data on deer and other species, vaccination practices and previous history of disease on the farm.

It was discovered that:

1. 83% of herds have serological evidence of leptospirosis - serovars *L. hardjo* alone 65%, *L. hardjo* and *L. pomona* combined 14%, and *L. pomona* alone 4%.
2. The prevalence of the infections was similar in all regions of New Zealand.
3. Most disease was caused by serovar *L. pomona* with some been caused by serovar *L. hardjo*.
4. When the infection is endemic in a herd the prevalence is low in deer 3 - 6 months of age and increases during the first year of life, remaining reasonably constant thereafter.
5. With newly introduced infection – transmission may be from deer to deer or cattle to deer, or possibly from sheep to deer. Transmission can also occur from deer to other livestock species.
6. The risk of disease appears to be higher when the serovar is *L. pomona*.
7. Infection with *L. hardjo* tends to persist (with deer acting as the maintenance host) whereas infection with *L. pomona* appears to be less persistent (deer appear to be acting as the accidental host).
8. A significant number of the deer shed leptospires in the urine.
9. Vaccination with "Leptavoid 3" manufactured by Schering-Plough Animal Health Ltd produced a good antibody response, reduced shedding of leptospires in the urine, reduced the prevalence and severity of kidney lesions.

Ayanegui-Alcerreca MA et al 2005 in their paper "Deer leptospirosis vaccination: A preliminary report" report that there was a significant enhanced calf survival to

weaning from 88% to 97% in the vaccinated herds. The conclusions they draw from this preliminary research are that vaccination with this product will provide significant protection for deer, reduce the risk of transmission of leptospirosis from deer to people, and provide a production response in some situations. A 3.7% increase in growth rate of young stock has been recorded in some trials (J. Moffat pers comm.)

The suggestion is made (Wilson et al 2005) that the deer industry must now consider the implications of the new found knowledge and assess its options which include the possibility of a nationally coordinated vaccination strategy similar to those adopted by the dairy cattle and pig industries. The paper proposed the establishment of a working party comprising industry stakeholder representatives to advise industry, and determine strategy is deemed appropriate by the industry.

Brown (2005) comments on the implementation of risk management programs in a number of the deer slaughter premises and the use of in-house risk assessment matrices to assess hazards to employees and quantify the associated risks based on the likelihood, severity, and consequence of harm. When applied to the leptospirosis hazard, in the absence of control measures, the risk score was a high "serious harm". With controls in place including eye, face and wound protection, as well as certain hygiene procedures, the score reduced from 270 to 60 which became a "minor moderate" harm. If known infected stock lines could be identified it would be possible to further reduce the harm levels to workers by employing additional control measures during processing of those stock.

Brown comments that the economic impact of leptospirosis can be significant to both the company and the affected worker. A North Island plant estimated that each case costs the company in excess of \$5,000. the time delay to confirm the diagnosis results in delayed ACC payments to the victim and financial stress in a number of cases. ACC levies to the meat industry have increased by 60% in the past two years. Leptospirosis has no doubt contributed greatly to the escalation of premiums to the industry (Brown 2005).

Meat Industry

In the period since 2001 further the work has been done evaluating different types of Personal Protective Equipment (PPE) and related matters with the view to isolating and minimising risk to employees in the meat industry of contracting leptospirosis. One outcome of the evaluations was the realisation of how advanced the anti-fogging technology had become over the two years since the publication of the Guidelines. Fogging was essentially non-existent in the newest masks and spectacles, leading to the conclusion that this major impediment to their use had been eliminated (Dowd 2003).

Some features were identified for modification such as with the Goggle and Face Shield the bottom of the face shield hit the workers chest when performing some aspects of the gutting task, and the goggles dug uncomfortably into the bridge of the nose when worn for longer than five minutes. Specially designed eye glasses

were rated best for comfort with particular advantages in the ease of head movement, light weight and the degree of facial cooling (Dowd 2003a).

Discussions between representatives of Asure and the Department of Labour in 2005 acknowledged that (Smith 2005):

1. Meat inspectors were at risk of contracting leptospirosis through the hands and therefore Asure's hazard management policy would include the use of protective gloves in high risk areas.
2. The exposure of meat inspectors, relative to other workers on the processing chain (due to meat inspectors' location on the chain and the nature of the work), meant that the risk of infection from splashing and aerosol factors was probably lower and therefore this supported Asure's proposal to reduce nose and mouth protection, but retain eye protection.
3. It was incumbent on Asure as the employer to upgrade protection levels as new information and/or technology became available (i.e. take all practicable steps).

Additionally it was agreed that a number of observational exercises would be undertaken to gather data on how often meat inspectors touched their face, nose and mouth areas while carrying out inspections – to provide information on the potential for hand to mouth and nose transmission. Another exercise would record the frequency of face splashes and the number of times protective glasses and exposed faces were splashed.

A draft document on leptospirosis and PPE, providing a rationale for proposed changes to staff, would be prepared and circulated with the request for feedback and discussion on the proposed changes.

Separate initiatives would be the provision of information to GPs with the view to fast tracking the diagnosis and treatment of suspected leptospirosis and the investigation of blood testing facilities with the view to accessing quick diagnostic tests.

Finally a comprehensive employee education program would be developed covering all aspects of leptospirosis, the personal hygiene practices, and protective measures and this would be included in the induction program for new staff and the annual refresher training.

Meat companies have placed particular emphasis on the use of gloves, both Kevlar to protect against cuts, and disposable waterproof gloves, to protect against contact with contaminated urine. Initiatives taken by one company include:

- Information on leptospirosis being given to all employees including a fact sheet as a hand out;
- PPE being identified for each of the various tasks. Job descriptions and task instructions being modified to include what PPE must be worn at that workstation;
- Appropriate signage being placed in the various parts of the plant;
- Policy on PPE to be distributed to all employees to ensure awareness;

- Random audits by team leaders, production manager and technical team to be completed to ensure that PPE is being worn;
- Disciplinary actions to be undertaken to ensure employees understand the consequence of non-compliance.

During induction training staff are given a wallet card to indicate to the doctor they work in the meat processing industry. Emphasis is placed on the requirement for washing after any urine contact and the reporting of any splashes.

INITIATIVES TAKEN SINCE THE PUBLICATION OF THE GUIDELINES

In the period since the publication of the Guidelines there have been at least 10 meetings of industry groups and stakeholders additional to the regular (4 monthly) meetings of the Meat Industry Association's Health & Safety Forum.

Department of Labour Paper: Towards a National Strategy of the Control of Leptospirosis

In October 2002 Frank Darby circulated this paper to a wide group of stakeholders requesting comment and feedback on a range of issues. Some significant points from that paper were that people who had contracted the disease, who had been surveyed, painted a picture of confusion and ignorance over recognition of leptospirosis, its suitable treatment, ACC entitlements, and the social acceptance of the disease (Aftermath 2002).

Having presented a number of datasets the conclusion is drawn that taken overall the data suggests that leptospirosis is an important occupational health problem and that efforts to prevent it, to address the early identification of the disease, and to advise GPs of its preferred manner of treatment - need to be ongoing.

This is supported by Baker, writing in "Family Practice News (Baker 1999) who claimed that leptospirosis was very common but often misdiagnosed and because the prevalence of it is under appreciated by GPs, probably 60% to 70% of patients with leptospirosis are initially misdiagnosed.

In the "National Strategy" paper vaccination is suggested as a viable option for all stock – dairy herds, beef herds, deer, and sheep and the costs of vaccination programmes for the different species are presented. However it is noted that more information is required on the source of the disease in humans and while vaccination of dairy herds is regarded as a "practicable step", and it would appear to be transferable to beef cattle and deer, questions remain as to whether vaccination for sheep is effective and a practical step.

A total of 13 possible steps for the control of leptospirosis were presented for comment:

1. The vaccination of all stock (or certain types of stock) passing into meat processing plants.
2. Meat processing plants refuse to accept non-vaccinated stock (or certain types of stock).
3. The refusal by herd testers and other non-farm employees to work with unvaccinated stock.
4. Dairy companies accept milk from vaccinated herds only.
5. Improved work practices - on farms and in meat processing plants including the use of splash containment devices and appropriate face protection - (See DOL Guideline)

6. The continued use and monitoring of the effectiveness of appropriate personal protective equipment (PPE) - on farms and in meat processing plants.
7. The initiation and/or maintenance of the practice of giving information to employees about leptospirosis during induction training and at regular intervals.
8. The maintenance of training given to employees about preventing leptospirosis (i.e. the safe work methods required to prevent infection).
9. A unified approach to the diagnosis and treatment of leptospirosis is adopted by doctors, government agencies (DOL, MoH, MAF, and ACC), employers, and employees.
10. The development of advice about the medical treatment of leptospirosis, its relation to ACC criteria and its communication to GPs.
11. Employees continuing to have available a card to take to a GP consultation for flu like symptoms - saying "I am at risk from leptospirosis".
12. Improve notification to the DOL NODS system.
13. Clarification of the ACC claims acceptance criteria and procedures.

Some of the challenges with respect to completeness of data sets are highlighted by the comments from ESR when it is stated:

"A total of 105 cases of leptospirosis were notified in 2001. Of these, 76 were recorded on EpiSurv as being confirmed cases. In comparison, 113 cases were laboratory-reported in 2001. Matching of laboratory-reported and notified cases indicated that 82 cases were both notified and laboratory-reported during 2001; suggesting that 23 cases were notified but not laboratory-reported, and controversially, 31 cases were laboratory reported but not notified."

Information on prosecutions involving leptospirosis is presented with one conviction being obtained in June 1995 with the farmer being fined \$15,000 and a second conviction, obtained in November 1999 resulting in a meat processing plant being fined \$3000.

Summary of responses to "National Strategy" paper

A summary of responses to the points made in that paper is contained in a memorandum by Dougall McNeill dated 28 January 2003.

The central focus of comments received was the option of vaccinating all stock, or certain types of stock prior to their entry to meat processing plants, and meat processing plant refusing to accept non-vaccinated stock. Two thirds of the submissions opposed the proposal because either it could not be considered a practicable step, or there was insufficient research which demonstrated its efficacy.

Rather than proposing a very costly (\$6m p.a. for beef cattle, and \$9m p.a. for sheep) national program for a regional disease it was considered that more attention should be focused on work practices, personal protective equipment, and training. The Department of Labour's current position on vaccination of different species is as follows:

Dairy cattle:	Vaccination is definitely a practicable step for all Dairy Herds. This is supported by Court decisions, the extent of contact of dairy farmers and their employees with urine and the efficacy of the vaccine
Beef cattle:	Vaccination would be effective – but exposure of farmers to urine is much less than for dairy farmers and the cost effectiveness would therefore be less owing to an increased requirement for stock movements
Deer:	Recent work suggests that vaccination may be a practicable step, may afford production benefits (increased fawning rate and growth rate). This question needs careful assessment by an Industry group.
Sheep:	Definitely not viable at present for reasons of cost and efficacy.
Pigs:	The Industry requires vaccination for leptospirosis before pigs will be accepted for slaughter

While most respondents support a greater unity of approach to the diagnosis and treatment by doctors it is interesting to note that ACC considered the option of a unified approach confused. It argued that the issue of medical treatment of leptospirosis has no relationship to the question of cover criteria and that its acceptance of cover did not need any clarification as there was no difficulty if diagnosis had been made and it was clear that the infection was occupationally acquired.

There was significant difference of view on this point between the Alliance Group which agreed with ACC and the Meat Workers Union which argued there were "huge problems in this area and that the problems were worse with employers who were part of the ACC partnership programme". The writer notes that given the figures set out in Table 4 it would appear that there is still difference of view on this issue.

It was suggested that because of the interest and disagreement between the parties consulted on the topic of vaccination, that the issues of testing, practicable steps, and effective prevention of leptospirosis require careful study if agreement is to be reached and progress made.

Meeting of stakeholder Discussion Group on "Leptospirosis in Sheep" at Massey University 1 April 2003

This meeting was attended by representatives from Massey University, the Meat Workers Unions, DOL, ESR, and animal vaccine manufacturers. The purpose was to exchange information about leptospirosis occurring in meat workers exposed to sheep (and other species) and of current knowledge of the epidemiology of leptospirosis in sheep. A major focus was the proposal by DOL that vaccination of animals going to slaughter was a practical option for preventing disease in the workers. The key objective was to identify gaps in knowledge about leptospirosis in both the human and animal arenas and determine priority areas for research.

It was acknowledged that information on the incidence of leptospirosis in "sheep only" meat works, and the serovars involved, was very limited. Obtaining good systematic data from human cases was essential.

Current measures to prevent infection in meat works were only partially effective and cases have occurred in people working in areas of the works that would have been considered low risk. Exposure to leptospirosis, in most cases, will not lead to recognised disease incidence. Specific objectives could include a cross-sectional study of blood samples from meat workers to determine seroprevalence for all six serovars endemic in New Zealand, a longitudinal study of seronegative workers to determine incidence of seroconversion (and disease) by serovar and work location, and an estimate of the cost of the disease to the industry based on lost work days.

It was noted that the available information on leptospiral infection of sheep was both sparse and dated. Specific objectives for study would include:

1. A national seroprevalence study of slaughtered sheep to determine seroprevalence by serovar, region, and class of stock (lambs, hoggets, and mature stock).
2. Epidemiology of leptospirosis on farms, including age of infection, enterprise types, and interspecies transmission.
3. Risk and duration of shedding by infected sheep and their role as potential maintenance hosts.
4. Vaccine efficacy related to reduction of renal infection and urinary shedding for relevant serovars.
5. Studies addressing the design of appropriate vaccination strategies and other interventions.

It was noted that it would be necessary to identify researchers to pursue these studies in the human and animal arenas. Massey University had appropriate facilities and expertise to undertake the work on animals. Efforts would need to be taken to pursue potential collaborators in the human work. No specific follow-up steps or actions appear to have been determined.

Mel Tyson's paper "Where are the Opportunities for DOL with Leptospirosis Prevention?"

This paper, dated 5 May 2003 which was presented to the Agricultural Industry Focus Group explored, among other strategies, the opinion that vaccination of affected species (beyond the dairy herd) maybe a new "practicable step" for sheep, cattle, deer and goats. But it was suggested that before this could be done convincing answers needed to be found to all of the following:

- What are the demographics for human cases?
- What was the likely host animal for each case and is there information on demographics (and degrees of infection and serovars) in these species?
- What are the demographics of vaccinated domestic species and what are the serovars in humans in these areas?
- Would the definition of "practicable" differ from one region to the next depending on the above?
- What are the serovars in each of the notified cases?
- What is the likely role of rodents and feral species and is there any data on rodent control?
- What the advances in testing livestock and other means of targeted information of infected/carrier animals?

- Could the imminent new system of animal identification ear tags identify risks for meat workers?
- Information about economic and social impact of infection.
- Information about time taken to reach diagnosis and treatment for sufferers.
- Is there data on the effectiveness of vaccines in all farmed species?
- Have there been field trials of vaccines by universities or animal remedies suppliers?

It is acknowledged that while there are numerous sources for these items of information they are both variable and in many different formats. It is a considerable exercise for a coordinator, with knowledge of the sources, to draw together compatible data for each case notified.

A central coordinator, preferably someone who is independent of the stakeholders should be found as this concept of independence was very important for the development of the Guidelines. Understandably there will be the requirement to find a source of funding for such a project and the paper suggests that it is an ideal time for DOL to re-gather momentum and a profile for leptospirosis in the industries. An eight step project plan is proposed.

Leptospirosis Update for Agricultural Workshop (dated 8 August 2003) and Leptospirosis Update (dated 1 September 2003)

This paper highlights a number of current issues and suggests a way forward because funds are not available to engage a sufficiently respected and knowledgeable contractor as recommended in the Mel Tyson paper (Tyson 2003) reported above.

Consequently it was proposed that DOL would engage the lead Government Agencies, specifically the Ministry of Health and ACC, to develop a better understanding of leptospirosis. It was noted that a project was a possibility but that preparatory work would need to be done prior to any meetings to address:

- Shared understanding and agreement about the leptospirosis procedures
- Opportunities for commonality in investigation procedures
- Identifying and removing barriers to more complete reporting
- Appropriate roles for DOL and PHU staff
- Resolution of privacy issues

Information is presented on what might be the impact of vaccination of sheep on meat workers and it is noted that research is needed to assess the efficacy of the vaccination of sheep as a practical step for preventing leptospirosis.

Leptospirosis Meeting - held on October 2003

The three purposes of the meeting were:

1. To discuss a draft DOL audit sheet about the practicable steps for preventing leptospirosis in the meat processing plants.

2. To discuss the worthwhileness of conducting the research necessary to establish the efficacy of vaccination against leptospirosis in sheep and in other animals.
3. To prepare for an industry gathering (e.g. a workshop or a conference) with the affected stakeholders that will provide a forum to share experiences about the prevention of leptospirosis and review general issues.

One proposed agenda item was to discuss the information needed to progress 4 current issues:

1. Any existing cost-benefit information on the vaccination of sheep and other farm animals.
2. Policies on glove use.
3. Evidence on the effectiveness of personal protective equipment.
4. Other current research.

However these questions were not addressed. It was resolved that:

1. Participants would comment on the draft Audit for Meat Processing Plants and a second draft would then be circulated for final comment before being made available for use by meat processing companies.
2. The MIA Health and Safety Forum would call a meeting of a subcommittee, with co-opted representatives of organisations not represented on the Forum, to develop an Action Plan for leptospirosis.

Key points seen for an Action Plan, as a result of the meeting on 21 October and subsequently, were:

1. A "whole of industry" approach is advocated.
2. There is strong anecdotal evidence that infection in sheep is increasing.
3. The action plan should cover the role of the GP and medical laboratories.
4. Could meat processing plants become more familiar with the expectations about prompt GP consultations, biological monitoring, and treatment?
5. The reporting of leptospirosis to ESR and DOL needs to be improved.
6. Look at recent improvements in the design of PPE.
7. Practicable steps are not static – experience in one plant informs what may be reasonably practicable nationally.
8. What is a practicable step in one plant may not be in another – but plants must make a fair trial of the step – and provide good evidence of why it has not been adopted.
9. Accredited employers may not appreciate issues of cover for leptospirosis.
10. The Leptosure programme exists and takes the comprehensive risk assessment approach.
11. A pilot programme to extend Leptosure to beef cattle is underway in the Taupo area.
12. Skin integrity is an important issue.
13. There may be methods to assess the risk posed by stock that arrive at a meat processing plant – perhaps by use of the animal health declaration form.
14. Meat processing plants are not dissimilar to operating theatres. An appreciation of hygiene practices (hand washing) similar to that of health

care personnel does not exist in the industry. Such an appreciation plus equivalent practices is advised.

Some additional points discovered after the meeting:

1. Industry wide communication of leptospirosis strategies, issues, results, and research should occur – the infrastructure to do this exists now.
2. More information could be written on the card taken to GPs – and reference could be made to a web site.
3. Trial of prophylactic doxycycline.
4. Meat works liaison with GPs.
5. Animal status declaration.
6. Leptospirosis DNA analysis by Canterbury laboratories – prompt turnaround time.
7. Involve families of affected persons.

Leptospirosis Meeting – held on 11 February 2004

The Meat Industry Association representative stated that the Association's preference was that attention be given to musculo-skeletal injury and that there was not enough funding to support further work on leptospirosis.

Comments were made on the draft Audit of Plant Procedures and with respect to research issues there was a need, on the one hand to focus on protection against possible exposure, and on the other hand, the efficacy of vaccination of the animal. This necessitates knowing where the animal's exposure comes from. Once the quantity of exposure and the source of exposure had been established it would be easy to come up with a preventative focus. Consideration was given to developing a plan for the research, possible sources of funding, the needs for government agencies to retain control, and the desire to maintain momentum.

Meeting of Stakeholders at the Wellington School of Medicine

The aim of this meeting on 4 August 2004 was to identify high priority research questions relating to the epidemiology, prevention and control of leptospirosis in New Zealand, and those which have a reasonable chance of proceeding in the medium-term (based on practicality, funding, motivated end users, and interested researchers).

It was noted that there are currently up to five streams of incidence reporting of the infection (i.e. notifications, laboratory data, NODS, ACC, and Meat Industry databases) which are not fully integrated. The comment was made that this data was "opportunistic information" rather than "organised surveillance".

The group identified and prioritised important research questions:

1. What is the incidence and distribution of human leptospirosis in New Zealand?
2. What are the sources of human infection, notably the risk from sheep?
3. What are the pathways to exposure?
4. What control measures are effective?
5. What is the impact of leptospirosis on production and economics?
6. What is the optimal treatment for leptospirosis?

Possible funding sources were discussed briefly.

1. The Health Research Council had just advertised a DOL joint research partnership with the Department of Labour and ACC.
2. The possibility of potential funding from the Zoonosis Steering Committee convened by the Interagency Zoonotic Disease Research Coordination Programme; and
3. Various parties in the meat industry.

A national industry workshop was proposed for the wider sharing of information and this idea was well-received.

In the afternoon a meeting of researchers developed the ideas presented in the morning with the view to identifying research projects that justified further development, and mapping out a plan for proceeding with them. Important short-term research priorities identified were:

1. What is the "true" incidence of the infection, based on the linking of data from multiple sources?
2. What are the sources of human infection? What proportion of human leptospirosis is due to sheep and other livestock? Who is exposed? Which meat handling practices contribute?
3. What is the impact of leptospirosis on individuals and society? Can this be partly ameliorated by improved recognition and early treatment of cases?

The suggested title for a research project was

"Identifying the sources and reducing the impact of human leptospirosis in New Zealand"

and the aims would be:

1. To identify the sources of human leptospirosis in New Zealand and assess their relative importance notably
 - a. Animal contact in the workplace, including the types of animals (in particularly sheep), precise forms of contact, and impact of PPE and behaviours.
 - b. Environmental sources, including occupational and recreational
2. To assess the impact of leptospirosis on those infected, notably the severity and duration of illness, and the timing and extent of antibiotic treatment.

Meeting of health and animal researchers

This meeting was held on the afternoon of 4 August 2004 to refine the aims of this study which are listed as:

1. To evaluate risk factors for seroconversion of *L. hardjo* or *L. pomona* in abattoir workers.
2. To investigate the severity of leptospirosis and occupational and life style risk factors among patients.
3. To study the distribution of available denominator information among leptospirosis patients and non-patients among abattoir workers.

4. To compare genotypes of *L. hardjo* and *L. pomona* from sheep at slaughter with genotypes from human leptospirosis patients.

The particular focus is the investigation of humans suffering leptospirosis and comparison with comparable persons who are free from the disease (but may be seropositive). The study will compare the two groups with regard to previous exposure patterns related to lifestyle and occupation. Any isolates of leptospira obtained from patients will be compared with sheep isolates to determine the degree of genetic homology between the strains. The purpose is to demonstrate evidence of the transmission of leptospira from sheep to humans.

In the seroconversion study approximately 160 available sera from healthy abattoir workers will be tested and related to age, place, and position on the carcass processing line. This will provide a basis for further sampling. A cohort of 400 high risk abattoir workers will be identified and followed up at quarterly intervals for two years. Blood samples from each worker will be tested for *L. hardjo* and *L. pomona* every three months. The risk factors and exposure histories of each worker will be updated by questionnaire at the time of sampling.

It is hoped also to undertake a descriptor study in which cases of leptospirosis will be investigated in detail using a standard questionnaire covering exposures during the incubation period and the duration and severity of the symptoms. It is proposed that the study will investigate all cases occurring in New Zealand over a two-year period.

It is also hoped to undertake an abattoir survey in which cases of leptospirosis among abattoir workers will be compared to non-cases with respect to available denominator information. This process will include a detailed survey of all abattoirs in New Zealand to establish the size of the workforce and the numbers working in each distinct exposure category.

A feature of these studies will be that the leptospira strains collected from cases will be genotyped by pulsed field gel electrophoresis (PFGE). This process will include an education programme aimed at abattoir health care services encouraging them to forward suitable specimens for culture. These strains will be compared to strains obtained from sheep in the other components of this project, and strains collected opportunistically from other animals.

Meeting of stakeholders on 17 August 2005

The meeting was attended by representatives of the meat industry, the Meat Workers Union, Massey University, the Wellington School of Medicine and the Department of Labour.

The agenda was to receive a briefing on results of the Massey University abattoir study, comment on the plan of action, and on the possibility of a national workshop on leptospirosis.

Massey University had obtained limited funding from a variety of sources which was enabling an abattoir study of sheep and deer to be conducted. Initial results

to date showed that each worker (including meat inspectors) on a sheep/deer line was exposed to an average of 19/239 shedding carcasses each day respectively. Unfortunately the funding was insufficient to provide sufficient samples to allow comprehensive statistical analysis.

While there is awareness of the issue in the meat industry and animal vaccine marketers, which is acknowledged by the Agricultural Health and Safety Council, the view was expressed that the farming community does not believe there is a significant problem.

Reference was made to the "Plan of Action" developed by Frank Darby in November 2003. Some 50% of the 104 cases notified to medical officers of health the previous year, and of the 113 laboratory confirmed cases, had come from persons working on the meat industry.

Mention was made of a proposed study to take blood samples from 400 volunteers in abattoirs (including those working in different parts of the plant e.g. the slaughter floor, in yards and in small goods department) at quarterly intervals over a two-year period to follow the rate of seroconversion. A key feature of the study would be that it will report leptospirosis on the basis of antibodies in the blood rather than people being diagnosed as being "sick".

Key questions being addressed include:

1. What is the total leptospirosis infection in humans – both incidence and distribution?
2. What are the modes of transmission, and hence the best methods for their control?
3. What are the roots of transmission from sheep and deer to meat workers?
4. What practicable steps should the industry be taking?
5. Is the Department of Labour's treatment advice up-to-date?

It was suggested that a one-day workshop for the meat industry would be beneficial so that attendees from all levels in the industry could see:

1. The situation other parties are in.
2. What other parties are doing in the face of a difficult problem.
3. The need to take the reasonably practicable steps open to employers in relation to known and foreseeable risks
4. Where the balance lies of employers' and employees' responsibilities

Meeting of Stakeholders at Massey University on 14 June 2006

Participants discussed work recently completed, currently under way, and topics that needed to be researched in order to elucidate key questions. Conclusions reached were:

1. It is currently neither reasonable nor feasible to establish the distribution of leptospirosis-infected herds and flocks in the entire country.
2. Objective 1 (national survey) should therefore be limited to sheep and to 2-3 regions with contrasting climate/ecology, probably representing

extremes for New Zealand. Such a reduced approach would save substantial funds.

3. Objective 2 (inter-species transmission) may be investigated experimentally by exposure of a sample of sero-negative animals (e.g. sheep) to an infected mob of another species (e.g. deer) on the same farm, and comparing sero-conversion of exposed with non-exposed animals (sheep).
4. Objective 3 (production response) will be included in vaccine efficacy studies at the animal level on non-vaccinated farms (Objective 4).
5. Objective 4 (vaccine efficacy) shall be limited to the comparison of vaccinated farms (all species) with non-vaccinated farms. It is understood that this approach requires a large number of farms, but that only a small number of animals will be followed on each farm. Thus a large portion of funding will be consumed by the cost of vaccine. To evaluate efficacy by the rate of shedding, the required sample will not be large given that initially non-infected animals are enrolled (because this would provide a high expected efficacy, thus a low sample size). Whether culture of kidneys at slaughter or dark-field microscopy combined with culture of urine is required probably depends on the species (renal culture for sheep and beef, urine samples from live animals for deer). Moreover, cultures need to be typed as efficacy should be evaluated for both serovars, provided dual infected farms will be available.
6. Objective 5 (wildlife) may be explored in a case-control approach, i.e. trapping and testing various wildlife species around infected and non-infected farms. A concurrently planned study on the distribution of Johne's disease in domestic species and wildlife could be exploited by testing wildlife for leptospirosis cultures and serovars. Thus funding would only have to cover extra testing.
7. Objective 6 (genotyping) will not be used for large field studies at this stage because of uncertainties about practical methods of sampling for cultures during a survey of live animals. Genotyping will initially be addressed by developing techniques at Massey University (Hopkirk Institute) using available isolates from sheep and deer. These isolates originate from slaughter stock and allow an analysis of within and between line distributions.

Comments have been requested from the attendees on these proposals by mid August 2006 with the view to drafting details (e.g. methods, sample sizes, budgets), obtaining confirmation by the end of September, and then seeking funding.

WHAT IS THE EXTENT OF, AND EXPOSURE TO, THE HAZARD?

What leadership is being shown by the Department?

It has to be acknowledged that leptospirosis is endemic in the New Zealand environment and that it is unrealistic to expect the existence of the organism in farm and feral animals, in waterways that are used for recreational purposes and during other casual exposures to be eliminated in the foreseeable future.

Leptospirosis is a serious illness in humans. It is preventable to an extent only, and therefore the emphasis must be on prompt effective treatment as well as prevention. The most important aspect is the necessity to establish an ongoing and worthwhile partnership between occupational health, human health, veterinary science, and the industry stakeholders.

The usual approach would be:

- The development of an overall strategy and operational components/projects in consultation with stakeholders;
- Making decisions on components/projects on the basis of good data and evidenced based solutions;
- Resourcing the projects with appropriate personnel, equipment and funds;
- Implementing the projects within the proposed timescales; and
- Auditing and monitoring progress with modification of subsequent stages if shown to be necessary or appropriate.

Most individuals and organisations consulted in the course of this project reported that the "Guidelines" had been reasonably well received and provided a good basis for a range of appropriate initiatives by employers and employees. However they need to be linked to actual reality in the field. The gap between what it is thought people should do, and what they do, is often vast.

The Department of Labour has actively initiated, facilitated and participated in meetings identifying research priorities. The Department is unable to contribute to the funding of research.

Since the publication of the "Guidelines" the Department of Labour has demonstrated a commitment to proactive intervention at a level commensurate with its ability to contribute.

A total of 210 Notices of Improvement (Formal and Advisory Notices) were issued between the beginning of 2000 and September 2005 relating to employees contracting leptospirosis. Before that date the Department was successful in taking two prosecutions and one is currently pending.

Research is needed to determine the full extent of the hazard. There are a number of questions which must be answered before the appropriate interventions can be focused.

The opportunity to obtain one complete and comprehensive dataset.

As noted elsewhere in the Report there are currently up to five streams of incidence reporting of the infection (i.e. notifications by GPs, laboratory data, entries lodged by various parties in the Notifiable Occupational Disease System (NODS), ACC, and Meat Industry databases) which are not fully integrated.

Many people who have had close associations with the disease are convinced that there is considerable under reporting – anywhere between two and ten-fold. Hawaiian data cited showed that when comprehensive testing was done in that survey the actual level of incidence was some 600% greater than expected, or reported. The absence of comprehensive and accurate data significantly inhibits the calculation of the total costs of leptospirosis and the hence the benefits and return on various preventive strategies.

The proposed Public Health Bill, scheduled for consideration at the Select Committee stages later this year, is intended to provide a frame work for managing public health risks that, in some circumstances, are unpredictable.

"The new legislative framework will cover the identification, assessment, and management of risks to public health. The Bill will focus on communicable disease and environmental health, and also provide a framework for dealing with current and future risks to public health not managed adequately under other legislation." (Proposed Public Health Bill – Background on www.moh.govt.nz).

While leptospirosis is not a communicable disease in the normal human to human situation, it will be important for the Department of Labour and ACC to liaise with the Ministry of Health and other relevant agencies to see if the new legislation will provide the opportunity for the comprehensive collection and reporting of leptospirosis data and how this can be achieved in an accurate, complete, and timely manner.

The opportunity to obtain comprehensive regional data

The proposals for the monitoring of bloods of workers in meat plants (hopefully to be commenced within the next 3 months) will provide useful data on the extent of seroconversion in those individuals over time and enable the reporting of leptospirosis on the basis of antibodies in the blood rather than people who are diagnosed as being "sick". An important aspect from the results will be information on the seasonality of occurrence.

Additionally the three important short-term research priorities identified by the group in August 2004 are particularly relevant:

1. What is the "true" incidence of the infection, based on the linking of data from multiple sources?
2. What are the sources of human infection? What proportion of human leptospirosis is due to sheep and other livestock? Who is exposed? Which meat handling practices contribute?
3. What is the impact of leptospirosis on individuals and society? Can this be partly ameliorated by improved recognition and early treatment of cases?

Research carried out and reported since the publication of the Guidelines has confirmed the widespread incidence of leptospirosis in deer (83% of herds) and that there are levels of infection in sheep, especially in hoggets and mature ewes such that workers in sheep only plants are exposed to the risk when processing these animals.

However more research is needed to quantify the extent of infection in sheep flocks, and to obtain more data on the efficacy, and production benefits, of vaccination programmes in beef cattle and deer and the impact of those programmes on levels of infection in sheep on the same farms.

This information is required to persuade and convince beef, sheep, and deer farmers of the need for, efficacy, and benefit of, these programmes - with respect to both the cost and labour requirements, for undertaking such a vaccination programme.

Useful proposals are being worked on by researchers at Massey University Institute of Veterinary, Animal and Biomedical Sciences and the Department of Public Health, Wellington School of Medicine and Health Sciences in consultation with key stakeholders. In the period since the publication of the Guidelines difficulties have been experienced in obtaining funding for research proposals which have been formulated.

A Pilot Project in Hawkes Bay

The Hawkes Bay and Tairāwhiti District Health Boards have consistently high rates (11.6 and 14.4/100,000 respectively) of incidence of leptospirosis (Baker 2004).

Hawkes Bay regional staff of the Department of Labour, the Medical Officer of Health, specialist occupational medicine physicians, organisers of the New Zealand Meat Workers Union, managers of meat processing plants, veterinarians and members of Federated Farmers and Rural Women have expressed strong interest in participating in a research project centred on that region.

The project would gather information on the incidence of leptospirosis in members of the farming community as well as the urban communities, explore links between the degree of infection in the various animal species (and by what serovars), with the exposure and incidence in humans. It would explore options of how knowledge of the disease status of animals could affect processes at the meat processing works. The efficacy and economics of the selected vaccination of different animal species could be researched, in combination with proposals being developed by Massey University.

Information gained on how members of the farming community view the disease and their reaction to possible measures to reduce its incidence could be very useful for the development of future strategies. The experiences of and attitudes to leptospirosis by members of the community could be ascertained in

combination with proposals from the researchers at the Wellington Medical School.

WHAT IS THE EXTENT OF HARM?

Accurate assessment of the extent of harm is particularly difficult based on the records available and because of the potential degree of under reporting, the inherent variability of symptoms, and variability also in the severity of the condition. Reports contained in case studies and included in publications such as "Aftermath" make sobering reading. Workers in the field report that in many cases the effects of leptospirosis can persist for periods well beyond the initial "recovery phase" of 3 – 6 months.

The differences of views between, on the one hand ACC, and on the other hand those who are affected by the condition need to be explored and resolved. ACC maintains that, especially since 1998 when leptospirosis was added to the Corporation's Schedule 2 that the acceptance and coverage of claims is much more straightforward. The ACC statistics show that covered claims, expressed as a percentage of lodged claims, is lower in the period since 2000-2001 than it was in the period 1991-1992 through 1999 – 2000. (See The Report's Table 3)

Other important factors in assessing the extent of the hazard are the challenges in testing for leptospirosis. One testing regime is that a specimen is referred for serological testing using the microscopic agglutination test (MAT) and that a second test is undertaken some 4 – 6 weeks later. A 4 fold increase in titre is required to provide confirmation of a positive diagnosis. The increase does not always happen within this time period but may take place several months later. Many patients, for a variety of reasons, do not return for the "convalescence" (i.e. second) test and therefore are not considered for being confirmed as having the condition.

Alternatively the individual's sample can be analysed using the polymerase chain reaction test offered by Canterbury Health Laboratories. The analysis of one sample provides a definitive diagnosis of the presence, or absence, of leptospirosis, however it is not able to provide information on the serovar causing the infection.

There are numerous accounts of delays by both GPs and hospital clinicians in ordering tests, and also in employers being reluctant to meet the cost of either the MAT or the PCR tests.

A significantly better estimate could be made of the extent of harm if there was good data on the number of people affected by leptospirosis and comprehensive details collected from all the 200 or so who are affected over a 2 year period. It has been suggested that maybe there are only 1000 workers in New Zealand that are really exposed and that it would be better to work extensively with these people.

It would be useful to know "how large is the number of workers in these groups?" and "are workers rotating around various tasks or are they staying in the same (high risk) job?"

Updating of the “Guidelines”

It is acknowledged that the “Guidelines” are readable and very good from a scientific point of view – but do people carry out what is recommended? It would be better to go for a limited number of things and get more people to do them well – especially those who are in the “really exposed” category. There is a need to find what workers think; what the key issues are, and what happens to people in the situations in which they are particularly at risk.

What is the cost of the harm?

At this stage some reasonable estimates can be made of the cost of the 42% of those contracting leptospirosis who are employees in the meat industry.

Reasonable data is available for their time off work, the medical and hospital costs incurred, and the need to employ additional staff to provide cover while affected employees are recovering. That would appear to be some \$405,000 per annum for employees in the meat industry.

However virtually no comparable details are currently available for the other 37% engaged in various kinds of “farming” and certainly not for the remainder in the “other” and “unknown” occupational groupings.

How can the risk be minimised?

For the meat industry one case of leptospirosis occurs for every 4 million carcasses processed hence there would be real advantages if there were tests developed to indicate when lines of stock that were actively shedding leptospires were being presented for slaughter. Lines so identified could be put through at the end of a shift and staff on the chain encouraged to take particular care and ensure that the maximum PPE was worn. In the meantime, for their own protection, workers must treat all stock as infected unless it is known otherwise.

Researchers at Massey University have liaised with workers in Thailand who reported that they had an antigen-detecting dipstick which can be used to detect leptospira in the urine of cattle. The test is not instantaneous, taking some 3 hours to give a result and does require the use of a centrifuge and other laboratory equipment. (A. Midwinter and J Collins-Emerson pers. comm.)

Workers associated with the International Leptospirosis Society indicate that they use a dipstick test as a screening tool for human serum and therefore the possibility of having an animal IgM dipstick made with species specific conjugate could be explored. A contact would be Rudy Hartskeeri contactable through the International Leptospirosis Society webpage. Issues relating to the dilution factor with composite samples and the possibility of cross contamination will need to be addressed and overcome.

WHAT IS THE EFFECTIVENESS OF VACCINATION AND OTHER SOLUTIONS

All animals are seronegative at birth and for dairy and beef cattle, deer, pigs and goats vaccination before the animal picks up any infection, will provide immunity in most cases. Once an animal is infected vaccination will not arrest the shedding of leptospire - the administration of antibiotics is required to achieve this. The efficacy of vaccination can be as low as 70% therefore vaccination of itself does not give operators 100% confidence of full protection.

Further work is required to obtain good data on the efficacy of vaccination with sheep, and also with other species, in the whole range of New Zealand pastoral farming situations.

Most vaccination programmes specify one shot within 6 – 8 weeks of birth and a second shot within 2 – 4 months and thereafter an annual booster. Cows and hinds can receive their annual booster during pregnancy (dairy cows often when they are dry) and the new born calves and fawns are afforded some protection through the colostrum in the mother's milk.

There is no vaccine available for humans in New Zealand.

Effective solutions therefore require humans to avoid exposure, either directly or indirectly, to the urine of infected animals, or through handling the reproductive tissues of infected animals, or substances or products contaminated by the urine from infected animals.

Consideration must be given to an overall risk assessment and management procedure and the effective communication of that to all employers, employees and to their visitors. The wearing and use of appropriate personal protective equipment is an important component of most effective solutions, combined with a high degree of personal hygiene. It is essential to ensure that all cuts or broken skin are adequately covered with water resistant protective dressings.

Significant awareness programmes for staff in various meat processing plants have been effective. Information sheets have been provided for employees and their families, information given to the medical providers, cards for staff to show to their doctor and the doctor being asked to provide antibiotics as soon as there is an indication of leptospirosis infection. These information programmes have been generally well received and have received good feedback – especially from staff who have had leptospirosis themselves.

WHY DO CERTAIN ATTITUDES EXIST?

Even though people may be well aware of leptospirosis and the human cost of having it – particularly as it lasts for 6 – 12 months, there are still difficulties in convincing people to take all the safety precautions. It was stated “Some see it as similar to smoking – people are aware of the possible consequences but still choose to smoke”.

There is a need for good education programmes which needs to be realistic, related to the pressure of work and throughput, and the limitation of resources, which in many situation means that shortcuts have to be taken. With only the occasional occurrence of leptospirosis (maybe one case every 3 or 4 years) in a meat processing plant, it is understandable that attention can sometimes be given to other more immediate matters.

Good data from the seroconversion study of meat processing workers will help to show how big the problem is and thus how serious it is. Unions need to work in partnership with management and come up with ideas for control, taking seriously the need to comply with agreed policies, and encouraging employees of the necessity to take care (as required by S 19 of the Act).

There are a number of information gaps in the meat works situation:

- There are questions about the necessary knowledge as to how to tackle the problem;
- What are the health and safety requirements?
- What are the employment matters?

The recommended action is to identify sections of the Guidelines which need amendment and generate an updated version will address these issues.

WHAT BEARING DO DESIGN ISSUES HAVE ON PROTECTION?

Meat inspectors are working in a high humidity environment. A key complaint is the need to wear the protective equipment that does not appear to have been designed specifically for the purpose of meat inspectors or the meat industry. Staff do not like the PPE as they are considered to impede vision and movement.

- with face shields there are difficulties wiping away a squirt of blood, claims of restricted peripheral vision, an increase of temperature around the face and head, and the weight of the device.

Trials were carried out with the air-feed mask but these were cumbersome, uncomfortable, and hot. New gear has been looked at and evaluated on the criteria of efficiency, efficacy and (lack of) distortion of vision.

It is reported that procedures in some works are really good – staff are strongly encouraging others to wear all relevant protective equipment. Adaptation of PPE to the particular circumstances of the various workstations within the various meat plants is ongoing. Automation of the most “at risk” processes is highly unlikely.

Good results have been obtained by operators wearing cut-resistant gloves in the non-knife hand, and the wearing of disposable water resistance gloves when handling kidneys and other organs that might be contaminated by leptospires.

No smoking requirements in plants mean that staff have to change out of all their white gear and go to a designated area before being able to have a smoke.

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MEETINGS AND CONTACTS

Date	Name	Organisation
9-Mar	Frank Darby	DOL
9-Mar	Zac Jordan	Impac Solutions
9-Mar	Geraint Emrys	DOL
9-Mar	Nick Matsas	DOL
9-Mar	Laurie Earl	DOL
16-Mar	Frank Darby	DOL
17-Mar	Zac Jordan	DOL
23-Mar	Dave Harrison	Meat Industry Assn
23-Mar	Frank Darby & Zac Jordan	
29-Mar	Chris Walls	Occupational Medicine Specialists Ltd
29-Mar	Frank Darby	DOL
30-Mar	Kevin Morris	ACC
31-Mar	Lewis Griffiths	NZVA
31-Mar	Elizabeth Somerville	NZVA
3-Apr	Graham MacBride-Stewart	ESR
3-Apr	Steve Garner	ESR
	Helen Brady	ESR
	Ruth Pirie	ESR
4-Apr	Michael Baker	Wgtn School of Medicine
13-Apr	Zac Jordan & John Hudson	DOL
18-Apr	Dr Colin Mackintosh	AgResearch, Invermay
21-Apr	Eric Mischefski	NZ Meat Workers Union
21-Apr	Maevis Watson	NZ Meat Workers Union
21-Apr	Miles Robinson	H & S Inspector DOL Napier
21-Apr	Anne Parker	Occupational Health Nurse
21-Apr	Murray Thomson	Regional Manager
24-Apr	Alan Julian	Vet, Gribbles Animal Health Hamilton
24-Apr	Dr Scott McDougall	Morrinsville Veterinary Centre
24-Apr	Dr John McCarthy	Vet, Animal Health Centre Morrinsville
26-Apr	Sue Graham	Occupational Health Nurse
27-Apr	John Monigatti	Doctor, ACC Workwise Auckland
28-Apr	Chris Walls	Dr, Occupational Medical Specialists
28-Apr	Peter Dowd	Anago Ltd
29-Apr	Dr Doug Wright	Former CEO MIRINZ
30-Apr	David Wallace	AgResearch Brd Member/Dairy Industry
1-May	Trish Postlewaight	H & S Manager, Taylor Preston
4-May	Zac Jordan & Frank Darby	
8-May	Andrew Stenson	Policy Manager, RNZ Coll of GPs
8-May	Frank Brenmuhl	Chair, Dairy Farmers of NZ
8-May	Ewan Kelsall	Policy Advisor, Fed Farmers of NZ
8-May	Dr Martin Bonne	Ministry of Health
9-May	Dr Cord Heuer	Massey University
	Dr Peter Wilson	Massey University
	Judith Collins Emerson	Massey University
	Alison Midwinter	Massey University

Date	Name	Organisation
11-May	Neville Rockhouse	Occupational Safety Management NZ
11-May	Ross Seaton	Gen Mgr Fresh Pork
11-May	Selwyn Dobbison	Vet Conslt Fresh Pork
11-May	Keith Sandilands	OS&H Manager PPCS
11-May	Brian Waltham	Training Manager PPCS
11-May	Martin Robb	
11-May	Amanda Stephens	NZ Meat Workers Union
12-May	David Murdoch	Canterbury Health Laboratories
12-May	Virginia Wells	Canterbury Health Laboratories
12-May	Trevor Anderson	Canterbury Health Laboratories
12-May	Kelvan Smith	Acting CEO Asure NZ Ltd
	Hamish Dobbie	Acting National Ops Mgr Asure NZ Ltd
26-May	John Wallaart	Farmsafe Programme Mgr ACC
30-May	Lorinda Pope	Schering-Plough Coopers
30-May	John Moffat	Schering-Plough Coopers
30-May	Roger Marchant	Schering-Plough Coopers
	Mike Stephens	Schering-Plough Coopers
31-May	Brendan Haughian	H & S Inspector DOL Man - Wang Region
7-Jun	Katie Owens	MAF Veterinarian
	Dot Daniel	AFFCO, Wairoa
	Joseph O'Keefe	IDC Wallaceville
	Clive Pigott	IDC Wallaceville