An overview of dropped hock syndrome cases in New Zealand cattle

IA Topham[*‡], KE Dittmer[*], KN Buckle[†] MC Gates[*§]

*School of Veterinary Science, Massey University, Palmerston North, New Zealand 4442
†Ministry for Primary Industries, 66 Ward Street, Upper Hutt 5140, PO Box 40-742
‡Current address: c/o 1021 Rakahouka-Hedgehope Road, RD2, Hedgehope 9872
§ Author for correspondence. Email: c.gates@massey.ac.nz

Supplementary Information 1. Data collection.

All available data sets were collated and categorised by year. Data types included questionnaire data (29/47 outbreaks; 61%), photographs (17/47 outbreaks; 36%), video footage (23/47 outbreaks; 49%), history (15/47 outbreaks; 32%), MPI summary data (9/47 outbreaks; 19%), post mortem examination results (26/47 outbreaks), and other anecdotal information (11/47 outbreaks; 23%). A copy of the MPI questionnaire form is provided as Supplementary Table 1. Photographs and video footage, where available, were converted to, and stored as, a numeric grade within the data frame. Qualitative post mortem examination data and supplementary history information were stored as text files.

A physical examination was performed by the attending veterinarian on at least one of the affected animals in each event. This information was recorded variously in MPI case notes, formal survey responses, photographs, and video footage. In most cases, in addition to the attending veterinarian, the attending MPI outbreak investigator also assessed video footage and photographs of at least one of the animals for comparison with the MPI case definition. Commonly, for outbreaks involving more than a couple of animals, the majority of cows were assessed by distance examination alone. In some cases, primarily those cases in which the veterinarian or a colleague had previously attended an outbreak, video footage and photographs were not obtained, and the diagnosis was made based on the findings of the attending veterinarian alone.

Data cleaning and processing

The data tables were imported into R statistical software (R-Development-Core-Team 2018) for cleaning and analysis. Any data entry errors were identified, checked against the data source, and corrected as required. MPI questionnaires were available for 29/47 outbreak events, where events are defined as individual outbreaks (cases clustered together in space and time). Outbreaks on the same farm in separate years are considered separate events. In four outbreak events, supplementary

history detail was supplied in free text comments on the survey responses, and via email and phone communications.

Questionnaire data

The data from the questionnaires were divided into four levels; (1) farm level data, (2) season level data, (3) mob level management data, and (4) individual cow data.

Farm level data included (1) Unique farm identifier, (2) farm name, (3) farm contact person, (4) farm address, (5) run-off address, (6) contact numbers, (7) NAIT number, (8) contact email, (9) farm area (effective Ha), (10) farm contour (steep/steep-to-rolling/rolling/rolling-to-flat/flat), (11) farm district, divided according to the 53 New Zealand administrative districts, and (12) farm region, divided according to the 17 administrative regions of New Zealand.

Season level data included (1) unique event identifier, (2) attending veterinarian's name, contact number, email address, and veterinary practice, (3) number of cows in the herd for the season, (4) number of first calving heifers entering the herd, (5) planned start of calving (PSC), 6) planned start of mating, (7) whether solely spring/autumn or year-round calving, (8) date of first case in outbreak, (9) date questionnaire was filled, (10) number of affected cows in the outbreak, and (11) whether there had been any previous cases on the farm.

Mob level data included (1) survey present y/n, (2) recent anthelmintic, vaccine, tick, bloat, and monensin treatment information, (3) copper, selenium, cobalt, iodine, zinc, phosphorus, magnesium, and calcium supplementation information, (4) feed type, quantity and quality prior to and at time of disease, and (5) potential stressor exposures. Potential stressor exposures prior to disease were empirically reported by farmers and vets in response to both the survey and direct inquiry from the MPI hotline.

Cow level history and clinical sign variables included post mortem examination, histopathology, biochemistry, haematology, trace element, and other laboratory testing. The presence or absence of the following clinical signs was also recorded: (1) progressive hind limb weakness, (2) both back legs affected, (3) shortened gait, (4) ataxia/wobbly on back legs, (5) dropped hocks and knuckled fetlocks, (6) flaccid tail, and (7) normal urination/defecation. Body condition scores (BCS) were recorded on a scale of 1 to 9 according to the DairyNZ guidelines. A summary of the data available for cow-level history details is provided in Supplementary Table 2.

Biochemistry and haematology data

A general biochemistry panel was submitted to New Zealand Veterinary Pathology or Gribbles Veterinary Pathology for 15/181 cows. In one cow, an in-house VetScan panel was performed at the referring clinic. Serum aspartate aminotransferase (AST) and creatinine kinase (CK) activity were

tested in an additional 6 cows. Haematology testing was submitted to either New Zealand Veterinary Pathology or Gribbles Veterinary Pathology in 14/181 cows. Further details are provided in Supplementary Tables 3 and 4.

Trace elements data

Blood and liver trace element testing for copper, selenium, iodine, and iron were variably available from 29/181 cows. With one exception, the data were obtained from Gribbles Veterinary Pathology test reports. In one case, the data was reported from the attending veterinarian as being "within the normal range". Further details are provided in Supplementary Table 5.

Infectious disease serology and PCR data

Leptospira PCR test results were available in 2/181 cows; *Leptospira borgpetersenii* serovar Hardjo microscopic agglutination test (MAT) in 4/181 cows; *Leptospira interggorans* serovar Pomona MAT in 3/181 cows; bovine viral diarrhoea virus (BVDV) antigen ELISA in 6/181 cows; and BVDV antibody ELISA in 4/181 cows. All testing was performed at Gribbles Veterinary Pathology (Dunedin).

Other Testing

Serum nitrate concentration was tested in 6/18 cows; blood lead in 4/181 cows; serum vitamin B12 in 6/181 cows; and vitamin E in 4/181 cows. Testing was performed at Gribbles Veterinary Pathology (Dunedin).

Post-mortem examination data

Of the 181 cows with identification, 18 had partial or full post mortem examinations performed. Of these, most were performed by the attending veterinarian, and some by pathologists from MPI or Massey University. An additional eight post mortem examination reports were available for animals without identification. The examination results indicate that these eight unknown cows were separate cows to the 16 with identification. It is not known whether any of these results correspond to the 165 cows without linked post mortem examination reports. Earlier post mortem examinations focused primarily on the nervous system; dissections of the muscles were not performed in all cases. A report of a single pathologist's examination and interpretation of nine unidentified cases, seen between 2012 and 2013, summarises the data from a further group of unidentified cases, which likely includes some of the eight individual unidentified cow reports. These unidentified cow data, along with associated histology data, have been kept separate to avoid error in the case that cows contribute to multiple sets. The data were entered from two types of record; MPI summary tables, which comprise the name of the finding and a binary yes/no, and from full histology reports.

Histopathology data

Histopathology data were available in 15/181 identified cows. Three more animals were recorded as having samples taken for histology, but no report matching these animals was available. Eight histology reports were also available from unidentified animals, which may include the three animals with no reports attached. Nine unidentified cows also contributed to a report by a single pathologist on histology from cases over 2012 and 2013. Histology tissue sample sets range from limited hind limb neural samples to a full range of visceral and non-visceral tissues, including brain. The data were entered from two types of record; MPI summary tables, which comprise the name of the finding and a binary yes/no, and full written histology reports.

Supplementary Table 1. MPI Questionnaire.

FARMER CONTACT DETAILS

Contact person's name			
Farm address			
Farms On Line number			
NAIT number			
Nearest town/city			
Phone No		**Mobile phone**	
E-mail			

Farm details

What is the effective area of the dairy farm?				**ha**
What numbers of cows are milked?				
When is the planned start of calving				
Whenis the planned start of mating				
How would you best describe your dairy set-up? (tick only one box)				
Totally spring calving herd				
Totally autumn calving				
Run a mix of spring calving and autumn calving herds				
What is the contour of your farm? Circle which applies				
Mostly steep	**Mostly rolling**	**Mix steep/rolling**	**Mix rolling/flat**	**Mostly flat**

History and diagnosis

What date was this case of sciatic palsy seen?	/ /
What date was this questionnaire completed?	/ /
On this farm how many other cattle have been affected with sciatic palsy?	
What signs were seen in the affected animal? (circle all selections)	
Progressive hind limb weakness	**Yes/No**
Both back legs affected but differing severity	**Yes/No**
Shortened gait	**Yes/No**
Ataxia, wobbly on back legs	**Yes/No**
Dropped hocks and knuckled fetlocks	**Yes/No**
Tail can be flaccid	**Yes/No**
Defaecation and urination normal	**Yes/No**
Blood calcium/magnesium/phosphorus levels normal	**Yes/No**

History details

Cow ID				
Is the cow homebred?				**Yes/No**
If purchased what date did the cow arrive				/ /
What is the age of the affected cow?				**mths**
What is the weight of the affected cow?				**kg**
What body condition score is the cow				
What is the breed of the affected cow?				
What date did the affected cow calve				/ /
Has the cow recently been seen bulling?				**Yes/No**
Are there fresh rub marks on the cow?				**Yes/No**
Are there bulls running with the herd?				**Yes/No**
Describe the health of the cow in last month before sciatic palsy (circle one)				
Excellent	**Good**	**Adequate**	**Poor**	**Very poor**

What date did the affected cow calve			/ /
Was the last calving assisted?			**Yes/No**
Was the cow treated for a metabolic condition?			**Yes/No**
If yes what date?			/ /
If yes what treatments were given?			
Was the cow down for any period of time after calving?			**Yes/No**
Has the cow been treated for mastitis?	**Yes/No**	**If yes date?**	/ /
Has the cow been treated for metritis?	**Yes/No**	**If yes date?**	/ /
Any other illnesses treated?	**Yes/No**	**If yes date?**	/ /
Has milk production fallen off before palsy started?			**Yes/No**
Has the cow been given any treatment for sciatic palsy?			**Yes/No**
If yes what treatment was used?			
Was there any sustained response to treatment?			**Good/Some/None**

Was the affected cow recently wormed?

Were the affected cattle recently wormed?	**Yes/No**
If yes please list the anthelmintic treatments given and the date of their administration	
Date of anthelmintic treatment	**Name of product used**
/ /	
/ /	

Was the affected cow recently vaccinated?

Were the affected cattle recently vaccinated?	Yes/No
If yes please list the vaccinations given and the date of their administration	
Date of vaccine treatment	Name of product used
/ /	
/ /	

Was the affected cow recently treated for ticks?

Were the affected cattle recently treated for ticks?	Yes/No
If yes please list the tick treatments given and the date of their administration	
Date of tick treatment	Name of product used
/ /	
/ /	

Was the affected cow recently given mineral supplements (copper, selenium, cobalt)

Were the affected cattle recently given mineral treatments?	Yes/No
If mineral supplements were given please list what products were used and when they were administered	
Date of mineral treatment	Name of product used
/ /	
/ /	
/ /	

Pasture quality

How would you describe the recent pasture quality? Please circle one on each row					
Paddock of disease outbreak	lush	good	average	poor	rubbish
Previous paddock	lush	good	average	poor	rubbish

Supplementary feeding

Was the affected cow receiving supplementary feeding?	Yes/No
Please list what supplements are currently being fed and when started	

Date first fed	Supplement fed	Feed rate
/ /		kg/cow/day
/ /		kg/cow/day
/ /		kg/cow/day
/ /		kg/cow/day

Supplementary feed quality

How would you describe the supplementary feed quality? Please circle				
	good	average	poor	rubbish
	good	average	poor	rubbish
	good	average	poor	rubbish

Additional treatments

Was the affected cow receiving any additional medication? (you may tick more than one box) and date when started treatment					
Zinc sulphate in the water for facial eczema prevention				Date	
Zinc oxide drenches for facial eczema prevention				Date	
Time capsule boluses for facial eczema prevention				Date	
Bloat treatment in the water				Date	
Rumensin treatment in the water				Date	
Other		Specify		Date	

Stressful incidents

Did the cow experience any additional stresses in the last month such as a water shortage, dehorning, transportation, blood testing, weighing?	Yes/No

Date of stressful event	Stressful experience
/ /	
/ /	
/ /	

Genetics

Details from MINDA	
Birth ID	
Breed code	

Farmer opinion

We would be very interested in your opinion as to what you think may have caused this cow to get sciatic palsy

Supplementary Table 2. Summary of the availability of cow-level history details for the 181 cases of Dropped Hock Syndrome in New Zealand from October 2012 to August 2017.

Variable	Levels	Number (%)Cows with data
Home bred v Imported		66 (36.5%)
Import Date		3 (1.7%)
Age		86 (47.5%)
Weight		68 (37.6%)
BCS prior to disease*	1-9	77 (42.5%)
BCS after/during disease*	1-9	21 (11.6%)
Breed	Jersey, Friesian, Kiwi Cross (Mixed Jersey/Friesian breeding), Angus	94 (51.9%)
Calving date		42 (23.2%)
Bulling	Y/N	74 (40.9%)
Rub marks	Y/N	76 (42.0%)
Bulls in with cows	Y/N	65 (35.9%)
Cow health prior to disease	Very good, Good, Average, Poor, Very poor	73 (40.3%)
Assisted calving	Y/N	33 (18.2%)
Calf born dead	Y/N	3 (1.7%)
Metabolic disease treatment	Y/N	40 (22.1%)
Cow Down	Y/N	40 (22.1%)
Mastitis treatment - recent	Y/N	37 (20.4%)
Metritis treatment - recent	Y/N	38 (21.0%)
Metritis treatment - date		2 (1.1%)
Other illness observed	Y/N	22 (12.2%)
Drop in milk output		11 (6.1%)
Dry cow	Y/N	50 (27.6%)
Treated for DHS	Y/N	64 (35.4%)
Treatment for DHS - response reported	One of: None, Improvement, Resolution	41 (22.7%)

* Body condition score observations were made by DairyNZ accredited scorers in 21 cases at dry-off, and at DHS diagnosis by a veterinarian in 15 cases, and the farmer in six cases. These six cows were dried off early and fed preferentially due to low BCS in the autumn.

Supplementary Table 3. Number of cases with serum biochemistry data available from 181 cows diagnosed with dropped hock syndrome in New Zealand between October 2012 and August 2017.

Test	# cows with test	% cows with test
Sodium mmol/L	15	8
Potassium mmol/L	15	8
Chloride mmol/L	15	8
Creatinine umol/L	15	8
Urea mmol/L	16	9
Phosphate mmolL	16	9
Total Protein g/L	16	9
Albumin g/L	16	9
Globulin g/L	15	8
A:G[1] ratio	15	8
Calcium mmol/L	16	9
Magnesium mmol/L	16	9
Bilirubin umol/L	15	8
GGT[2] IU/L	15	8
GLDH[3] mmol/L	15	8
B-OHB[4] mmol/L	15	8
AST[5] IU/L	22	12
CK[6] IU/L	21	12
Bicarbonate mmol/L	11	6

[1] Albumin:Globulin ratio
[2] Gamma-Glutamyl Transferase
[3] Glutamate Dehydrogenase
[4] Beta-Hydroxybutyrate
[5] Aspartate Aminotransferase
[6] Creatinine Kinase

Supplementary Table 4. Number of cases with haematology data available from 181 cows diagnosed with dropped hock syndrome in New Zealand between October 2012 and August 2017.

Test	# cows with test	% cows with test
RBC[1] $x10^{12}$/L	14	8
Hb[2] g/L	14	8
PCV[3]	14	8
MCV[4] fl	14	8
MCH[5] pg	14	8
MCHC[6] g/L	14	8
Platelets $x10^9$/L	2	1
WBC[7] $x10^9$/L	14	8
Neutrophil x10^^{9}/L	14	8
Lymphocyte $x10^9$/L	14	8
Monocyte $x10^9$/L	14	8
Eosinophil $x10^9$/L	14	8
Fibrinogen	14	8

[1] Red blood cells
[2] Haemoglobin
[3] Packed cell volume
[4] Mean corpuscular volume
[5] Mean corpuscular haemoglobin
[6] Mean corpuscular haemoglobin concentration
[7] White blood cells

Supplementary Table 5. Number of cases with blood and liver trace element results from 181 cows diagnosed with dropped hock syndrome in New Zealand between October 2012 and August 2017.

Test	# cows with test	% cows with test
Serum Iron µmol/L	4	2
Serum Copper nmol/L	22	12
Blood Selenium nmol/L	3	1.5
Serum Selenium µmol/L	15	7.5
Liver Copper µmol/kg	10	5
Liver Selenium (quantitative results not available)	5	2.5
Serum Iodine µg/L	1	0.5