



Incidence of calf scours and associated risk factors in southern New South Wales beef herds

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Objective The aim of this study was to identify the incidence of morbidity and mortality associated with calf scours in beef calves between birth and 14 days of age. Farm characteristics, animal factors and management practices were also assessed for any association with calf scours being present on the farm.

Methods A questionnaire and return address envelope were distributed to 721 farms with at least 50 head of beef cattle in the Hume area of New South Wales, Australia.

Results In total, 147 (20.4%) farmers responded to the survey, of which 76 (51.7%) indicated calf scours did occur on their farm. On average, farmers estimated the morbidity of calf scours was 4.5%, but only 0.2% of all calves died as a result of scours. Affected herds were more likely to have multiple breeds and a higher proportion of cows with mismothering problems or weak calves compared with unaffected herds. These differences were confirmed with regression analysis. A large proportion of farmers with affected herds reported the loss of many calves from 'unexplained' or 'sudden' death within the first 14 days of life.

Conclusions The incidence of calf morbidity was lower and mortality was within the same range compared with other studies on beef farms around the world. The high percentage of farms reporting losses from 'unexplained' or 'sudden' death of calves requires further monitoring and diagnostic and economic investigations.

Keywords beef cattle; calf scours; risk factors; sudden death

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Calf scours is one of the most important causes of loss of beef and dairy calves between birth and 14 days of age.^{1,2} The incidence of morbidity and mortality depends on pathogens and risk factors associated with the animal, environment and applied management systems. A Canadian case-control study assessing calf scours on beef farms reported a morbidity of 34% on case and 10% on control farms, with mortality rates of 6.2% and 0.1%, respectively.³ A study in France⁴ found morbidity of calf scours was 14.6%, with more than half the cases occurring in the first week of life and only 15% of cases occurring after 14 days of age. The overall mortality rate was 3.6%. A Swiss study of low-input beef farms reported an average calf mortality of 6.1%, with a large variation of 0–50% between farms.^{5,6} The two main recorded causes of death were respiratory (26%) and calf scours (26%). A Colorado study reported a calf mortality of

4.5% from birth to weaning, with the most common causes of death besides dystocia and stillbirth being hypothermia (12.4%) and scours (11.5%).⁷ A study of southern Australian beef properties reported that 33% of the farms included in the study reported an overall mortality rate >2% in calves between birth and 16 weeks of age.² When this period was divided into five different age groups, the highest mortality rates were seen in calves younger than 5 days old (0.3%) and between 6 and 21 days of age (1.0%).²

The pathogens involved in calf scours are well known and described in many studies, but the prevalence differs between countries and is related to the industry (beef or dairy) in which calves are born.^{1,2,4,8} In Argentina, a study of beef and dairy farms reported the most commonly found pathogen in calves less than 30 days old was bovine rotavirus (45.1%), whereas dairy calves were most commonly infected with *Cryptosporidium parvum* (29.6%).⁹ The French study of beef farms isolated bovine rotavirus in 47.4% of cases and *Cryptosporidium* in 16.5% of scouring calves from birth to 30 days of age; *Escherichia coli* was isolated from 20.3% during the first days of life.⁴ An Australian study of dairy and dairy-beef operations found that bovine rotavirus was the most common pathogen identified (79.9%) followed by *C. parvum* (58.5%), *Salmonella* spp. (23.8%), bovine coronavirus (21.6%) and *E. coli* K99 (17.4%).¹ That study also noted that bovine rotavirus and *Salmonella* spp. were more likely to be identified in samples collected from dairy-beef than dairy properties.¹

Specific management factors related to the incidence of calf scours in overseas studies are often associated with hygiene, such as heifers being calved in a separate location and calves with scours and their dams being placed in a quarantine paddock.^{3,10} Nutrition is another important area of management and, more specifically, feeding corn silage, extra protein, vitamin, copper or salt supplements has been associated with the incidence of calf scours.^{10–12} The most important animal factor identified was parity, with low-parity heifers having a higher incidence of scours in their offspring because of the production of less and lower quality colostrum, more calving difficulties and potentially poorer mothering skills than older parity cows.¹¹ Poor drainage in the nursing area and a large calving area were some environmental factors associated with calf scours.³

So far there is little evidence in Australia regarding the association between possible risk factors and scours in beef calves up to 14 days after birth.² To improve this, a survey to collect information was conducted among beef properties in the Hume area, New South Wales, to identify the incidence of morbidity and mortality of beef calves affected with scours between birth and 14 days of age and to investigate farm characteristics or management practices associated with scours being present.

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Materials and methods

Data collection

In February 2011, a questionnaire and return address envelope were distributed to 721 farms with at least 50 head of beef cattle in southern New South Wales, selected from the database provided by the Hume Livestock Health and Pest Authority. The questionnaire contained 32 questions divided into four sections: general farm information, incidence/record keeping/treatment, on-farm risk factors, and data collection and evaluation (survey available on request from corresponding author). Dichotomous questions were used because of their simplicity to answer and the responses were coded for statistical analysis. Each returned questionnaire was given a farm number based on the farm address. Farmers who did not wish to be identified were able to remove their address from the returned questionnaire, but these farmers were then removed from the risk factor study.

Statistical analysis

A descriptive overview of all results of the returned questionnaires was conducted, followed by a comparison of variables between farms where calf scours was considered present and farms not known to have calf scours. A two-sided t-test was used for continuous variables and Chi-square test was used for categorical variables or Fisher's exact test if the number of responses was less than five data points per cell in contingency tables. All variables with a P-value <0.10 between the affected and unaffected farms were tested in a univariable logistic regression model and in a multivariable logistic regression model, with backwards stepwise elimination of variables to determine significant management risk factors associated with a difference between the high- and low-incidence farms. Only variables significant at $P < 0.05$ in the likelihood ratio test were retained in the final model. All analyses used SPSS for Windows (version 17.0, Chicago, IL, USA).

Results

In total, 147 (20.4%) farmers responded to the survey, of which 76 (51.7%) indicated calf scours occurred on their farm. On average, farmers estimated 4.5% of their calves were affected (range 0.5–80%), of which 5.0% died (range 0–100%). This resulted in an average mortality of 0.2% of affected calves as a result of scours (Table 1). Although only 13 of the 76 farms recorded the actual number of affected calves. Subsequent analysis of these 13 farms revealed that 7.2% (range 3–11%) of calves were affected of which 2.3% (range 0 to 6%) died resulting in an average mortality of 1.7%.

In total, 32/76 (42%) of the affected farms showed a difference in the incidence of affected calves between heifers (8.4%) and older parity cows (12.1%), and calves that died from scours (1.5% (heifers) and 5.9% (older parity)), but the difference was not significant (Table 1).

Generally, affected herds were larger (592 head) than unaffected herds (415 head; $P < 0.01$) and were more likely to have multiple breeds compared with a single breed (19% vs 6% farms, respectively; $P = 0.02$) (Table 2).

The most common treatments reported to be administered were fluids (oral and IV) by 55 (75.3%), and antibiotics (54.8%). 19 (25%) recorded the numbers that were treated and 23 (30.3%) recorded

Table 1. Estimated percentage of calf scours

	% (SD)	P value ^a
Estimated percentage, 76 farms		
Calves with scours (morbidity)	4.5 (11.5)	
Calves that died from scours (mortality)	5.0 (14.4)	
Estimated percentage when difference heifers/cows (%), SD) 32 farms		
Calves with scours (heifers)	8.3 (17.2)	0.374 ^b
Calves with scours (cows)	12.1 (25.1)	
Calves that died from scours (heifers)	1.5 (5.5)	0.187 ^b
Calves that died from scours (cows)	5.9 (18.7)	

^a $P < 0.05$ for significance level difference between heifers and cows.

^bComparison between heifers and cows.

those that died from scours. Only one farmer indicated that laboratory investigation of samples from calves with scours was used to identify the pathogen involved. Interestingly, a larger proportion of farmers with affected herds indicated they lost many calves from 'unexplained death' (34%) and 'sudden death within the first 14 days of birth' (16%) compared with farmers with no calf scours (15% and 1%, respectively; both $P < 0.01$) (Table 3). Mothering problems or weak calves were also seen more regularly on affected farms compared with unaffected farms (19% vs 4%, $P < 0.01$). The averaged (\pm SD) length of the calving season was 10.1 (\pm 3.6) weeks for affected farms and 8.8 (\pm 2.6) weeks for unaffected farms, but did not significantly differ ($P = 0.44$). The range of body condition scores at time of calving was reported as almost similar between the affected and unaffected farms. From the on-farm risk factors (Table 4), only the risk factor of 'vaccination against clostridial diseases' had a P-value <0.10 and was included in the logistic regression models. The final multivariable model indicated that unaffected farms were more likely to have only a single breed on the farm compared with affected farms (odds ratio 0.24) and affected farms were 2.5-fold more likely to have unexplained deaths of calves and almost 9-fold more likely to have sudden death of calves than unaffected farms (Table 5).

Discussion

The main objective of this study was to identify the incidence of calves affected with scours and the associated mortality. The average morbidity of 4.5% was substantially lower than in other studies, in which it ranged from 10% to 34%, and the mortality rate of 0.2% was low but within the previously reported range of 0.1–6%.^{3,5,13} However, as in other studies, there was a significant variation among farms in both morbidity (0–80%) and consequent mortality (0–100%). It is most likely that producers in the current survey underestimated the actual morbidity, which is underpinned by the average mortality of 1.7% in the subgroup of only 13 out of the 76 affected farms (Table 1) on which the producer recorded the number of calves affected and the number that died from scours. It is also possible that not all farmers correctly understood the terms 'morbidity' and 'mortality' as this terminology is not used daily by farmers. Therefore the words 'affected' and 'death' should have been used instead. Given that almost 35% of

Table 2. Farm activities, breed, number of (co)workers and number of animals for all (overall), affected (scours) and unaffected (non-scours) farms

Variable	Overall	Scours	No scours	P value ^a
Farm type (n,%)				
All farms	147 (100%)	76 (51.7%)	71 (48.3%)	
Only beef	64 (43.5%)	34 (44.7%)	30 (42.3%)	0.762
Beef and wheat	22 (15%)	13 (17.1%)	9 (12.7%)	0.286
Beef and sheep (wool and meat)	29 (19.7%)	15 (19.7%)	14 (19.7%)	0.753
Beef, wheat and sheep (wool and meat)	30 (20.4%)	12 (15.8%)	18 (25.4%)	0.195
Beef and other (dairy, deer)	2 (1.4%)	2 (2.6%)	0 (0.0%)	NA
Breed (n,%)				
Single breed	129 (87.8%)	62 (81.6%)	67 (94.4%)	0.016
Multiple breeds	18 (12.2%)	14 (18.4%)	4 (5.6%)	
Hereford	40 (27.2%)	21 (27.6%)	19 (26.8%)	0.527
Angus (black and red)	81 (55.1%)	42 (56.0%)	39 (55.7%)	0.553
Average (co)workers (mean, SD)				
Full-time	1.3 (1.2)	1.5 (1.3)	1.0 (1.0)	0.549
Part-time	0.9 (1.4)	1.0 (1.7)	0.8 (0.8)	0.874
No. of animals per farm (mean, SD)				
Heifers	127 (215)	159 (243)	94 (176)	0.007
Cows	276 (386)	307 (333)	243 (435)	0.014
Bulls	18 (62)	24 (83)	11 (24)	0.023
Steers	93 (148)	110 (172)	74 (113)	0.057
Total	514 (716)	592 (705)	415 (713)	0.006

^aP < 0.05 for significance level between the cohort Scours and No scours.

Table 3. Reasons for calves dying within 14 days of birth on farms affected and unaffected by scours

	Overall		Scours		No scours		P value ^a
	n	%	n	%	n	%	
Unexplained death	36	25.5	26	34.7	10	15.2	0.008
Mothering problems/weak calves	17	11.6	14	18.7	3	4.2	0.006
Neonatal respiratory diseases	6	4.1	4	5.3	3	33.3	0.367
Sudden death within 14 days of birth	13	8.9	12	16.0	1	1.4	0.002

^aP < 0.05 for significance level between the cohort Scours and No scours.

producers on affected farms reported unexplained and sudden death of calves, the relatively low incidence of scours observed in this study may have been the result of misdiagnosis. Pathological confirmation of the diagnosis was not regularly performed, with only one producer having laboratory data available. Financial constraints and logistic difficulties are possible reasons for this. On the unaffected farms, one in six producers reported dead calves without a diagnosis and identified them as 'unexplained death'. For these producers, pathology would be an important diagnostic tool and the results used to improve treatment/and prevention protocols in future calving periods.

The economic loss of a dead calf in the beef industry is important. A study of 73 farms estimated the mean cost per calf death as US\$216, of which US\$208 was attributed to the potential value of the calf and an additional US\$8 for veterinary costs, drugs, producer's labour

and carcase disposal.⁷ Another study estimated the mean-per-cow increase in net income for a beef herd could be US\$7.44, US\$14.93 and US\$22.42 for morbidity and mortality reductions of 20%, 40%, and 60%, respectively.¹⁵ The study by Gunn et al. reported the cost of calf scours ranged from AUD\$0.50–\$68.60, with a mean cost of AUD\$18.70 per breeding cow.² In another study, scours during the neonatal period resulted in a significant weight loss (10.7 kg) between birth and weaning compared with healthy calves,¹⁴ so even the 4.5% incidence in the examined beef herds equates to a substantial financial loss.

The risk factors included in this study were carefully selected from other studies and although there are differences in climate and management systems, the findings suggest a minimal number of significant factors. Biosecurity-related practices of buying cattle from saleyards or other properties did not result in any difference. The use

Table 4. General management practices, mineral supply, milk production and vaccinations for all (overall), affected (scours) and unaffected (non-scours) farms

	Overall		Scours		No Scours		P value*
	n	%	n	%	n	%	
Cows and heifers wintered in the same paddock	33	22.6	15	19.7	18	25.7	0.338
Cows and heifers calve in the same paddock	30	20.5	16	21.1	14	20.0	0.875
Shelter for calves in the first 14 days	54	37.0	29	38.2	25	35.7	0.760
Buy cattle from saleyards	51	34.9	23	30.7	28	39.4	0.267
Buy cattle direct from other properties	89	60.5	46	60.5	43	60.6	0.996
Use a quarantine paddock when new cattle come onto the farm	63	43.4	32	42.1	31	44.9	0.923
Mineral supply heifers and cows	33	22.6	16	21.1	17	24.3	0.641
Mineral supply cows only	4	2.7	4	5.3	0	0.0	NA
Mineral supply heifers only	3	2.1	0	0.0	3	4.3	NA
Milk production of heifers in the first week of lactation							
Very good/good	95	65.9	48	69.6	47	62.7	0.940
Just sufficient/below sufficient	49	34.0	27	30.4	22	37.3	
Milk production of cows in the first week of lactation							
Very good/good	135	92.5	69	90.8	66	94.3	0.718
Just sufficient/below sufficient	11	7.5	7	9.2	4	5.7	
Cattle vaccinated against							
Pestivirus	38	25.9	20	26.3	8	25.4	0.894
Leptospirosis	70	47.9	39	51.3	31	44.3	0.396
Clostridial disease (5 in 1)	102	69.4	58	76.3	44	62.0	0.059 ^a
<i>E. coli</i>	8	5.4	4	5.3	4	5.6	0.921
Breed own replacement heifers	130	88.4	69	90.8	61	85.9	0.253
Restricted calving or year-round calving							
Restricted	129	87.4	66	86.8	63	88.7	0.489
Year-round calving	17	11.6	10	13.2	7	9.9	

*P < 0.05 for significance level between the cohort Scours and No scours. ^aP < 0.10. NA, none applicable.

Table 5. Results of the separate single (univariable) and final multiple (multivariable) logistic regression models

Variable	Univariable model					Final multivariable model				
	B	SE	P value ^a	OR ^b	CI OR ^c (95%)	B	SE	P value	OR	CI OR (95%)
Constant	NA					1.019	0.58			
No. of heifers	0.002	0.001	0.092	1.002	1.000–1.004	NA				
No. of cows	0.000	0.000	0.315	1.000	1.000–1.000	NA				
No. of bulls	0.008	0.007	0.288	1.008	0.994–1.022	NA				
Single–multiple breeds	–1.33	0.59	0.025 ^d	0.26	0.08–0.85	–1.41	0.61	0.022 ^d	0.24	0.07–0.81
Unexplained calf deaths	1.09	0.42	0.010 ^d	2.97	1.30–6.77	0.91	0.45	0.042 ^d	2.48	1.03–5.98
Mothering problems/weak calves	1.65	0.66	0.012 ^d	5.20	1.43–18.97	NA				
Sudden death of calves	2.59	1.06	0.014 ^d	13.33	1.68–105.47	2.16	1.08	0.046 ^d	8.68	1.04–72.29
Clostridial (5 in 1) vaccination	0.68	0.36	0.061	1.977	0.97–4.04	NA				

^aP < 0.05 for significance level between the cohort Scours and No scours. ^bOdds ratio. ^cConfidence interval odds ratio (95%). ^dIncluded variables were significantly different between affected and unaffected farms (P < 0.05). NA, none applicable.

of a quarantine paddock, which was equally applied on both affected and unaffected farms, also made no difference. However, biosecurity is a main priority in all animal health programs and potentially the main source of new infections on farms. Additional mineral supply, wintering cows and heifers in the same paddock or vaccinating against common disease did not differ between the two groups, with the exception of clostridial diseases. For animal-related factors, only the presence of multiple breeds and of mothering problems/weak calves were found to be significant. Possible reasons why commonly known risk factors did not apply to the situation in NSW could be the different environment and management systems compared with overseas studies. Most of the farms in the current study are mixed farming systems (56.5%), have winter cows and heifers in different paddocks (73.4%) and segregate them for calving in separate paddocks (79.5%). Shelter for young calves is not likely to be an important factor because the most common pathogens associated with scours are bovine rotavirus and *C. parvum*,¹ but would be more effective if *E. coli* was an important issue. Poor drainage in the nursing area is not very likely to be an important factor, as this is not a commonly used practice on beef farms in New South Wales. Milk production, an important selection trait within the Australian beef industry, is also not an issue, as more than 90% of the producers indicated that the milk production of their cows was good to very good.

The two most common pathogens detected in this and other studies are bovine rotavirus and *C. parvum*^{1,4,9} and each pathogen requires a different management approach. A correct diagnosis would help in developing a plan for this or next year's calving season and prevent or treat new cases in the current season. The results of the final regression model indicated that unexplained or sudden death of calves was associated with affected farms. A possible explanation could be the time between infection and death of the calf. We focused on the period between birth and 14 days of age, which is when the pathogens related to calf scours can cause death very quickly and if not observed by the farmer it will be recorded as a 'sudden' or 'unexplained' death of a calf. Besides time, the criteria used to identify affected calves could be an issue. The fact that only a small proportion of farmers recorded information on scours and just one farmer submitted samples to a laboratory might indicate that the criteria for identifying affected calves are insufficient. Therefore, factors such as 'monitoring' and 'criteria to identify affected calves' might be areas of focus in both future research and advice given to farmers to control or prevent calf scours. The other significant factor, single or multiple breeds, can be related to the management system of the farm. Each breed requires its own optimal management system. Managing several breeds instead of one can cause suboptimal conditions for each breed, resulting in increased morbidity and mortality rates in the calves. Overall, it can be concluded that the morbidity and mortality associated with calf scours on southern NSW beef farms is low compared with other studies but with significant variation among farms. Under-reporting, the high non-response rate and incorrect diagnosis could have confounded these findings. Many risk factors found to be associated with scours in overseas studies did not apply to the farms investigated in the current

study. Still the question remains, which additional questions could have been included that could help to explain the difference between affected and unaffected farms? With hindsight, questions regarding the frequency and methods of monitoring calves during the calving season and the criteria used by farmers to identify an affected calf should have been included. The main recommendations from this study include improving the monitoring and diagnosis of calf scours to identify common pathogens and to investigate causes of neonatal deaths. This information could then be used to develop farm-specific management protocols for the effective treatment of neonatal calf scours in New South Wales. Possible methods to improve the submission rate of faecal samples would be to inform farmers more about the financial impact of calf scours and develop sampling kits, including ice packs, that are easy to use on farms and can be directly transported from the farm to laboratory.

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