MEAT & LIVESTOCK AUSTRALIA

On farm

Calf Scours in Southern Australia

A review of the impact of calf scours on beef enterprises

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Final Report prepared for MLA by:

Alison Gunn BVSc MVS MACVSc
Clarke and Goulding Veterinary Practice
PO Box 1292
Mount Gambier SA 5290

Meat and Livestock Australia Ltd
Locked Bag 991
North Sydney NSW 2059

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ABSTRACT

This study was carried out to determine the impact of calf diarrhoea on Australian beef enterprises. Calf scours was demonstrated to be a significant and time-consuming disease problem on many beef properties. Calves were most severely affected between one and six weeks of age. Twenty-eight percent of respondents had a prevalence of 20% or greater in one or more of the age groups and 33% of respondents had a mortality rate greater than 2% from 0 to 16 weeks. A historical survey of veterinary pathology laboratories in 4 states established that the most common pathogens isolated from faecal samples are cryptosporidia and rotavirus. Diagnosis of calf scours was shown to be frustrating, because it is relatively expensive and results are not guaranteed. Producers were employing a large and contradictory range of management practices to control and treat calf scours, indicating that there was little clear and consistent advice available. The establishment of key management strategies at a herd level is essential to minimise calf scours in Australia. This report details the strategic research, product development and extension required reducing the impact of calf scours on beef enterprises.

LIST OF ACRONYMS

ABARE	Australian Bureau of Agricultural and Resource Economics
AHL	Animal Health Laboratories
CSP	Calf scour package
DNRE	Department of Natural Resources and Environment
DPI	Department of Primary Industries
DPIWE	Department of Primary Industries, Water and Environment
EAEEC	Enteropathogenic attaching and effacing E. coli
ELISA	Enzyme-linked immunosorbent assay
EMAI	Elizabeth MacArthur Agriculture Institute
ETEC	Enterotoxigenic E. coli
HEC	Haemolytic E. coli
MPCSP	Major pathogen calf scour panel
MZN	Modified Ziehl-Neelsen
NATA	National Association of Testing Authorities, Australia
NHEC	Non-haemolytic E. coli
PIRD	Producer Initiated Research and Development
RT-PCR	Reverse transcriptase-polymerase chain reaction
RVL	Regional Veterinary Laboratory

EXECUTIVE SUMMARY

The aim of this project was to compile and assess all available knowledge on calf scours in the Southern Australian beef industry in order to better define the problem and recommend where further research, extension and product development is required. These goals were achieved by collating and analysing information from surveys of interested producers and cattle veterinarians working in the industry, as well as analysis of historical data on beef calf scours from 4 veterinary laboratories.

This study has shown that calf scours is a significant and time-consuming disease problem on many of the properties surveyed. It is a multifactorial disease and there are no recently published scientifically proven studies showing how to prevent outbreaks in Australian conditions. Diagnosis is frustrating, because it is relatively expensive, results are not guaranteed, and when pathogens are isolated the appropriate advice and interpretation is sometimes inconsistent.

The impact of calf scours on some properties is severe. Information was collected from survey respondents on the number of calves affected in different age groups. Twenty-eight percent of respondents had a prevalence of 20% or greater in one or more of the age groups, and 33% of respondents had a mortality rate greater than 2% from 0 to 16 weeks. This degree of severity was supported by epidemiological data from submissions from laboratories in NSW and WA, where the mean mortality rate from reported outbreaks was 6%.

The cost of calf scours to the enterprises surveyed ranged from $0.50-$68.60 per breeding cow with a mean cost of $18.70 per breeding cow. Significant cost was involved in herds with high mortality or when a high proportion of calves needed to be treated with intravenous fluids.

There was a large variation reported in the presentation of the scour problems. Some farmers described large numbers affected (up to 100 % of calves from 0 - 6 weeks) but low mortality, others had a high mortality compared to the number of calves observed affected. This latter presentation is concerning and requires better definition and determination of the underlying causes. Much of the variation in presentation will relate to the virulence of different pathogens, but it should be noted that there is no standard case definitions for a scouring calf, and this needs to be established.

Laboratory results from Tasmania, Victoria and Western Australia indicate that the major causes of calf scours in these states were rotavirus and cryptosporidia, and the main age groups affected are 1 to 6 weeks. The New South Wales laboratories had a statistically higher proportion of submissions from calves aged 7 to 16 weeks, and the most common diagnoses in this state were coccidia, enterotoxaemia and nematode infections. As *Cryptosporidium parvum* can survive in cool moist conditions for many months and rotaviruses are stable in faeces, it is probable that in cooler southern climates these pathogens are surviving much longer and possibly from one calving season to the next.

The percentage of submissions from which there was no diagnosis was between 25% and 45% across the 4 laboratories from which data was collected. In many cases there is intermittent shedding of a pathogen, or the samples are taken before the infective stage of the pathogen is present in the faeces. However in many laboratory submissions not all the major pathogens were tested for. The cost of testing enough samples to establish a diagnosis can be significant and it would be common for veterinarians to only use faecal samples to confirm common aetiologies. However where a complete panel of diagnostic tests for the major pathogens was carried out the diagnosis rate was higher. Many laboratories also noted that where full cost recovery is applied, veterinarians often request that faecal tests are carried out in stages, stopping when a pathogen is isolated. The consequence of this strategy is to attribute a problem to a single pathogen when the actual diagnosis is more complex.

Treatment of calves is time consuming and affected calves can be slow to recover. The actual diagnosis is seldom known resulting in empirical treatment that is prescribed across a veterinary surgeons counter after a conversation on the current problem. Eighty-four percent of respondents to the detailed farmer survey were treating affected calves with electrolyte solutions, however there is a huge range of treatment protocols with respect to the amount fed, type of electrolytes used, whether calf is separated from its mother or not, and if so for how long. This is just an example of the large and contradictory range of management practices farmers are using to control and treat calf scours, indicating that there is little clear and consistent advice available.

After extensive analysis the only clear relationship between management practices and calf scours shown by the second questionnaire is that calf scours is strongly related to spring calving. However the fact that other management practices were not shown to contribute is related to the imprecise method of data collection (i.e. numbers estimated over the phone as opposed to analysis of records); the subjective nature of the available information about the farm; and the large range of different environments in the study population. Other management practices are likely to be contributing to calf scours in Australia

Experience overseas has shown that the most important method of controlling calf scours is through good management practices. These aim to minimise the level of infection in the calves' environment, increase the non-specific resistance of the calf and minimise stress. Best practice recommendations for management strategies to minimise calf scours in Australia need to be researched and presented to farmers. Although there is a need for case control studies to determine key management strategies for the Australian beef industry, the initial step should be a combination of a literature search and application of first principles to establish standard recommendations. The literature search should encompass grassland cow-calf operations from overseas and research that has been carried out in the dairy industry. Having established the most likely strategies to minimise calf scours the most significant of these can be confirmed by detailed studies.

The survey respondents extensively requested the development of vaccines. This study has identified the major pathogens affecting different regions and on many farms therapeutic control methods for these pathogens may be valuable. Effective vaccines are likely to be beneficial for a specific problem or pathogen on seriously affected properties. However wider industry benefit is likely to be achieved by establishing appropriate management strategies.

The focus for development of management strategies and further research should be to minimise the impact of calf scours in calves aged 0-6 weeks in wetter cooler areas of Australia. Good preventative strategies for enterotoxaemia and nematode infestation in older calves are already well established. Strategies aimed at minimising disease in a narrow target population will mainly focus on prevention of infectious disease and these principles can then be broadened to include older calves and other neonatal diseases.

An overall strategy to minimise the impact of calf scours would have significant benefits to the Australian beef industry. Objectives of this strategy should encompass:

- establishment of key management strategies at the herd level to minimise calf scours
- development of a scoring system for disease severity and case definitions for scouring calves that will improve definition of the problem on farm
- standard recommendations of appropriate and affordable diagnostic procedures and pathways on farm and at the laboratory, including establishment of the role of post mortems
- establishment of the significance of coronavirus, bovine torovirus, EAEEC and selenium deficiency in calf scours in Australia
- standardisation of the interpretation and reporting of laboratory results
- coordination between industry across state borders and with state agriculture departments to specifically investigate and establish diagnoses for outbreaks where there is a high mortality rate (suggested level greater than 5%)
- establishment of appropriate treatment protocols that address
    a) simple and effective ways to manage sick calves
    b) appropriate protocols for the administration of therapies to provide a good clinical outcome
    c) minimising the risk of antibiotic resistance
- extension of these strategies to farmers, veterinarians and veterinary pathology laboratories

Extension is also required to promote recognition by veterinarians and industry of the significant costs and other impacts that calf scours can have on an enterprise

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1. BACKGROUND

Scours in beef calves has been an ongoing issue for producers for many years. A 1966 study of beef cattle diseases in Victoria noted that over 80% of properties experienced some form of white scour, and on just under 50% of properties this was regarded as a problem[1]. Subsequently 2 PIRD projects have been carried out on this topic, but unfortunately yielded few answers to the producers involved. Studies from overseas have shown that calf scours is a major cause of economic loss to beef producers and although research has been carried out overseas into preventative strategies and control of calf scours, there is little Australian research that documents the impacts of this disease on beef enterprises, or demonstrates preventative and treatment strategies to minimise this impact. This study was commissioned after beef scours was identified as an ongoing issue to some producers.

2. PROJECT OBJECTIVES

The aim of this project was to compile and assess all available knowledge on calf scours in the Southern Australian beef industry in order to define the impact this disease is this having on beef producers, determine the common pathogens involved and identify where there are gaps in our knowledge across all aspects of diagnosis, control and treatment. The outcome is to recommend where further research, extension and product development is required.

These goals were achieved by collating information using the four-part process outlined below.

2.1. Producer surveys

An initial short survey was published in Feedback magazine that was designed to gauge the severity of calf scours that some producers were suffering, and obtain a basic understanding of the approaches they had taken to remedy the problem. A second more detailed survey of willing respondents was then carried out to acquire information on the demographics of the respondents and the risk factors on their farms. This survey also obtained information on the epidemiology of the disease, the management of affected calves, and the producers' perspective of the economic impact that the disease had on their enterprise.

2.2. Survey of cattle veterinarians

A notice was published in the Australian Cattle Veterinarian asking for veterinarians that were willing to respond to a survey on calf scours in their district and if possible provide any diagnostic results that they had collated. Questionnaires were sent to respondents, and also to practices in major beef areas where practitioners had not volunteered to participate in the survey. This ensured that all major beef producing areas in Southern Australian were included.

Practitioners were asked to provide details of the beef enterprises in their district and an overview of how calf scours affected these enterprises. Information was also collected on the range of morbidity and mortality that they were presented with and the approximate numbers and types of pathogens that had been diagnosed in their practices in the previous 5 years. They also provided information on the management changes and treatment regimes that they recommended. Finally they were asked for their opinion on further research, extension and product development that needs to be carried out on this topic.

2.3. Survey of veterinary laboratories in southern Australia

Veterinary laboratories in southern Australia were telephoned to obtain information on the number of calf scour samples that they processed each year and the tests that they would routinely perform on these samples. Information was also obtained on the ease of collation and analysis of their records.

2.4. Collation of laboratory data

Calf scour data was collated and analysed from information provided jointly by Intervet and the DNRE (now DPI) laboratory at Bendigo, from the DPIWE Mount Pleasant Laboratory in Tasmania, from Agriculture WA - Animal Health Laboratories and from the Regional Veterinary Laboratories in New South Wales.

3. RECOMMENDATIONS - IMPROVING THE APPROACH TO CALF SCOURS IN AUSTRALIA

The predisposing factors, causes and management of calf scours in cow calf enterprises is poorly understood by producers and veterinarians. A whole of industry approach is required to ensure clear and consistent advice, together with structured systems to minimise the impact of this problem. This program needs to encompass producers, farm advisers, veterinarians and veterinary pathology laboratories and could be structured on similar but larger programs already ongoing in the dairy industry. The program or projects should achieve the following deliverables:

3.1. Establish key management strategies at the herd level to minimise calf scours

A significant amount of research has been carried out overseas on management of cows and calves to minimise the impact and transmission of enteric pathogens. Much of the initial work was carried out in Canada in the 1970's and 1980's[2]. However little structured research has been carried out in Australia to demonstrate best practice management to minimise calf scours in cow calf operations, and consequently there are few consistent recommendations for producers.

An extensive literature search is required looking at both overseas research in the beef industry, and also the dairy industry both overseas and in Australia. From this a set of standard recommendations that can be expected to work under Australian conditions can be compiled. Many of the recommendations should be based on the first principles of disease control.

These recommendations should include management of cows from prior to calving until the calves are four months of age, and should have a significant emphasis on the peri-parturient period. Different management strategies that can be used for different enteric pathogens must be considered and this will lead to increased benefit from diagnostic tests. The recommendations should also address biosecurity at a herd level, and specifically target purchasing calves to replace dead calves, or to run as additional calves on a dam. Indirect methods of transmission such as flies and ducks should be included in a biosecurity review. Methods of decontaminating areas where affected calves have been run also needs to be addressed.

Having established a set of standard management procedures, it may be appropriate to test the most significant of these using case control studies.

3.2. Develop a scoring system that will improve definition of the problem on farm

The current study showed that some farmers have a high proportion of calves affected with very little or nil mortality. On other farms more calves died than were reported affected with calf scours. Whilst recognising that different pathogens will have different presentations, at present there is not a standard definition of a scouring calf accepted within the Australian cattle industry.

In order to minimise the confusion in the industry and to better recommend when treatment strategies and management controls should be applied, it is necessary to establish case definitions for Australia. These definitions need to be at an individual and outbreak level and consider the age group of the affected calves.

3.3. Recommend appropriate, affordable and reliable standard diagnostic procedures and pathways on farm and at the laboratory, including establishment of the role of post mortems

At present there is a large variation in the number of samples that are submitted to laboratories and the testing protocols carried out. To a large part this has been determined by cost factors, however all states except Victoria at present have some degree of subsidisation, at least for major disease outbreaks where deaths are occurring.

Standard protocols and diagnostic decision trees need to be determined that addresses the following issues:

- the appropriate number of faecal samples that should be submitted
- the amount of faeces that should be submitted and whether swabs are acceptable
- the appropriate calves to sample with respect to stage of infection and the benefits of sampling unaffected animals in the same group
- opportunities to pool samples to minimise costs whilst still achieving satisfactory diagnoses
- the sensitivity and specificity of the tests used
- the role of post mortems -how many and what are the appropriate samples
- is a post-mortem alone an appropriate test or should faecal samples be submitted from others in the group?
- appropriate testing strategies for different age groups
- the benefits of routinely running a complete panel of diagnostic tests to determine if there are multiple pathogens involved
- standardisation of serotyping of E. coli including identification of fimbrial adhesins to differentiate pathogenic E. coli and allow accurate interpretation of results.
- the inclusion of ELISA tests for coronavirus and bovine torovirus
- The role and efficacy of "calf-side" dip-stick assays both at the laboratory and veterinary practice level

These issues need to be addressed both from the aim of being able to come to a reliable diagnosis for the majority of cases, and to ensure there is economic benefit to the producer from the diagnostic work-up. Some of this information is already available in standard texts and advice from veterinary laboratories, however it is generic advice and there would be a huge benefit in compiling it into a document that addresses the specific issue of calf diarrhoea.

Having established appropriate diagnostic protocols it is also important that all laboratories are working to the same standards. The development of a national diagnostic test certification scheme would ensure producers get value for money and provide quality assurance for export markets. In this scheme aliquots of the same sample would be sent to each of the laboratories for testing and the results of testing compared to check for consistency between laboratories. This scheme should have a broader outlook than just faecal samples – for instance semen testing, and work within the framework of the current NATA accreditation scheme

3.4. Recommend standards for the interpretation and reporting of laboratory results

Most enteric pathogens are present in the faeces of non-affected animals and there are no industry-recognised guidelines as to how many positive samples are required to confirm that the isolation of enteric pathogens is significant. This needs to the established and standardised.

The other area where there is currently confusion is the isolation of E. coli. When coliforms are not serotyped or tested for adhesins, there is no confirmation that the isolate is pathogenic unless histology is also available. A large number of producers and veterinarians attribute disease to E. coli on the basis of a culture alone. Whilst appropriate testing need to be addressed, interpretation of the result from the laboratory would also be helpful to determine when a culture is significant.

3.5. Establish coordination between industry and state agriculture departments to specifically investigate and establish diagnoses for outbreaks where there is a high mortality rate (suggested level greater than 5%)

The epidemiological information collected from producers and veterinary laboratories have shown that there are a significant number of outbreaks of calf diarrhoea occurring with a high mortality rate. In many cases a conclusive diagnosis as not been established for these outbreaks.

In many states investigation into disease outbreaks is already subsidised when there is high mortality rates. There would be significant industry benefit to target investigation towards such outbreaks and coordinate results across states to determine the aetiology of high mortality events. As well as establishing the causative pathogen it is also necessary to establish whether these outbreaks are solely due to the virulence of the pathogen, or whether recognition and appropriate treatment of affected calves is contributing to the severity of the problem.

3.6. Investigate the role of enteropathogenic attaching and effacing E. coli in calf scours in Australia

EAEEC are associated with disease in calves aged 4 days to 2 months of age and no Australian veterinary laboratory has been routinely testing for the serotypes associated with these E. coli. E. coli is considered a significant pathogen by many veterinary practitioners, especially in older age groups, but the study of laboratory data only yielded one positive diagnosis of EAEEC. If E.coli actually are the cause of disease in older calves it is likely that they are EAEEC. Further investigation is required to establish if known EAEEC serotypes are associated with disease outbreaks in Australia, and determine if other serotypes are consistently associated with disease in calves.

3.7. Establish appropriate treatment protocols

Effective treatment of sick calves is a challenge for many beef producers. In order to improve clinical outcomes it is necessary to document convenient and simple management practices to ensure that calves get an appropriate course of treatment.

Issues that should be addressed include:

- establishment of a treatment decision tree to facilitate recognition by producers of the appropriate animals to treat and the most effective treatment protocols
- simple methods of identification, such as coloured neck bands, so that calves can be identified from one day until the next
- Practical methods of handling mobs of affected calves
- appropriate isolation facilities for affected animals
- criteria for separating the calf from its mother
- protocols for feeding electrolytes and opportunities for extension of these – ie with the fluids when purchased
- improving treatment outcomes by establishing a diagnosis
- the role of oral antibiotics
- appropriate use of injectable antibiotics
- minimising the risk of antibiotic resistance

3.8. Extension of strategies

Having established appropriate protocols and procedures that will minimise the impact of calf scours on Australian beef enterprises and ensure effective procedures are carried out when there is an outbreak, this information needs to be disseminated to farmers, veterinarians and veterinary pathology laboratories where appropriate.

It is likely that the most appropriate format for this will be written guidelines together with best practice procedures and protocols. In order to promote wider industry recognition it may be necessary to run courses for farmers either as a stand-alone program or by providing materials to veterinarians.

Extension is also required to promote recognition by veterinarians and industry of the significant costs and other impacts that calf scours can have on an enterprise.

Any extension program should have a subsequent evaluation program and assessment methods should be considered when the program is designed.

3.9. Industry recommendation: improving disease surveillance

This study involved substantial collation of information from veterinary laboratories and in many cases submissions could not be included because not enough information was available. Moreover in all cases the original submission forms had to be accessed to confirm epidemiological and breed information making data collection slow and expensive. Some laboratories did not have a good enough retrieval system to make collation of any reliable data cost effective. The problem is three-fold

i) Veterinarians are not providing enough information when submitting samples

ii) Some submission forms do not request appropriate information. In the current study the focus was the beef industry and some laboratory forms do not have the proviso to differentiate breed or industry

iii) Laboratories are using different computer systems, with different and often incomplete information stored on them, and varying abilities to export this information into other formats.

Effective and efficient disease surveillance should be a major priority for the Australian animal export industries. For this to occur standardisation of submission forms for production animals is essential, together with recognition by veterinarians of the importance of providing epidemiological details. This needs to be combined with effective and complete recording in a standard format across all veterinary laboratories to allow for the rapid and efficient collation of national disease data.

4. REVIEW OF PREVIOUS MLA RESEARCH

Over the past ten years two Producer Initiated Research and Development (PIRD) projects have been carried out on calf' scours.

4.1. 93/N17 Tallangatta study number one

The first study was carried out in Tallangatta into the effectiveness of E. coli vaccination (Bovac) in 1995. The project also studied the organisms causing scours in calves to weaning in the Albury/Wodonga region and assessed the impact that calf scours was having on reducing efficiency from herds in North East Victoria and Southern NSW.

4.1.1. Vaccination trial

1300 cows on 10 farms were used in a vaccination trial where every second cow or heifer was vaccinated. Cows were vaccinated six weeks before planned start of calving and again 4 weeks later. Sixty-six scouring calves from both vaccinated & unvaccinated dams were sampled using faecal swabs. ETEC is most likely to affect calves aged less than 7 days of age, however no faecal swabs were taken from calves in this age group in the unvaccinated group and only three from the vaccinated group. *E. coli* was isolated from twice as many calves from the unvaccinated group (19 vs. 9) in calves eight days and older, however no serotyping was carried out. This decrease may be attributable to the vaccine, but is unlikely to result in variation in clinical disease. The Bovac vaccination specifically aims to prevent enterotoxigenic *E. coli* with the K99 antigen from affecting calves in the first week of life. This pathogen may be isolated from older animals but it is not pathogenic unless there is immune suppression.

The only isolates reported from the faecal swabs were *E. coli*, cryptosporidia, and rotavirus, with some *E. coli* and cryptosporidia being isolated from the same faecal swab.

Table 1: Analysis of all faecal swabs taken from farms during first Tallangatta study

Total	E. coli	Rotavirus	Cryptosporidia	E. coli & cryptosporidia	Nil
66	28	6	16	12	15

Although information on the number of calves affected and treatments used should have been collected little information is provided in the final report on the range of morbidity and mortality between farms or between vaccinated and unvaccinated animals. We are told that the incidence of severe scours (those requiring treatment) was around 15 percent of all calves in the trial and deaths due to scours were approximately 4% of all calves.

An analysis of 150-day liveweights of 73 calves showed no significant difference between the vaccinated and unvaccinated calves. Faecal swabs from this farm indicated that their primary problem was cryptosporidia. No other weights were collected and although the protocol for an economic analysis was set up no figures were presented in the final report.

4.1.2. Producer survey

A survey was conducted in the Tallangatta Valley in 1995 following a season of acute calf scours in autumn 1994. Both beef and dairy properties were included, however no indication of the number of properties surveyed is given.

The percentage of calves reported to be affected by scours in 1994 varied from 2% to 90%. Most calves affected with acute scours were between 5 days to three weeks of age.

From samples that had been taken it was concluded that in that area:

- *E. coli* was less responsible than the other organisms as a cause of scours
- verotoxin-producing *E. coli* may be contributing scours

- *Salmonella* spp and possibly Cryptosporidium spp are more likely to be the causes of microbial scours
- parasitic scours may be responsible

Diagnostic tests were slow, generally taking longer than one week, and often inconclusive

Farmers noted that calves born early in the season were responsible for infecting later calves, and the later calves were much slower to respond to treatment or died. This was especially the case on dairy farms.

The producer survey indicated that the 1994 calf scour outbreak in that district could be related to or associated with:

- the abundance of good quality green summer feed prior to the autumn calving period
- a lack of shade and a long distance for calves to travel to water
- poor vaccination programs for clostridial diseases and leptosporosis
- first calf heifers
- introduction of stock, especially introduction of calves to replace dead calves
- extreme heat, wet or windy days followed by thunderstorms

It was also noted that incidence of calf scours was minimised by:

- the application of lime to the paddocks which pregnant cows had access to
- running pregnant cows in sheep paddocks or bush paddocks before calving

4.1.3. Treatments used

Several farmers reported not using any treatment at all and veterinary advice was usually sought only for stud calves. It was noted that veterinary advice from different sources varied.

Mild scours were treated with tablets and electrolytes, more serious cases by tablets electrolytes and injectable antibiotics. Acute scours were regularly treated with IV fluid therapy and antibiotics, but still resulted in a number of deaths. It was noted that in beef herds early intervention can be difficult, and late treatment resulted in increased treatment cost.

The dose of electrolytes used varied and it was suggested that the recommended dose on the pack may be too low. It was also reported that antibiotics had very little or no effect. This statement referred to injectable antibiotics as it was also noted that the use of tablets together with electrolyte replacement was most beneficial.

Treatment was frustrating, as animals that responded to initial treatments with electrolytes would become sick again.

It was recommended that farms affected by scours should routinely collect and analyse faecal swabs, but post-mortem examination of untreated acutely affected animals is the best diagnostic tool. Faecal swab samples can be difficult to interpret because of mixed infections.

4.2. 96/V04 Tallangatta study number two

This study in 1999 was a 4 way trial looking at *E. coli* vaccination and selenium injection prior to calving. It also aimed to determine the causative organisms for scours in calves less than four weeks of age, to devise management strategies to maximise calf survival during the first four weeks, and to assess the impact of calf scours on herd efficiency.

Twenty-seven percent of the 431 calves born on the three farms during the monitoring period had some degree of scours, with the herd incidence varying from 20 to 32 percent. There was no significant difference between any of the treatment or control groups.

Marginal selenium deficiency was only diagnosed on one farm, although only 4 cows were sampled on each property. On the marginal property there was no significant difference between selenium treated and non-treated animals. However it was also noted that the dose of selenium given was half that recommended by the manufacturer.

There was no benefit shown by *E. coli* vaccination, however *E. coli* was not cultured from any of the farms and was probably not the cause of calf scours on these farms.

Faecal samples from three farms were tested for rotavirus, coronavirus, *Salmonella*, *Yersinia* and pathogenic *E. coli* strains, however the only organisms isolated were cryptosporidia. No information was given as to the number of samples from which this was cultured, or the age of the calves from which this was isolated. In the conclusion is the project coordinator commented that the presence of cryptosporidia were inconclusive, however this statement was not explained.

There was no significant difference in the 300-day weights of scouring and non-scouring calves.

4.3. 99V07 Proposed Pakenham Study

The Pakenham Beefcheque group also applied to run a PIRD project on calf scours. Its aim was to increase the understanding of the group of the major factors that affect calf health and survival during the first few months of life, and to specifically investigate whether poor transfer of maternal immunity is an important factor for the early health and performance of beef calves as they are managed on the farms in that district. However the project did not take place as the group and their advisers were unable to agree on methodology.

5. PRODUCERS EXPERIENCE WITH CALF SCOURS - PRELIMINARY QUESTIONNAIRE

5.1 Methodology

A short survey on calf scours was published in Feedback magazine in February 2003. The aim of this questionnaire was to gauge the level of interest among beef producers and give a brief overview of their experience with calf scours. Information was collected on the size of the enterprise, the number and age groups of calves affected, treatments used and their perspective on the significance of calf scours to their enterprise

5.2. Results

Seventy-six producers responded to this questionnaire; forty-eight considered calf scours to be a major problem in their enterprise, 21 considered it a minor problem, 4 enterprises had no problem with calf scours and 3 properties had previously experienced a problem.

5.2.1. Demographics

Thirty-one respondents were from Victoria, 20 from New South Wales, 10 from South Australia, 10 from Western Australia, 3 from Queensland and 2 from Tasmania.

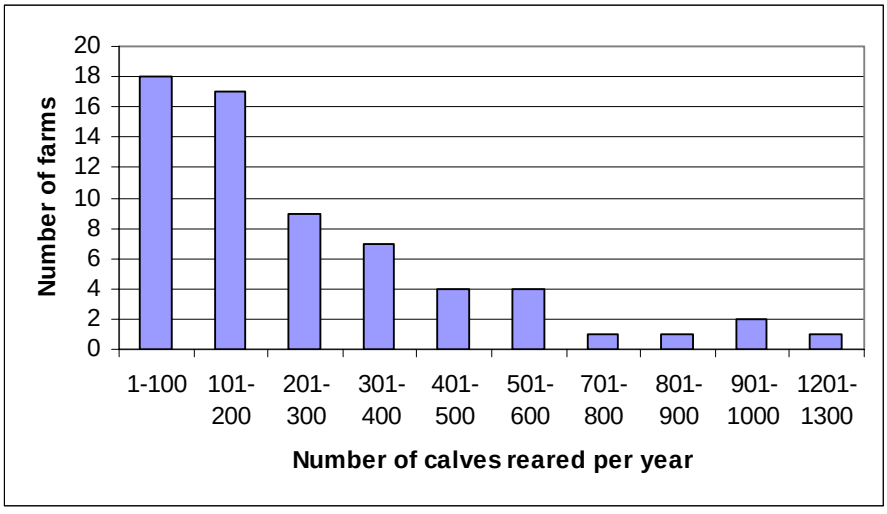
Sixty-seven of the respondents had a cow calf enterprise, 4 were calf rearers, and 5 participated in both types of enterprises. One of the latter purchased dairy – cross heifer replacements as calves to rear on cows and it was only in the purchased calves that there was a problem

The four calf rearing properties included one white veal operation that raises 12,500 calves a year, and another farmer who raises six calves at one time. Due to the small number of these operations and the large discrepancy in the type of their operation subsequent analysis was only carried out on the sixty-seven cow calf enterprises.

Two of these were in Queensland, one was within 10 kilometres of the New South Wales border and the other within 40 km of the border, both in the Warwick area. Due to their proximity to NSW it was decided to include them in the data analysis.

Eighteen farmers (28%) raised 100 calves or less, 17 (27%) farmers raised between 101 and 200 calves a year, twenty farmers (31%) raised between 201 and 500 calves a year, eight farmers (12%) raised between 501 and 1000 calves per year and one farmer raised 1300 calves a year.

Figure 1: Number of calves reared per farm per year



Stocking rates varied from 0.5 to 32 DSE per hectare for the 61 respondents that provided this data. Fifty-four producers had one calving period a year and 13 producers had two. Only three producers calved all year-round. Producers were asked in which months they calved their cows, and these were grouped into spring (August to November), summer (December and January), autumn (February to May) and winter (June and July). 71% of producers calved cows in autumn and 56% in spring. The distribution of farmers calving in each period for each state is shown Table 2.

Table 2: Distribution of calving period by State (number of farms) τ

State	Spring	Summer	Autumn	Winter
NSW	18	1	11	8
QLD	2	1	1	1
SA	2		10	
TAS	2			1
VIC	13	3	16	6
WA	1	1	9	1
Total	38	6	47	17

τ total number is greater than the number of farms involved in the survey due to farms having more than one calving period, or they calving period overlapping two or more seasons

5.2.2. Producers experience with calf scours in cow calf enterprises

Forty-two producers considered calf scours a major problem, 19 a minor problem, 2 had previously had a problem and thirteen producers did not consider calf scours to be a problem on their properties. Seventy-six percent of producers (n=51) had consulted their veterinarians with this problem. However 14% of producers (n=6) who considered this a major problem had not consulted their veterinarian. Both producers who had previously had a problem with calf scours had consulted their veterinarian.

Thirty-seven percent of producers (n=25) reported some calves affected within five days of birth. Seven producers had between 30% and 50% of their calves affected and 1 producer reported 90 percent of their calves affected at this age.

Sixty percent of producers (n=40) had calves affected between 6 - 21 days of age. Eleven producers had between 30% and 50% of their calves affected, with 1 producer reporting 70% of calves affected and another 100% of calves affected at this age. However, in the latter case mortality rate was zero.

Sixty three percent of producers (n=42) reported calves affected between three and six weeks of age. Three producers had between 30 and 50% affected, and five producers had 50% or more affected. However no producers described the extreme numbers reported in the younger age groups.

Thirty one percent of producers (n=21) had calves affected between 7 and 16 weeks. In general this age group was less of a problem, but there was still one producer with 50% of his calves affected and another producer with 65% affected

Table 3: Numbers of farms with calves affected in each age group

Percent affected	Age of Calves Affected			
	0-5 days	6-21 days	3-6 weeks	7-16 weeks
0%	42	27	25	46
0.1 - 5%	14	9	12	11
5.1 - 10%	3	8	8	5
10.1 - 15%	0	1	3	0
15.1 - 20%	3	9	4	2
20.1-30%	3	4	7	1
30.1 - 50%	1	7	3	1
> 50%	1	2	5	1

5.2.3. Mortality rates

Seven producers (10%) lost more than 5% of calves in one or more age groups.

Twenty-five percent of producers (n=17) lost calves from scours within five days of birth. (Table 4) Two producers had a mortality rate greater than 5%.

Forty-two percent of producers (n=28) lost calves between 6 - 21 days of age. Four producers had a mortality rate greater than 5%.

Forty-three percent of producers (n=29) lost calves between three and six weeks. Four producers had a mortality rate greater than 5%.

Nine percent of producers had calves die between 7 and 16 weeks. This age group was not as badly affected with no more than 2 percent losses.

Table 4: Mortality rate in different age groups (number of farms)

Percent affected	Age of Calves Affected			
	0-5 days	6-21 days	3-6 weeks	7-16 weeks
0%	50	39	38	61
0.1-2%	12	17	17	6
2.1-5%	3	7	8	0
5.1-10%	2	4	4	0

5.2.4. Isolates from faecal samples

Faecal samples had been carried out on 20 farms with pathogens had been isolated on 18 farms, 16 of which considered that they had a major problem with scouring calves, and one farm that had previously had a problem. Only farms in NSW, Vic and WA reported that they had taken faecal samples. The most common isolate was *E. coli* (n=14) followed by coccidiosis (n=8) and rotavirus (n=6) (Table 5). More than one pathogen had been isolated from faecal samples on 11 farms. *E. coli* and coccidiosis were isolated together on 7 farms, and in 6 of the 7 properties where rotavirus was isolated *E. coli* was also cultured. On 2 farms all three of these pathogens were isolated together with *Salmonella*. *E. coli*, rotavirus and coccidiosis had been isolated in all three states, all 4 cryptosporidia isolates were reported from Victoria, and both *Salmonella* isolates from New South Wales.

It is not possible to draw significant conclusions relating pathogen isolated to the age of the calves affected. This is partially due to the small number of farms that reported isolates and also because in this short survey we did not enquire at what age the samples had been taken and many farms had calves affected across several age groups. As a general rule the relationship between isolates and age group followed the trend that would be expected from their pathogenesis. However *E. coli* was most commonly isolated on farms that had calves affected between five days and six weeks. There was little association between *E. coli* isolation and calves affected at less than five days and no association between *E. coli* isolation and high mortality at less than five days. As *E. coli* was mainly isolated on farms in conjunction with another pathogen it is likely that it was not the primary cause of the scours.

Table 5: Number of farms reporting culture of major pathogens

Pathogen	Number of isolates[φ]
E. coli	14
Rotavirus	6
Coronavirus	0
Cryptosporidia	4
Coccidiosis	8
Salmonella	2
Yersinia	0

[φ] total number greater than total number of farms due to multiple isolates on many farms

5.2.5. Use of vaccination

Five producers used *E. coli* vaccination in their cows and only one used a *Salmonella* vaccine. Sixty three percent of producers (n=42) vaccinated for Clostridial diseases +/- Leptospirosis. The producer that vaccinated for *Salmonella* also vaccinated for *E. coli*, had isolated both pathogens from faecal samples, and stated that scours was no longer problem on his property. The other four respondents who vaccinated for *E. coli* all considered calf scours to be a major problem on their farm. *E. coli* had been isolated from faecal samples from three out of four properties.

5.2.6. Stocking rate

Cow calf enterprises that considered calf scours a major problem reared between 40 and 1300 calves a year. There was also a wide range of stocking rates. Three of the four producers who considered that calf scours was not a problem on the property had stocking rates less than 0.2 cows per hectare, but 14 properties with a similar stocking rates considered calf scours to be a major or minor problem.

5.2.7. Treatments used

Sixty-nine percent of all respondents used proprietary antibiotic scour treatments in the form of tablets or liquid and 73% used oral electrolytes. Forty-six percent used injectable antibiotics and 19% had used IV fluids. IV fluids were only used by producers who considered that they had a major problem, and were most commonly used when the age group affected was 6-21 days. There was significant association between use of IV fluids and isolation of rotavirus ($p < 0.01$) and *E. coli* ($p < 0.01$). Producers who considered they had a major problem also showed a trend towards using more oral electrolytes compared with those that had a minor problem (81% vs. 68%).

Very few other treatments were reported. One respondent used “red cordial”, another used fresh water and a third used “paddock management”

6. PRODUCERS EXPERIENCE WITH CALF SCOURS - DETAILED SURVEY

The aim of this survey was to better define the scour problem on the respondents' properties and to determine more specific information on management strategies and how they might relate to the problem. Information was also collected on the range and success rate of treatment strategies employed, as well as the interaction the producer had with their veterinarian regarding calf scours. The majority of the respondents to the first farmer survey were from cow-calf enterprises, therefore it was decided to confine a more detailed study to these farms.

6.1. Methodology

A comprehensive telephone survey was designed and 60 of the 76 respondents from the first farmer survey participated. Twelve of the original participants declined to participate in any further survey and four were calf rearing enterprises. Most of the information collated is descriptive details on management practices, the scour problem on the farm, and various treatment and preventative strategies.

Information on the number of calves affected was collected for different age groups. Age groups were selected that were likely to relate to possible pathogens. The percentage of animals affected in each age group was calculated by taking the number of cows calved minus the expected 0-48 hour death rate as the initial denominator. For each age group apart from the youngest, the number of animals known to have died in the preceding age groups was subtracted from the initial denominator. In order to compare different age groups the prevalence was converted to an attack rate, which equates to the prevalence per week. Farms were then grouped according to the maximum attack rate in any age group into low attack rate (< 5%, n=32) and high attack rate (≥5%, n=25) herds. The two groups of herds were compared against the presence or absence of a range of specific management factors using Fisher's exact test[3] in order to show any relationship that existed.

6.2. Results

6.2.1. Herd demographics and management practices

Twenty-five respondents were from Victoria, 16 from New South Wales, 8 each from South Australia and Western Australia, 2 from Tasmania and 1 from the Warwick area of Queensland. Forty-four of the respondents considered calf scours to be a major problem on their farm, 12 respondents considered it a minor problem and 4 respondents either had no problem or no longer had a problem.

Twenty-three enterprises supplied the feedlot industry, 20 produced vealers, 13 sold their stock as stores, 8 sold replacement heifers, and 22 had other markets for their cattle. The main breed of cattle on the respondents enterprises were Angus cattle represented by 21 farms, 21 farms had crossbred cattle, 7 Hereford, 5 Murray Grey cattle and the rest of the farms ran Limousin, Charolais, Shorthorn and Friesian cattle.

The number of breeders on the enterprises concerned varied from 46 to 1300 with a median of 240 (Figure 2). Twenty-six farmers had increased the number of breeders by more than 20 percent in the last three years, on 23 farms the number of breeders had stayed the same, and on 11 farms the number of breeders had decreased by more than 20 percent. Fourteen farmers that had increased their number of breeders had also increased their stocking rate, and 12 farmers had kept their stocking rate the same. Six farmers that had decreased their number of breeders had also decreased their stocking rate, 4 farmers had kept their stocking rate same and 1 had increased their stocking rate. The majority of farmers (n=43) had a stocking rate of eight DSE/ha or less, a further 15 farmers had a stocking rate of 8 - 16 DSE/ha and two farmers had a stocking rate of 32 DSE/Ha.

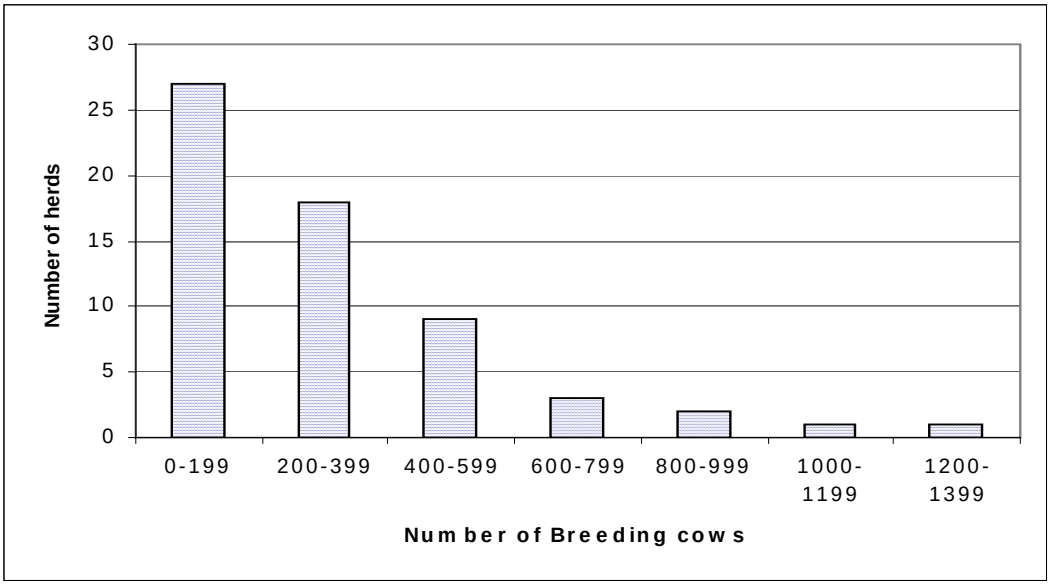
Twenty-six herds calved in spring, 2 in summer, 39 in autumn and 14 in winter. The calving percentage of the herds varied from 53% to 102% with a mean of 92% and median of 94%. Forty-five herds (75%) routinely pregnancy tested their cows.

Less than 5% of calvings were assisted in 56% (n=34) of herds, between 5 and 10 percent of calvings were assisted in 33% (n=20) of herds, and six herds assisted in excess of 10% of calvings. Mortality rates

at or within 48 hours of calving were generally low with 36 farmers reporting that less than 2% of calves were lost at this time. Twenty-two herds lost between 2% and 5% of calves and 2 herds lost between 5% and 10% of calves. Forty-two percent of herds were easy calving with less than 5% of cows having an assisted birth and a less than 2% mortality rate.

Figure 2: Variation in the number of breeding cows between survey respondents

Herd Management



The weaning percentage of 50 herds for which that information was available varied from 75% to 107% (mean 96%, median 96%). For the 8 herds that had not yet weaned their last drop the branding percentage varied from 79% - 100% (Mean and median = 90%).

Thirteen farmers purchased calves or unmated heifers, and a further 6 had purchased some calves in the preceding year to foster onto cows. Seven farmers routinely purchased mated heifers and 9 purchased adult cows. Thirty-five farmers did not purchase any additional breeding stock or calves to foster.

6.2.2. Management of cows and calves

6.2.2.1. Calving Management

Forty-two respondents had a set calving paddock or paddocks and 17 rotated their calving paddocks. Fifteen farms had less than 10% shelter from the prevailing wind in their calving paddocks, three farms had no shade, and 18 farms had only the occasional tree to provide shade. Seven farms had calving paddocks that were wet more than 50% of the time, 29 farms had calving paddocks that were never wet and on the remaining farms the calving paddocks were wet in inclement conditions. Seven respondents vaccinated against *E. coli* and two against *Salmonella*

6.2.2.2. Colostrum management

Thirteen farmers supplemented their calves with colostrum or colostrum substitutes, however not one of them tested the quality of the colostrum and only one farm had checked the effectiveness of colostrum transfer by blood testing calves to check for antibody or serum protein level.

6.2.2.3. Management of cows with young calves

Two-thirds of farms (n = 40) use the same paddocks for cows with young calves every year. On thirteen farms less than 25% of paddocks where cows and calves are run are sheltered from the prevailing winds. Twenty-one farms had more than 75 percent of paddocks sheltered from the prevailing wind. Fifty-eight farms had water available in all paddocks but on 11 farms there were obstructions preventing the calves

from drinking. On 29 farms there was less than 200 m between shade and water, on twenty-six farmers this distance was between 200 and 499m and on five farms this distance was greater than 500 m.

6.2.2.4. Nutritional management

Forty farms are used a rotational grazing pattern (either rotational, cell grazing or strip grazing), 12 farms set stocked and 7 farms used a combination of both.

The majority of farms (n=47) supplemented their herd with some hay, although in most cases (n=28) this was only between 1-50 kg/DSE /year, 13 farms supplemented with silage and 7 with grain. Most farmers (n=44) did not routinely condition score their cows.

Mineral deficiencies had been tested for on 18 properties in the last 10 years. Five properties were shown to be deficient for copper, cobalt and selenium, 7 properties were shown to be deficient in selenium only, 1 property was deficient in copper and another in cobalt. A total of 37 herds supplemented with minerals, and 22 herds supplemented with more than one type of mineral. Twenty-four herds supplemented with selenium, 22 with copper, 21 with cobalt and 16 with magnesium.

6.2.2.5. Other diseases

Although other diseases were prevalent in the study herds they were generally at a low level. Twenty-five herds experienced grass tetany, but in the majority of cases (n=21) less than 5% of the cows were affected. Twenty-eight herds had cows go down with milk fever, but this incidence was less than 5% in 27 of the herds. Twenty-one herds had calves with pneumonia, but in 20 herds less than 5% of calves were affected, 26 herds had calves with infected navels and 22 herds in calf with joint ill. Twenty herds whose calves were affected by calf scours had no other disease problems in their calves, nor did the two herds that did not have problems with calf scours.

6.2.2.6. Preventative measures

Vaccines are currently available for *E. coli* and *Salmonella*, and a rotavirus vaccine was available until it was withdrawn in the late 1990's. Of the 57 farms that reported a problem with calf scours 7 respondents vaccinated against *E. coli* and two against *Salmonella*. Neither of the properties that vaccinated for *Salmonella* had had *Salmonella* isolated from faecal samples, and the two properties where *Salmonella* was isolated did not vaccinate.

Only 3 of the properties that vaccinated for *E. coli* had had *E. coli* isolated. Of these respondents only two thought that vaccination had resulted in lower morbidity and mortality from scours in their calves. None of the other respondents that vaccinated for *E. coli* had seen any benefit from the vaccine. The reasons given for not vaccinating against *E. coli* by six respondents that had had *E. coli* isolated on their property were as follows

- had discussed the possibility with their veterinarian but didn't think the problem was severe enough to warrant it (2 respondents),
- too expensive
- had tried vaccinating but results not good enough to warrant the time and expense, plus timing was a problem before calving
- not had a problem since
- did not feel the *E. coli* was the sole cause for the problem, other factors need fixing first.

Only 2 respondents had vaccinated for rotavirus when that vaccine was available, one of these respondents had felt this was beneficial.

6.2.2.7. Calf scours on the survey farms

Respondents were asked to provide the number of calves that had scoured in the most recent calving period for the age groups 0-5 days, 6-21 days, 3-6 weeks and 7-16 weeks. Because the calves and their dams are often all run together as one mob, many farmers found it difficult to be specific on the ages

affected. Three farmers were unable to provide precise numbers and so the following information is from 57 properties. The majority of farms had calves affected in the 6-day to six-week period, although on one third of farms calves were affected in the first 5 days of life and a similar proportion had calves affected at 7-16 weeks of age. Only 3 farms had calves that were affected when they were older than 16 weeks. Sixteen farms had a prevalence of 20% or greater in one or more of the age groups, and 19 farms had a mortality rate > 2% from 0 to 16 weeks. The mean, median and range of prevalence and mortality rate for each period for the 57 farms that provided data are shown in Table 6. The age at which clinical signs were first observed are shown in Table 7.

Table 6: The prevalence of calf scours and associated mortality rates for each age group

Prevalence	**0-5 days**	**6-21 days**	**3-6 weeks**	**7-16 weeks**	**>16 weeks**
Mean	4.2%	12.1%	8%	2%	0%
Median	0%	5.5%	4%	0%	0%
Max	94%	96%	52%	25%	3%
Min	0%	0%	0%	0%	0%
Number herds affected	19	41	45	17	3
% Herds Affected	33%	72%	79%	30%	5%
Mortality rates					
Mean	0.3%	1.0%	0.6%	0.2%	0.0%
Median	0.0%	0.0%	0.0%	0.0%	0.0%
Max	5%	9%	6%	7%	0%
Min	0%	0%	0%	0%	0%
Number herds affected	12	28	20	5	1
% Herds Affected	21%	49%	35%	9%	2%
Number of herds with mortality > 2%	2	9	5	1	0

Table 7: The age at which calves first showed signs of scours on the 57 properties

Age signs first seen	**Number of farms**
0-5 Days	19
6-21 Days	22
3-6 Weeks	11
7-16 Weeks	3
Don't have a problem	3

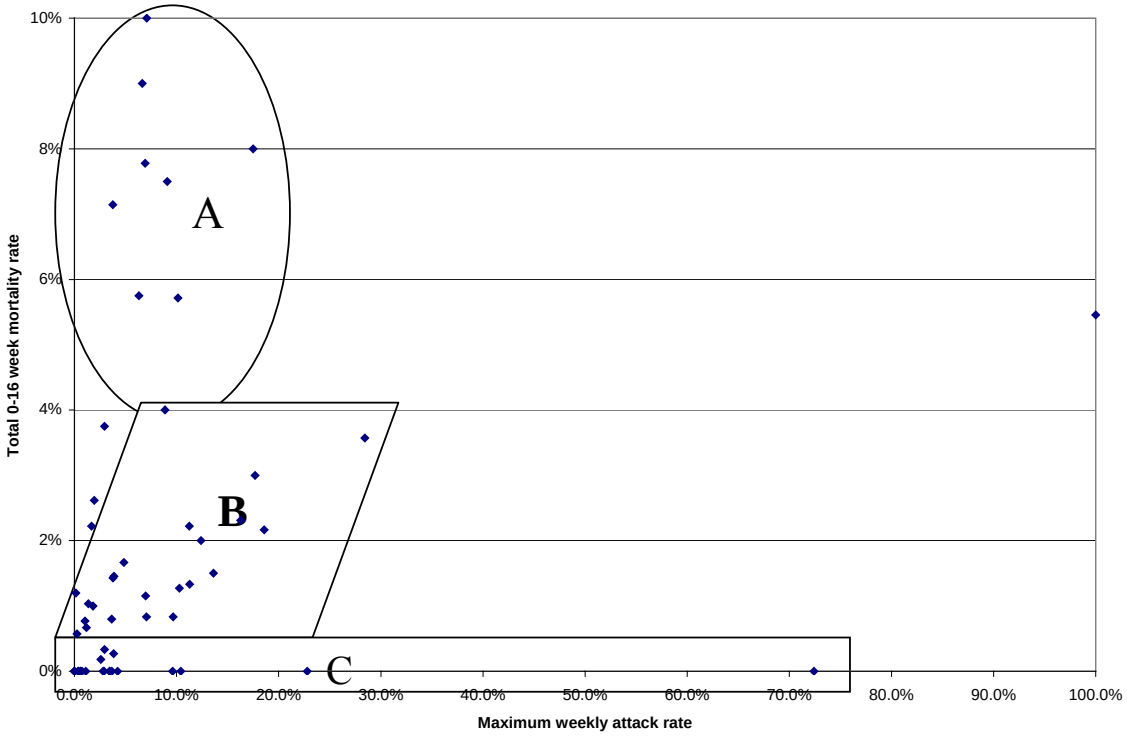
In order to compare the different periods the attack rate was calculated for each week. Between 0-5 days 12 herds had attack rates greater than 5%, from 6-21 days 16 herds had attack rates greater than 5% and from 3-6 weeks 8 herds had attack rates greater than 5%. The range of attack rates for each age group is shown in Table 8.

Table 8: Mean median and distribution of attack rate between herds in each of the different age groups

	Age of calves			
Attack rate	**0-5 days**	**6-21 days**	**3-6 weeks**	**7-16 weeks**
Mean	5.3%	5.3%	2.6%	0.2%
Median	0.0%	2.4%	1.4%	0.0%
0%	38	16	12	43
0.1-5%	7	25	37	14
5.1-10%	4	6	5	
10.1-15%	4	4	2	
15.1-20%	2	3	1	
20.1-50%		3		
>50%	2			

When this is plotted against the total mortality for the 0-16 week period it can be postulated that there are several different presentations of calf scours (Figure 3). However this also demonstrates that there is likely to be a large range in the definition of calf scours. Area A outlines outbreaks of calf scours that are observed to have a high mortality compared to the attack rate. This may indicate severe illness, or a failure to recognise symptoms early enough resulting in a high mortality. Area B shows a strong positive correlation between attack rate and mortality corresponding to a classic disease pattern. In general neither mortality nor attack rate are very high in this group. Area C shows cases of calf scours with no mortality. In these herds that attack rate can be high, in this case in excess of 70%, but there is little or no mortality. This is possibly a nutritional scour or self-limiting disease, however the question must be asked if these are just animals with loose faeces due to lush grass.

Figure 3: The maximum attack rate (In weeks) compared with the total mortality rate for the 0-16 week period.



Affected calves showed a variety of symptoms, with the most common ones being dehydration, watery faeces, soft faeces and lethargy. The range of signs observed and the frequency of their occurrence are shown in Table 9.

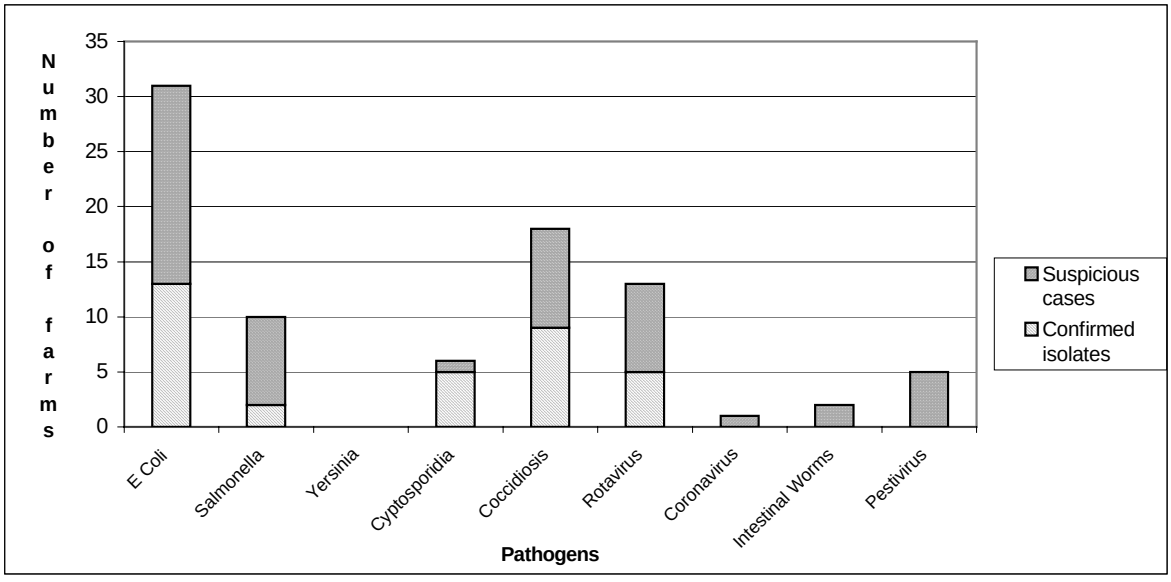
Table 9: Common symptoms observed in scouring calves and the number of farms they were observed on

Blood in faeces	31
Coughing	5
Death	43
Dehydration	53
Distended Abdomen	18
Kicking at Belly	13
Lethargy	50
Panting	22
Soft Faeces	50
Straining	26
Watery diarrhoea	52

The pathogens on the survey farms:

Twenty-five of the sixty respondents had had faecal cultures carried out on their farms. A veterinarian had recommended that samples should be taken on a further 9 farms but this had not been done. Pathogens had been isolated from 18 farms and 10 of these farms had had multiple pathogens isolated. Two of the 18 farms knew that a pathogen or pathogens had been isolated but could not remember what. The total numbers of each pathogen isolated from the 16 farms are shown in Figure 1. Farmers were also asked if they were suspicious of particular pathogens even if nothing had been isolated or if tests had not been done. Twenty-three farmers were suspicious of a specific pathogen or pathogens and these are also shown in Figure 4.

Figure 4: The number of farms with confirmed isolates from faecal samples or suspicious cases of each pathogen



E. coli was the most common isolate and was found on 13 farms, however on it was isolated from all 10 farms with multiple pathogens. The other pathogens were mainly coccidia (9 farms) and also cryptosporidia, rotavirus and Salmonella. Although one farmer was able to relate different isolates to different years and distinguish the numbers affected, the majority of farmers attributed the same outbreak to multiple pathogens. The mean percentage of calves affected in 8 known multiple pathogen outbreaks was 14% (Median 11%, range 0.3-35%) and the mean mortality rate was 3% (Median 3%, range 0-10%). Apart from E. coli the only other single isolate was Cryptosporidium, The three farms affected reported a morbidity of 16%, 21% and 100% and a mortality of 8%, 8% and 1% respectively.

6.3. Factors that predispose to calf scours

Farms were divided into high and low prevalence farms on the maximum weekly attack rate across the first 16 weeks of life. High attack rate farms had a maximum attack rate > 5% for one or more weeks of this period. Management factors that might influence calf scours were compared between the 25 high farms and 32 farms that had an attack rate less than 5% per week using the McNemar's test to compare proportions.

A high attack rate was strongly associated with spring calving (71% vs. 24%, $P < 0.001$). Attack rate was also higher in herds where grass growth coincided with calving (65% VS 29%, $P < 0.05$). It is likely that the latter is a reflection that the problem is much more common in spring calving herds. A low attack rate was associated with fertiliser application in the summer (18% VS 0, $P < 0.05$).

Within the limits of the accuracy of the data and the number of herds surveyed no association could be shown between a high attack rate and the following possible predisposing factors.

6.3.1. At Calving

- calving in the summer, autumn or winter
- colostrum supplementation
- the % of births assisted
- the mortality rate in the first 48 hours
- if the same paddock was used for calving every year
- whether the calving paddocks were rotated or set stocked
- the amount of shelter from the prevailing wind or shade in the calving paddock
- the amount of time the paddocks were muddy at calving

6.3.2. Neonatal management

- the amount of shelter from the prevailing wind or shade in the paddocks where calved were reared
- the distance from shade to water in the calving paddock
- availability or accessibility of water
- water source

6.3.3. Nutritional management

- the stocking rate on the farm
- set stocking or rotational grazing
- grass growth in any specific month of the year

- fertiliser application in autumn, spring or winter
- the feeding of hay, silage or grain
- known deficiencies in copper, cobalt or selenium
- mineral supplementation

6.3.4. Concurrent diseases on the farm

- grass tetany
- milk fever
- calf pneumonia
- joint ill in calves
- naval ill in calves
- diagnosis of pestivirus

6.3.5. Management practices

- castration when less than 16 weeks
- dehorning when less than 216 weeks
- age when first drenched for worms
- change in stocking rate over the past 3 years
- change in cow numbers over the past 3 years
- Purchase of replacement breeding stock
- Purchase of calves to foster onto cows

6.4. Management of sick calves

Respondents were asked about how they managed scouring calves and what treatments they used. Fifty-seven respondents that had a calf scour problem answered this part of the survey. Forty-eight respondents check for sick calves once or twice a day when the calves were young. The remaining respondents check between every second day up to once a week. Twenty-seven respondents had an isolation area for sick calves for sick calves and their mothers. Fifteen farmers do not isolate cows and calves or separate sick calves from their mothers for treatment. Thirteen respondents isolate cows and their calves from unaffected animals for up to 3 days, nine respondents isolate cows and their calves for over three days and some cases for over a week, and a further three respondents isolate cows and their calves until calves have stopped scouring.

A total of 23 respondents separate calves from their mothers for treatment as routine practice, and five separate calves when they are more severely affected. Twelve farmers separate calves from their mothers for up to 24 hours, nine farmers separate calves for 25-48 hours, 4 farmers separate calves for more than 48 hours and a further three separate calves until they have stopped scouring and/or they can stand.

Forty-eight farmers feed calves electrolytes when they are scouring, however only 17 feed more than four litres a day, and seven feed 2 litres or less (Table 10). Four farmers that feed less than 2 litres leave calves with their mothers, but one farmer separates calves from the dams for over 48 hours. Two farmers that separate the calves from the mother do not feed any electrolytes at all. Of the 25 farmers that feed electrolytes when the calf is on the dam at least three of them feed electrolytes solutions containing

sodium bicarbonate and a further eight feed unknown solutions that may contain sodium bicarbonate. Only 4 farmers feed electrolytes solutions containing additional energy.

Table 10: Litres of electrolytes fed per day to scouring calves

Amount of electrolytes/day	Remove from dam		
	No	Sometimes	Yes
<2 L	4		3
2.1-4 L	12	3	9
4.1-6 L	5	1	7
>6 L	1	1	2
Don't feed	7		2

Four farmers do not use any antibiotic treatments for scouring calves, 22 farmers use only oral antibiotic scour tablets or liquids, 7 only use antibiotic injection and 23 use both. The most common antibiotic injections used are trimethoprim sulphurs, oxytetracycline and penicillin. On 21 properties there is significant under-dosing of antibiotic treatments, most commonly because treatment course was not long enough.

The reported recovery rates from farms that provided this information is given in Table 11, however this information could not be related to the severity of disease in the affected animals. It is likely that animals that were not treated were less severely affected and animals given electrolytes, injectable and oral antibiotics were more severely affected. Very few calves were given IV fluids, it was used on 6 properties with between 4% and 25% of calves on each property being treated and in most cases it is likely to be given to severely affected calves. The highest mean recovery rate was achieved when electrolytes only were used.

Only 16 farmers treat every scouring calf, most farmers only treat calves are that sick or dehydrated or that they “can catch”. Only eight farmers treat calves with more specific clinical signs such as blood in faeces or watery scours.

Depending on how cows with young calves are managed and the severity of the scour outbreak, treatment of affected calves can be very time-consuming. Forty percent of respondents (n=23) reported that it took between 40 and 60 minutes per day to treat each affected calf, fourteen respondents said it took between 20 and 40 minutes per day and only 16 respondents reported that it took less than 20 minutes per day per calf. Two respondents reported that it took between 1 1/2 and three hours to treat each affected calf.

Table 11: Reported recovery rate (% of calves treated) of treatments used

Treatment	No farms	Mean (%)	Median (%)	Range (%)
Electrolytes only	13	97	100	90-100
Oral antibiotics only	15	91	100	50-100
Injectable Antibiotic only	6	86	95	50-100
Electrolytes & oral antibiotics	23	86	90	50-100
Electrolyte & Injectable antibiotic	2	85	85	75-95
Injectable & oral antibiotics	7	92	95	70-100
Electrolytes, injectable & Oral antibiotics	6	78	88	50-100
IV fluids	5	45	30	0-100
No treatment	10	96	100	60-100

6.5. Interaction with veterinarians

Most respondents would contact their veterinarian with a scour problem when the usual treatment was not working or when calves started dying (Table 12). Six respondents stated that they would never contact a veterinarian with a calf scour problem.

Table 12: The stage at which respondents would contact their vet with a calf scour problem

Reason for contact	No. respondents$^{\tau}$
Non response to usual treatment	19
When calves start dying	18
When mortality > 2%	9
Never	6
When at least 5% of the group are affected	4
When scours first noticed	3
When need more antibiotics	3
When 10% Need Treating	1
When mortality > 5%	1
When mortality > 10%	1

τ Some respondents recorded more than 1 reason

Only 14 respondents would expect their veterinarian to visit the farm when they have a calf scour problem, with the majority (n=32) expecting that their veterinarian would prescribe them drugs and advice over-the-counter. Six farmers would expect their veterinarian to ask them to bring calves into the clinic, and a further 11 would expect to be asked to bring faeces samples in. Post-mortems had only been carried out on calves on 14 of the affected properties.

6.6. The effects of calf scours on the enterprise

Only 13 farmers did not notice any effect of calf scours on the growth of their calves. Twenty-one farmers could identify calves that had scoured 1 month later, 15 farmers could identify calves that had scoured 2 months later and eight farmers could identify calves that had scoured at weaning. No respondents had calculated the exact cost of calf scours to the enterprise, 4 respondents estimated the cost at between $2000 and $20,000 per annum, and one farmer had calculated that it cost $30.50 to treat each calf.

6.7. Economic losses due to calf scours

The losses due to an outbreak of calf scours include:

- Calf death - which is effectively the loss of income from a cow for the year
- Cost of treatment of the calf, including the time taken, which can be significant in a paddock situation
- Impact on growth rate and possible lower weaning weight
- Culling cost of the dam (in most situations she is likely to be culled because she does not have a calf at foot at weaning/marking
- Loss of genetic potential from the calf and the dam
- A decreased capacity to improve and maintain the herd

The economic losses for each farm for the year preceding survey was calculated from the information the respondents had provided on number of calves affected and dead, treatments used and the proportions

of animals treated, and the time respondents had given to treat each calf. Costs that we used to calculate these are shown in Table 13.

Table 13: The costs used to calculate economic loss from calf scours for each study farm

Cost of loss of calf (includes loss of income/cost of replacement calf	$150.00
Cost of time/hr to treat calves	$15.00
Cost of electrolytes/litre	$1.25
Cost of scour tablets/liquid per day	$1.00
Cost of short-acting antibiotic injection per day	$1.50
Cost of long acting antibiotic injection	$3.50
Cost of intravenous fluids	$120.00
Cost of culled cow (replacement cost - income from culled cow)	$300.00

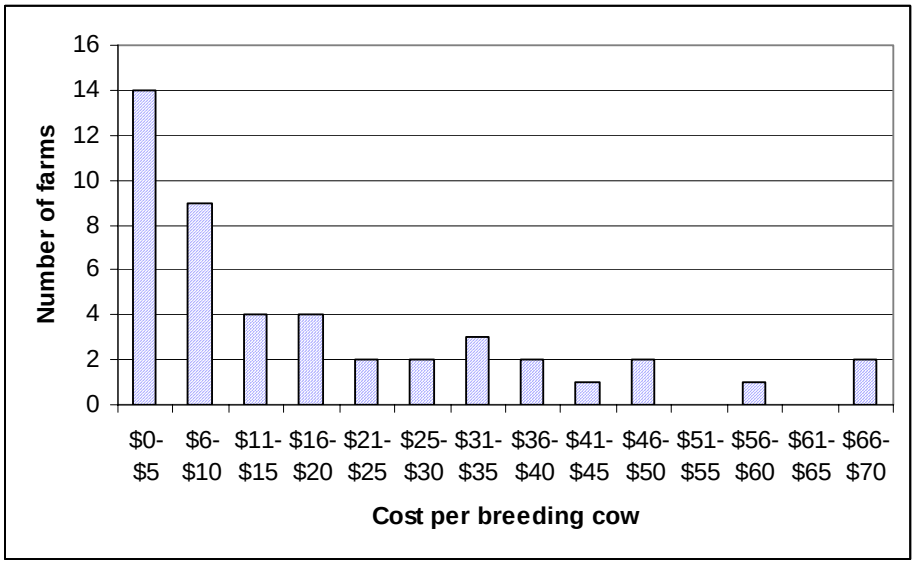
This estimate does not include any amounts for the impact on the growth rate, loss of genetic potential or the reduction in capacity to improve and maintain the herd, as these figures were not known.

The impact of calf scours can be calculated as estimate of the cost per scouring calf, the total cost to the enterprise or the loss per breeding cow, which adjusts for variation in the size of the enterprise.

Adequate information was available from 46 respondents. The cost of a scouring calf was calculated by estimating the chance and cost of treatment (including time for treatment) for each farm together the the chance of the calf dying. The mean cost was estimated as $73.30 (median $51.90, range $5.31 - $297.50) Low estimates related to herds with large numbers of scouring calves, most of which were not treated. Properties with a high cost either treated a significant number of calves with intravenous fluid or had a high mortality rate.

The loss per affected property varied from $128 to $41,138, and the mean loss per breeding cow was $18.70 (median $11.40, range $0.50 - $68.60). The range of loss per breeding cow is shown in Figure 5.

Figure 5: The range of loss per affected cow from calf scours in the year preceding the survey



6.8. What the respondents would like to minimise their calf scour problem

Forty-nine respondents had suggestions for solutions to their calf scour problem. The majority of suggestions (n=23) were to develop better vaccines. Ideally this vaccine would prevent all infectious causes of scours, preferably be one shot or even better combined with 7in1, and be cost effective! Eleven respondents would like to see better treatment options and protocols; 8 respondents would like more education, information and extension; 5 respondents would like to see better tests and investigation protocols; 3 respondents would like effective ways to prevent the spread and remove contagious bacteria and viruses from the environment; and 2 respondents would like better information on nutrition.

7. CATTLE VETERINARIANS EXPERIENCE WITH CALF SCOURS

7.1. Methodology

A comprehensive study of cattle veterinarians' experience with beef calf scours was carried out across the southern states of Australia using a written survey of major large animal practices.

In initial advert was placed in the Australian Cattle Veterinarian to identify interest veterinarians. Additional veterinarians were recruited from major beef cattle areas from where there were no respondents.

7.2. Results

Of the 55 practices surveyed, 39 surveys were returned (69% response rate). The number of practices surveyed in each State is shown in Table 14. One practice that responded from New South Wales did not have a significant number of beef clients in their area, and one Victorian practice did not have time to fill out the survey. These practices were excluded from any further analysis.

Table 14: The number of practices in each state surveyed on their experience with beef calf scours

State	Replied	No reply	Total	Percentage response
NSW	16	7	23	70%
SA	4		4	100%
TAS	5	2	7	71%
VIC	9	6	15	60%
WA	4	2	6	67%
Total	38	17	55	69%

Over half of the practices (n=21, 58%) serviced 200 beef farms or less, 17% (n=6) serviced between 201 and 400 beef farms and 9% (n=3) serviced more than 400 beef farms. Another six practices (17%) were unable to supply the number of beef farms that they serviced. Cow-calf operations made up more than 75% of the beef clients for 64% (n=23) of the practices surveyed, and for a further 25% of practices cow-calf operations made up between 50% and 75% of their beef clients.

Fifty-eight percent of veterinarians considered scouring in beef calves to have significant economic impact on producers in their area, ranging from 20% in Tasmanian to 75% in South Australia and Victoria (Table 15). Veterinarians reported that an average of 9% of cow calf operations that they serviced were affected (range 0-20%).

Table 15: Veterinarians perceptions on the economic impact that calf scours has on their beef clients

State	No economic impact	Rarely has economic impact	Question not answered	Significant economic impact	Total
NSW	6 (40%)		1	8 (53%)	15
SA	1(25%)			3 (75%)	4
TAS	3 (60%)		1	1 (20%)	5
VIC		1	1	6 (75%)	8
WA	1 (25%)		1	2 (50%)	4
Total	11 (31%)	1	4	20 (56%)	36

7.2.1. Disease presentation

Scouring calves were most commonly presented between 6 and 21 day of age in 44% (n=16) of practices. Twenty-eight percent of practices (n=10) treated the most scouring calves between 3 and 6 weeks, and 22% (n=8) of practices treated the most scouring calves between 0 and 5 days of age. Only two practices saw the most scouring calves between 7 and 16 weeks.

The group sizes presented varied from 10 to 300 calves (mean = 90.6 ± 7.0). Morbidity and mortality rates declined with age, but typical morbidity rates exceeding 75% of the group were reported especially in the younger age groups. Typical mortality rates up to 70% were also reported in the 0-5 day age group, with the average mortality reported for this group at 12% (Table 16).

Table 16: Typical morbidity and mortality rates for scouring beef calves according to age group

	0-5 days		6-21 days		3-6 weeks		7-16 weeks		> 16 weeks	
	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality
Mean (±Std)	21.1 (± 22.0)	12.0 (±16.0)	23.4 (±17.8)	7.3 (±7.0)	17.5 (±13.6)	4.4 (±5.0)	7.8 (±5.5)	2.1 (±3.4)	6.4 (±3.5)	1.8 (±3.6)
Min	5	0	2	1	1	0	2	0	2	0
Max	100	70	75	30	50	21	20	10	10	10

7.2.2. Laboratory work up

Almost all veterinarians surveyed used the agriculture department laboratory in their state or the laboratory contacted to the State Department. Several Victorian practices used a private laboratory for some or all of their samples. In states where full cost recovery has been introduced in the past five years the comment was made by many practices that they no longer submitted as many, if any samples.

7.2.2.1. Tests requested

Apart from two practices that treated very little calf scours, all practices had submitted faecal samples to a laboratory. However, 16 practices (46%) only submitted samples for 10% or less of the cases that were presented, and only 5 practices submitted samples for 50% or more of the cases that presented. A large majority of practices (n=27) submitted five samples or less and only four practices submitted more than five samples. Interestingly only one of these practices was in a state where full cost recovery was possible. One practice routinely submitted 5-10 samples from 75% of the cases presented. This practice appeared to have a good knowledge of the aetiology of calf scours in their area.

Only 14 practices (39%) requested a “calf scour package”, however this is probably because this is not available in New South Wales. Where practices specified the tests that they wanted carried out 58% requested a faecal float, 95% requested a bacterial culture and sensitivity, 63% requested viral isolation, 42% requested *E. coli* typing where appropriate, and only 11% requested *Salmonella* phage typing. However laboratories would provide the latter if *Salmonella* were cultured.

7.2.2.2. Pathogens isolated

Respondents were asked to estimate the approximate number of pathogens isolated in the last five years. Response to this question was varied and some respondents only indicated approximate percentages. Of the 29 respondents to this question, two practices had not submitted samples. The number submitted by the remaining range from 3 to 270 (Mean 55 ± 62).

E. coli was isolated from all states, and only 2 practices reported that it had not been isolated from samples that they had submitted. In 15 practices it contributed to less than 25% of the total samples, and in eight practices it contributed to between 26 and 50% of the total samples. In one practice in South Australia it contributed to 60% of the total samples and in another in New South Wales *E. coli* was isolated from 90% of the samples submitted. It was isolated across all age groups of calves, but most commonly in calves aged six weeks or less. Thirty-six percent of veterinarians saw *E. coli* as a significant problem in calves aged 5 days or less, and the same percentage considered it to be a significant problem in calves aged 3-6 weeks. Forty-four percent of veterinarians saw *E. coli* as a significant problem in calves aged 6-21 days. In three veterinary practices *E. coli* was considered a significant problem in calves aged 7-16 weeks. Resistant *E. coli* were reported from 12 practices across all states. The most common antibiotics that *E. coli* were resistant to were trimethoprim sulphur, oxytetracycline and ampicillin, however one practice reported *E. coli* resistant to everything except gentamycin and two practices reported *E. coli* resistant to all antibiotics tested for.

Coccidiosis was the second most commonly reported pathogen and was reported from all states. It contributed to less than 25% of the diagnoses in 16 practices, and none of the diagnoses from eight practices. In one practice in New South Wales it contributed to between 26 and 50% of the diagnoses and in two practices in New South Wales E. coli contributed to between 51 and 75% of diagnoses.

Rotavirus was the next most commonly reported pathogen and was isolated from all states, but 9 practices reported that it had not been isolated from samples that they had submitted. It contributed to less than 25% of the samples submitted from 15 practices, between 26 and 50% of the samples from two practices and 57% of the samples submitted from one practice in Western Australia.

Salmonella was isolated from all states except for WA. It was not reported from 14 practices, contributed to less than 25% of the total samples in 12 practices and 33% of the total samples in one practice. Resistant *Salmonella* were reported from 10 practices in all states except WA. Most common resistances were to trimethoprim sulphur, oxytetracycline and neomycin. One practice reported a *Salmonella* that was resistant to all antibiotics tested.

Cryptosporidium was only reported in 11 practices across all states. It contributed to less than 25% of the diagnoses in nine of these practices, and between 26 and 50% in two practices.

Yersinia was also isolated from all states except WA. It was not reported from 17 practices and in the remaining 10 contributed to less than 25% samples submitted.

Coronavirus was not reported from practices in South Australia or Western Australia, and in total 19 practices did not report its isolation. However it should be noted that not all laboratories carry out coronavirus isolation. It was reported as contributing to less than 25% of all samples in 8 practices.

Three practices reported other diagnoses contributing to less than 25% of the samples. These included nematodes and mixed pathogens

Samples from which there was no growth/no diagnosis were reported from 16 practices. In seven practices these made up less than 25% of all samples, in three practices that made up between 26 and 50% of all samples, in four practices they made up between 51 and 75% of all samples and in one practice 76% of all samples.

7.2.3. Vaccination

Fifty-three percent of practices had between 1 and 5% of their clients that used *E. coli* vaccination, and one practice had 10% of their beef clients that used this vaccine. In comparison only 17% of practices had beef clients using *Salmonella* vaccine and again in these practices it was only used on between 1 and 5% of farms. There appeared to be no relationship between practices that had clients that vaccinated, and the isolation of either pathogens in faecal samples, or the perception of how significant a problem *E. coli* was to their clients.

7.2.4. The veterinarians approach to a calf scour outbreak

Veterinarians were asked the following questions on their initial approach to a scour outbreak

If a beef farmer contacts you with a calf scour problem:

Does your practice have a standard protocol / checklist to work up a calf scour problem

What % of these inquiries would you visit the farm?

For those cases where you don't visit the farm, what % of the time would the farmer bring faeces samples in?

What % of these inquiries would you dispense the farmer treatment without a visit?

What % of the time would a farmer refuse a visit when you insist on one before dispensing prescription animal remedies?

Five of the 26 practices (19%) that answered part a) had a standard protocol or checklist within their practice to work up a scour problem. One practice never visited a farm with a scour outbreak and the majority of practices (25) visited farms 20% of the time or less (Table 17). Only five practices visited the farm 50% of the time or more. There was a positive trend between the percentage of time that a farm was visited and the number of beef herds in the practice area (R^2=0.36, P< 0.01).

Table 17: The percentage of scour outbreaks for which a practice would visit the farm

	Number (& %) of practices
0	1 (3%)
1-20%	25 (69%)
21-40%	1 (3%)
41-60%	4 (11%)
61-80%	0
81-100%	1 (3%)
Not Answered	4 (11%)

Four practices never asked the farmer to bring in faeces samples if they did not visit the farm, and 20 practices only asked for faecal samples less than 20% of the time. Six practices collected faecal samples at least 50% of the time.

The low level of visits was reflected in the fact that 23 practices dispensed treatment over-the-counter for 60% or more cases of calf scours. However many practices qualified this by stating that prescription drugs would only be dispensed to bona fide clients and/or they would only treat with electrolytes. Only one practice refused treatment without a visit, and three practices dispensed treatment for 20% of the time or less.

Most practices (26) found that farmers accepted that they should have a visit if the veterinarians insisted, however six practices noted that the majority of clients declined a visit.

7.2.5. Management changes

Thirty-one veterinarians routinely recommended management changes when faced with an outbreak in scouring calves, however the management changes that were recommended varied and there were a few changes that veterinarians consistently found successful.

7.2.5.1. Management changes in cow calf operations

Veterinarians were asked to rate the success they had found with common management changes that have been suggested in a calf scour outbreak. The management changes recommended in cow-calf operations and the success that veterinarians had found with them are shown in Table 18. The most common management change that veterinarians found to be very or moderately successful was to change the paddock that the affected herd is running in (Table 18). Other management changes that veterinarians found to be very or moderately successful were to vaccinate for *E. coli* before calving (13 practices), to provide additional shelter (11 practices), to fence off muddy areas +/- areas where calf "creches" are located (9 practices) and to alter the time of calving to a different season (9 practices).

The veterinarians were also asked for management changes that they recommended which were not included in the questionnaire. These changes and their success rate are shown in Table 19, however each change was only recommended by one veterinarian/veterinary practice.

Table 18: A breakdown of the success rate that veterinarians have found with a range of common management changes in cow calf operations

Management changes recommended for cow calf operations	Very Successful	Moderately successful	Little Success	Don't recommend or not answered
Provide additional shelter	4	7	7	18
Change paddock that affected herd is running in	7	19	4	6
Fence off muddy areas +/- areas where calf "creches" are located	3	6	3	24
Vaccinate cattle for *E. coli* before calving	4	9	5	18
Vaccinate cattle for *Salmonella* before calving	2	1	2	31
Alter timing of calving – different season	2	7	4	23
Manage 1st calvers separately	1	4	5	26
Check colostrum quality of heifers	0	2	1	33
Check colostrum quality of all age groups, either every cow or selected animals	0	1	1	34
Monitor serum protein or antibody levels in calves	0	2	2	32

Table 19: Other management changes suggested by veterinarians treating a scour problem in cow calf operations

Avoid unnecessary yarding: Treat sick calves in paddock	Very successful
Early recognition & treatment	Moderately successful
Ensure adequate nutrition of breeders	Moderately successful
Feed adequate quantities of electrolytes	Very successful
Increase hygiene	Moderately successful
Maintain colostrum bank	Moderately successful
Medical pen for affected calves	Moderately successful
Move healthy cattle & leave affected animals in paddock	Very Successful
Reduce effective stocking rate	Very Successful
Reduce feed intake	Moderately successful
Remove from mother for 24 hrs	Very Successful
Rotate calf paddocks annually	Very successful
Rotational graze with sheep	Very successful
Selenium supplements (From known deficient area)	Moderately successful
Switch to poorer pasture	Moderately successful
Treat intensively for concomitant pinkeye/eye problem and ensure fly control	Moderately successful

7.2.5.2 Management changes in calf rearing operations

Only 22 practices (60%) that responded recommended management changes in cow calf rearing operations- this reflected the number of practices that serviced these clients. Nineteen of these practices found that improving hygiene was very or moderately successful in controlling calf scours (Table 20). Other management changes that veterinarians commonly found very or moderately successful were to introduce incentives that ensured calves received adequate colostrum at birth, and to ensure the different calves from different sources were kept in separate groups.

Addition recommendations that practitioners had had success with included mixing the milk powder properly, to feed ad lib pellets from day one, and to mix yoghurt with the milk powder.

Table 20: A breakdown of the success rate that veterinarians have found with a range of common management changes in calf rearing operations

Management changes recommended for calf rearing operations	Very Successful	Moderately successful	Little Success	Don't recommend or not answered
Improve hygiene	8	11	2	1
Introduce incentives to ensure that calves get adequate colostrum at birth	5	12	1	4
Ensure that calves from different sources are kept in separate groups	1	13	3	4
Ensure calves are fed twice a day for first 2 weeks	2	11	0	9
Ensure calves have access to fresh water at all times	2	11	2	7
Decrease number of calves in the pen	4	9	5	4
Feed calves electrolytes for 1st 24 hours on the farm	2	9	0	11
Introduce an "all in all out" policy	2	7	2	11
Change the milk powder formulation so that calves are getting more total powder	2	4	1	15
Rear calves in individual pens for 1st 2 weeks	1	4	3	14
Change the milk powder formulation so that calves are getting less total powder	1	3	2	16
Change from powdered milk to whole milk	1	2	1	18
Change from whole milk to powdered milk	0	1	1	20

7.2.6. Treatment of scouring calves

Ten practices (26%) only treated calves when they were depressed. Twenty-six practices isolated the calf or the calf and its mother. All veterinarians gave oral electrolytes with or without an additional energy supplement. Only one practice did not report using any antibiotic treatment at all. Thirty-two veterinarians treated with antibiotic scour tablets or liquid, although 18 veterinarians used these only when the calves were depressed. Twenty-four practices used injectable antibiotic treatment, which in the vast majority of cases was either oxytetracycline or trimethoprim sulphur. One practice sometimes treated with amoxil, and another used apramycin. Twenty of these practices treated only depressed calves with injectable antibiotics.

Twenty-six practices (66%) used IV fluids, although twenty-one of these practices only used them in 5% of cases or less. One practice used IV fluids for 20% of cases. Eleven practices that used IV fluids also used subcutaneous fluids, two of these practices also used intra-peritoneal fluids. Two practices also reported using blood transfusions in sick calves where there was evidence of compromised immunoglobulin transfer.

Other treatment supplements used by practitioners included colostrum supplements, kaolin, warmth especially rugs, anti-inflammatories, dextrose, red cordial and probiotics.

7.2.7. The assistance that veterinarians would like to help overcome calf scours

Veterinarians were asked what assistance their practice would like to overcome scours on beef farms. A large majority wanted more information on effective preventative strategies (Table 21). Other popular requests were information packages for farmers and information on "best practice" investigation protocols.

Table 21: Types of assistance that veterinarians would like to overcome calf scours

Assistance required	Number of veterinarians that would like this type of assistance
Information on effective preventative strategies	27
Information packages for farmers	19
Information on "best practice" investigation protocols	17
Regular updates from local laboratories on most common isolates and resistance patterns	16
Interactive website for farmers	16
Information on appropriate laboratory work-up	13
Newsletter "grabs"	11
Farmer workshops	8
Interactive website for veterinarians	7
Educational videos	5
Educate farmers on early intervention and clinical signs	2
Education re control of spread and uptake of pathology	1
Information on effective treatment strategies	1
More information on the epidemiology of calf scours	1
Scientific advise on calf rearing considering good welfare practices and decreased labour	1
Educate farmers on economic impact of calf scours	1
Educate farmers on the value of vaccination	1

Veterinarians were also asked where they saw the main areas of further research and /or product development needed to be to minimise the impact of scours in beef enterprises. The most common request was for more vaccines, especially rotavirus. The areas of product development, further extension and further research that veterinarians' see as assisting in management of calf scours in beef calves are listed in Table 22.

Table 22: Areas of product development, further research and further extension that production animal veterinarians see as beneficial to assist management of scours in beef calves

Product development	Number of requests
Vaccine development	7
Rotavirus vaccine	4
Multivalent Vaccines - *Salmonella* / E. coli / Rotavirus / Pestivirus	1
Oral Coccidiosis treatment.	1
Oral Colostrum products	1
Treatment for cryptosporidia	1
Further research	
Causative factors for scours in open range beef cattle scours	1
Define the extent of the problem with some appropriately set up “on farm” surveys	1
Research to demonstrate to farmers that high milk production in cows is not responsible for scouring in calves	1
Non medical methods of prevention and control	1
Role of iron in white scours	1
Study of factors affecting the immune system of calves (and dams)	1
Value of whole blood transfusion	1
Further extension	
Preventative management	2
Extension package - guidebook/ guidelines	1
Effective vaccination protocols	2
Better advice on powdered milk products especially re mixing and frequency of feeding a little & often	1
Farmers want a "one-shot cure-all"! Main emphasis is on educating farmers to treat correctly with available products (lots of fluids)	1
Increase farmers awareness of the service that vets can provide	1

8. REPORT FROM A SURVEY OF VETERINARY PATHOLOGY LABORATORIES

Veterinary laboratories across southern Australian were telephoned to determine the approximate number of calf scour samples processed in the past year and their common protocols for processing these samples. A summary of the services offered by the laboratories is shown in Table 24.

8.1. New South Wales

New South Wales agriculture has three regional veterinary laboratories; the Elizabeth Macarthur Agricultural Institute at Menangle and 2 regional laboratories at Orange and at Wollongbar. Idexx also has laboratory in Sydney, but they indicated that they received very few cattle samples.

EMAI processes between 50 and 100 calf scour samples a year with a smaller number processed by Orange and Wollongbar. (The number of beef calf scour samples from 1997 to June 2003 is shown in Table 27.) Protocols are standardised between the three laboratories. The laboratories do not offer a calf scour package and veterinarians request the tests that they require. A latex test is used for rotavirus, and other viruses are detected by electron microscopy if requested. *E. coli* is not routinely typed.

8.2. South Australia

Most samples would be sent to Idexx-VPS - this is the laboratory used by PIRSA and samples can be eligible for a free processing. In 2002 - 2003 financial year 43 calf scour packages were carried out, together with 172 cultures of bovine faeces of unknown age.

Calf scour package includes culture and sensitivity, rotavirus ELISA and Cryptosporidium, plus coccidiosis and faecal egg counts for calves more than 4 weeks of age. They do not have a space on the submission form for breed or beef/dairy and consequently were not be able to provide information on beef scour pathogens.

8.3. Tasmania

Samples are sent to the Department of Primary Industries Mount Pleasant laboratory in Launceston. They process an average of 37 samples per annum when including both faecal and post-mortem samples. Their calf scour package includes *Salmonella*, *E. coli*, *Yersinia*, rotavirus, cryptosporidium, coccidiosis and faecal egg count, but this varied depending on the age of the animal from which the samples is submitted. Most veterinarians prefer to select a calf scour package. *E. coli* is not routinely checked for fimbrial antigens or serotyped.

8.4. Victoria

Samples are processed by the DPI Laboratory at Bendigo, Gribbles Laboratory in Melbourne and Gippsland Pathology in Traralgon. Some samples are sent to Department of Primary Industries laboratory at Bendigo because of their relationship with Intervet and because it is the *E. coli* reference laboratory for Australia.

Gippsland Pathology offers one calf scour package that includes *Salmonella*, *Yersinia*, rotavirus and cryptosporidia with the coronavirus at the veterinarians request. Coccidia and faecal egg count can also be requested. *E. coli* is not routinely typed, but K99 can be identified at the laboratory. They have not collated any data and their system would not be suitable to do this.

Gribbles Pathology offer 4 calf scour packages (Table 23) that 90 percent of veterinarians would select. Coronavirus is tested using an ELISA test and is part of their routine virology. Faecal float for strongyles and eimeria are not part of any of their panels but can be added as an option at the veterinarians request. Data is stored electronically and the submission forms are kept as optical images. They do collect data on breed but only “Bovine” is in an electronic format, and the original submission form would have to be consulted to obtain the breed.

Table 23: Calf scour packages offered by Gribbles pathology in Melbourne

Panel name	Tests included
Faecal 1	Rotavirus, Cryptosporidium and Coronavirus
	Culture and serotype for *E. coli* K99
Faecal 2	Rotavirus, Cryptosporidium and Coronavirus
	Culture for *Salmonella* and Yersinia
Faecal 3	Culture for *Salmonella* and Yersinia
Faecal 4	F1 and F2 combined

The Department of Primary Industries Laboratory at Bendigo receives a lot of scour samples due to its relationship with Intervet. They have recently introduced a calf scour package that includes *Salmonella*, *E. coli*, *Yersinia*, rotavirus, cryptosporidia and coccidia. They have also recently introduced an ELISA test kits for Coronavirus. *E. coli* isolates are routinely checked for fimbria and are serotyped when thought to be a significant growth

8.5. Western Australia

Scours in beef calves is perceived as a large problem by practitioners in the south-west, one practitioner in Albany had 45 farmers turn up to an invite only seminar. Most samples are sent to the government laboratory and are processed free where there is high morbidity or mortality, but the laboratory will only carry out one free investigation per property. Murdoch University processes very few samples, mainly from calves seen by veterinarians from their ambulatory clinic. Vetpath (a private laboratory) does not receive calf scour samples.

The Department of Agriculture in WA has two animal health laboratories one in Albany and one in Perth. The Perth laboratory receives most of the data from across the state and often caried out histology on calf scour investigations. They do not have a calf scour package as such, but have standard protocol that is culture and sensitivity, rotavirus, cryptosporidium and electron microscopy. They are also trialing a calf scour dipstick test manufactured by Biox and imported from Belgium.

8.6. The cost of diagnosing calf scours:

The prices charged by the different laboratories were collated to estimate the costs involved in a thorough diagnostic work up and the range of these are shown in Table 25. The cost of a basic scour package ranged from $110- $624. Whilst recognising that in some cases the animals may not be of the correct age group to require a complete set of testing (ie samples may not necessarily have a FEC carried out as well as K99) this figure gives an indication of the potential costs involved. It should also be recognised that at present all states except Victoria have some degree of subsidisation for production animal laboratory tests, especially where mortalities are occurring. Therefore the laboratory charges may not be that high depending on the criteria applied. The producer may also have to pay the veterinary investigation costs as well as costs for any post mortem that occurs. Therefore for most producers a complete diagnostic procedures including appropriate faecal samples and post mortems can be expected to be between $500 - $1000 where they are not eligible for subsidisation of laboratory costs.

Table 24: Summary of laboratory services

State	Laboratory	No samples per year	Differentiate beef or breed	CSP offered	Check for Coronavirus	Check K99	E. coli Serotype
NSW	RVLs	30-40	Breed	No	Not routine have EM	Not Routine	Not Routine, can do on-site
SA	Idexx-VPS		No	Yes	No	No	Not routine send samples to VPS on request
Tas	DPI Mount Pleasant	37	Yes	Yes	No	Currently trialling test	No
Vic	Gippsland Pathology	3-400 80% Dairy	No	Yes	On request	Y	No
Vic	Gribbles pathology		Yes on sub form but not electronically	Yes (4)	Routinely using ELISA	Y	
Vic	DPI Bendigo		No	Yes	Just started using ELISA	Y	Often
WA	AHL Albany	< 20	Breed	No	EM	Y	Not routine, send some cases to Bendigo - interesting cultures or histopathology
WA	AHL Perth	50	Breed	No	EM and Biox Calf scour Sticks, but see very few	Y	

Table 25: The range of costs involved in a laboratory work-up

Laboratory test	Mean	Median	Range
Single culture and sensitivity including isolation of salmonella and yersinia	$51	$43	$30-$105
Single culture and sensitivity including testing for K99[ð]	$47	$49	$35-$56
5 faecal egg counts	$44	$35	$20-$78
5 calf scour packages[¥]	$393	$424	$110-$624
5 sections for histology	$98	$88	$78-$137

ð: does not include one laboratory that does not test for K99
¥ Includes culture and sensitivity for E. coli & salmonella, faecal egg count, rotavirus, cryptosporidia, coccidiosis (and coronavirus ELISA in 3 out of the 6 laboratories)

9. COLLATION AND ANALYSIS OF LABORATORY DATA

9.1. Methodology

Historical calf scour data was collated from Intervet Australia, the Regional Veterinary Laboratories in New South Wales, the DPIWE Mount Pleasant laboratory in Tasmania, the DPI Veterinary Laboratory at Bendigo in Victoria and from the Agriculture WA Animal Health Laboratories. Submission forms were analysed to find samples from beef calves that were less than four months of age. The samples were from both cow calf enterprises and calf rearers and in most cases the enterprise type was not identifiable. Due to the few number of submissions that actually identified a breed or enterprise type, many submissions were assumed to be from the properties as the calves were male or mixed sex.

Where available information was collected on the location of the properties; the history of the problem; the age of calves affected; the type of samples submitted; the laboratory tests carried out and the subsequent diagnoses. This was then analysed to determine the range of morbidity and mortality reported, the common pathogens affecting each age group and the proportion of samples tested for major pathogens. For each laboratory the proportion of submissions that were tested for a "Major Pathogen Calf Scour Panel" (MPSCP) was noted. These were samples tested for rotavirus and cryptosporidia and coccidia as well as having a culture and sensitivity, and *Salmonella* enrichment carried out.

The tests used from each laboratory to diagnose the common pathogens are shown in Table 26. In general the tests were similar except for cryptosporidia and coronavirus. The variation in these tests will contribute to some of the variation in results between laboratories

Table 26: Variation in testing procedures between the participating laboratories

Laboratory	Salmonella	Cryptosporidia	Coccidiosis	Coronavirus	Rotavirus
DPI Bendigo	individual culture	MZN stain	Faecal float	Not tested in period of study (now using ELISA)	Latex agglutination (now using ELISA)
Agriculture WA	individual culture	fluorescent antibody test	Faecal float	EM – not routine	Latex agglutination
Mt Pleasant	individual culture	MZN stain	Faecal float	Not tested	Latex agglutination
RVL NSW	individual or pooled culture	flotation or MZN stain	Faecal float some coccidial flotation or intestinal scraping	EM – not routine	Latex agglutination

In many submissions a major pathogen was only diagnosed from a low proportion of samples. Whilst recognising that many of the major pathogens, notably viruses, can be isolated from clinically normal calves, this pathogen was used as the diagnosis for the submission. If more than one pathogen was isolated then the submission or sample was categorised as "multiple pathogens", without specifying which pathogens were involved in the case.

9.2. NSW Laboratory Samples

Data was collected from NSW Regional Veterinary Laboratories for 1997-June 2003.Two hundred and fifty four samples from scouring beef calves were processed from 179 submissions in this period. One hundred and fifty-six samples included faeces or intestinal contents. The rest were fixed or fresh tissues only, together with blood samples for mineral analysis or Pestivirus antigen capture ELISA. The number of submissions received at each laboratory per year is shown in Table 27.

The age groups of the calves affected are shown in Table 28. The majority of the samples submitted to all 3 laboratories were from calves that were 7-16 weeks of age.

Table 27: The number of beef calf scour submissions for each NSW laboratory from 1997- June 2003

Year	EMAI Menangle	Orange	Wollongbar	Total
1997	31	11	11	53
1998	9	5	8	22
1999	15	6	13	34
2000	12	6	5	23
2001	6	2	4	12
2002	11	3	10	24
2003	3	6	2	11
Total	87	39	53	179

Table 28: The distribution of submissions by calf age group

Age of calves (weeks)	Number of submissions	Percent of total submissions
< 1 week	17	9%
1-3	47	26%
4-6	41	23%
7-16	74	41%
Total	179	

Morbidity data was provided for 120 submissions (Table 29) and mortality data for 149 submissions (Table 30). The highest morbidity was in the younger age groups of calves and although there was little difference in the mean mortality rate between the age groups there was a decrease in the median mortality rates. Mortality is seen as a major reason for submission of samples, with 114 submissions reporting this.

Table 29: The range of morbidities reported in affected calves and variation with age

Age of calves (weeks)	Number of Submissions	Mean no. at risk	Median & range of no at risk	Mean morbidity	Median & range of morbidity
< 1 week	9	56	40 (4-200)	23%	13% (1-90%)
1-3	34	50	36 (7-300)	16%	10% (1-83%)
4-6	30	138	55 (10-700)	14%	7% (0.4-80%)
7-16	47	82	50 (1-300)	18%	6% (0.3-100%)

Table 30: The range of mortalities reported in affected calves and variation with age

Age of calves (weeks)	Number of Submissions	Mean no. at risk	Median & range of no at risk	Mean mortality	Median & range of mortalities
< 1 week	13	63	50 (4-200)	7%	4% (0-50%)
1-3	40	59	38 (7-450)	9%	5% (0-80%)
4-6	35	125	60 (7-700)	4%	2% (0-20%)
7-16	61	117	50 (1-1700)	6%	2% (0-50%)

9.2.1. Diagnoses

Initial examination of the data shows that there is a wide range of diagnoses in all age groups and no diagnosis was reached from between 34% (7-16 weeks) and 52% (1-3 weeks) of samples in each group. This data set illustrated the role of histology, confirming of two cases each of colibacillosis, enterotoxaemia and coccidiosis, and one case of *Salmonella*. However many of the histological diagnoses were still non-specific or pertaining to individual animals such as peritonitis, hepatopathy and abomasitis.

Further analysis of the samples submitted that contained faeces or intestinal contests showed that a MPCSP was only carried out on 37 of the 221 samples. When the proportion of submissions with faeces or intestinal contents that were tested for the major pathogens was analysed it was shown that a culture and sensitivity was carried out on 78% of submissions, *Salmonella* was tested for in 82% of submissions and Yersinia in 44%. A faecal egg count was carried out on 31% of submissions and coccidia tested for in 44% of submissions. Rotavirus latex agglutination was carried out on 41% of submissions and cryptosporidia tested for in 46% of submissions, and electron microscopy was only carried out on 9% of submissions. The proportion of submissions in each age group for rotavirus, cryptosporidia, coccidia and nematodes are shown in Table 32 to Table 35. It can be seen that a higher proportion of younger calves was tested for rotavirus, and a higher proportion of older calves was tested for coccidia and nematodes. However in all age groups a significant number of submissions was not tested.

Table 31: A summary of all diagnoses from submissions (and samples) for the different age groups.

	Age of calves				Submission diagnosis as % of total submissions
Diagnosis	**< 1 week**	**1-3 weeks**	**4-6 weeks**	**7-16 weeks**	
	Number of submissions (with number of samples in brackets)				
Coccidia		1 (3)	6 (8)	10 (15)	9%
Colibacillosis¥	4 (5)	2 (2)	5 (9)	1 (1)	7%
Coronavirus	1 (1)				1%
Cryptosporidium	1 (1)	5 (5)	3 (3)	2 (3)	6%
E. coli K99 +ve	1 (1)	1 (1)			4%
Enterotoxaemia		2 (2)	1 (2)	5 (7)	1%
Miscellaneous		1 (1)	4 (4)	9 (9)	8%
Multiple pathogens	3 (4)				2%
Nematodes		2 (2)		6 (20)	4%
No Diagnosis	6 (7)	29 (32)	17 (21)	30 (40)	46%
Pestivirus				3 (5)	2%
Rotavirus		4 (12)	3 (4)	2 (2)	5%
Salmonella		1 (1)	2 (4)	3 (6)	3%
Selenium deficiency				1 (10)	1%
Yersiniosis				1 (1)	1%
Total	16 (19)	48 (61)	41 (55)	74 (119)	

¥ one diagnosis on histology – all others were cultures of *E. coli*

Table 32: Rotavirus diagnoses and the proportion of submissions tested in each age group

Age of calves (weeks)	Positive	Negative	Not tested	% tested
< 1 week	3	8	5	69%
1-3	3	24	19	59%
4-6	3	13	21	43%
7-16	2	8	47	18%
Total	11	53	92	41%

Table 33: Cryptosporidia diagnoses and the proportion of submissions tested in each age group

Age of calves (weeks)	Positive	Negative	Not tested	% tested
< 1 week	2	6	8	50%
1-3	5	21	20	57%
4-6	3	19	15	59%
7-16	2	14	41	28%
Total	12	60	84	46%

Table 34: Coccidia diagnoses and the proportion of submissions tested in each age group

Age of calves (weeks)	Positive	Negative	Not tested	% tested
< 1 week		4	12	25%
1-3	1	18	27	41%
4-6	7	14	16	57%
7-16	10	15	32	44%
Total	18	51	87	44%

Table 35: Nematode diagnoses and the proportion of submissions tested in each age group

Age of calves (weeks)	Positive	Negative	Not tested	% tested
< 1 week		3	13	19%
1-3	2	8	36	22%
4-6	4	9	24	35%
7-16	8	15	34	40%
Total	14	35	107	31%

9.3. Tasmanian Laboratory Samples

Data was collated from the DPIWE Mount Pleasant Laboratories at Kings Meadows from May 1997 until June 2003. In this period there were 31 submissions for scouring beef calves distributed through 13 postcode regions of Tasmania. The total number of samples submitted was 50. The majority of the samples were submitted from calves that were 1-3 weeks of age. The number of submissions per year is shown in Table 36 and the age groups of calves affected in Table 37. Very little epidemiological information was available on the final laboratory reports provided.

Table 36: The number of beef calf scour submissions at the Mount Pleasant Laboratories from May 1997- June 2003

Year	Number of Submissions
1997	5
1998	5
1999	4
2000	1
2001	5
2002	8
2003	3

Table 37: The distribution of submissions by age group of calves affected

Age of calves (weeks)	Number of submissions	Percent of total submissions
< 1 week	2	6%
1-3	17	55%
4-6	4	13%
7-16	6	19%
Unknown §	2	

§ Assumed to be less than 4 months from history provided

9.3.1. Diagnoses

It was not possible to see any major trends in the pathogens isolated due to the low number of submissions (Table 38). The majority of samples were submitted from calves aged 1-3 weeks of age, and in this group the most common pathogen isolated was cryptosporidia. A diagnosis was not reached in 45% of all submissions. Mount Pleasant Laboratory does not test for coronavirus since a survey they carried out in the mid-nineties revealed it was seldom isolated.

Table 38: A summary of all diagnoses from submissions (and samples) according to age groups affected.

Diagnosis	Age of calves					Submission diagnosis as % of total submissions
	< 1 week	1-3 weeks	4-6 weeks	7-16 weeks	Unknown	
	Number of submissions (with number of samples in brackets)					
Coccidia				1 (1)		3%
Cryptosporidia		4 (5)			(1)	13%
Miscellaneous	1 (1)	2 (2)				10%
Multiple pathogens		2 (5)		1 (1)	1 (0)	13%
Nematodes				1 (1)		3%
No Diagnosis	1 (1)	7 (7)	3 (3)	2 (2)	1 (9)	45%
Rotavirus					(1)	
Salmonella		2 (5)	1 (5)			10%
Yersiniosis				1 (1)		3%
Total	2 (2)	17 (23)	4 (8)	6 (6)	2 (11)	

9.3.2. Diagnostic protocols

A MPCSP was only carried on 18 samples from 7 submissions. Overall 58% of submissions were tested for rotavirus, 68% for cryptosporidia and 42% for coccidia. A culture and sensitivity was carried out on 94% of submissions, isolation for Yersinia on 61% and a faecal egg count on 29% of submissions. However it is often not indicated to test for all pathogens on all samples and to minimise cost it is often appropriate to vary testing strategies depending on the age groups affected. This data that shows that there was a higher percentage of submissions from calves that were 1 to 3 weeks of age tested for cryptosporidia and rotavirus, and a higher percentage of submissions from calves that were 7-16 weeks of age tested for coccidia and nematodes (Table 4)

Table 39: Variation in the percentage of submissions tested for a pathogen with age of animals affected

Age of calves (weeks)	Number of submissions	Percent of submissions tested for pathogen			
		Cryptosporidia	Rotavirus	Coccidia	Faecal Egg Count
< 1 week	2	0%	0%	0%	0%
1-3	17	88%	76%	35%	24%
4-6	4	50%	50%	50%	25%
7-16	6	33%	17%	67%	67%

9.4. Victorian Laboratory Samples

9.4.1. Intervet Database 1997-1999

One hundred and seventy-three scour samples were submitted to Intervet between 12/12/97 and 20/12/99. Of these only 36 submissions were positively identifiable as beef samples compared with 67 submissions were from dairy calves. The beef submissions contained 127 faecal samples. Fourteen submissions were processed in 1998, 21 in 1999 and one from Dec 1997. The samples were from all southern states except Tasmania (Table 40). Fifty three percent of submissions were from calves aged between 1 and 3 weeks of age (Table 41). This may reflect the fact that samples were sent to Intervet to determine if *E. coli* or *Salmonella* was present in order to make a vaccine.

Table 40: The number of beef calf scour submissions by State from Dec 1997 until December 1999

State	Number of Submissions
NSW	5
SA	7
VIC	23
WA	1

Table 41: The distribution of submissions by age group of calves affected

Age of calves (weeks)	Number of submissions	Percent of total submissions
< 1 week	1	3%
1-3	19	53%
4-6	5	14%
7-16	3	8%
Unknown §	5	14%
Multiple age groups	4	11%

§ Assumed to be less than 4 months from history provided

9.4.1.1. Diagnoses

Multiple pathogens were isolated from nearly half of the submissions. These were generally a combination of cryptosporidia and rotavirus plus or minus *Salmonella*. At a sample level the most common significant isolate was cryptosporidia followed by rotavirus. Seventy-five percent of samples grew non-haemolytic *E. coli*, however no pathogenic serotypes were identified. The diagnosis was not reached in 46% of samples, but due to the multiple samples submitted only 25% of submissions did not have an aetiology established.

All samples were tested for cryptosporidia, coccidia and had a culture and sensitivity with *Salmonella* enrichment carried out on them. One submission for was not tested for rotavirus. No Faecal egg counts were reported.

Table 42: A summary of all diagnoses from submissions (and samples) according to age groups affected

Diagnosis	Age of calves						Submission diagnosis as % of total submissions
	< 1 week	1-3 weeks	4-6 weeks	7-16 weeks	Multiple age groups	Unknown	
	Number of submissions (with number of samples in brackets)						
Coccidia			(1)	(1)	1		3%
Cryptosporidia		3 (20)	1 (2)			1 (3)	14%
Multiple pathogens		10 (13)	1		2	2 (1)	42%
No Diagnosis	1 (2)	2 (42)	2 (3)	2 (3)		2 (6)	25%
Rotavirus		3 (11)		1 (3)	1		14%
Salmonella		1 (7)	(1)	(1)		(3)	3%
Total	1	19	4	3	4	5	

9.4.2. DNRE/Intervet database 1989-1995

Laboratory data was also available DNRE/Intervet from 1989 until 1995. This was analysed separately mainly because the dates were not consecutive to the previous database. There were a total of 135 submissions comprising 478 samples from all states of Australia. The distribution of samples and submissions are shown in Table 43.

Table 43: Distribution of samples submitted to the Bendigo DNRE laboratory between 1989 and 1985

State	Number of Samples	Number of submissions	Number of postcode areas
NSW	198	51	33
QLD	42	13	11
SA	13	5	5
TAS	6	3	2
VIC	210	59	46
WA	9	4	3

Submissions from Queensland were removed from the data set before analysis of diagnosis. Analysis of 122 submissions showed that the most common pathogens were cryptosporidia, coccidia and rotavirus. However the most notable feature is the high proportion of submissions with no diagnosis. Further analysis demonstrated that there had been a notable decrease in the proportion of samples from which there was no diagnosis between 1989 and 1995 (Table 45). Although a culture and sensitivity had been carried out on 98% of submissions, and rotavirus, coccidia and cryptosporidia had been tested for on over 80% of submissions, many of the early submissions had not been tested for all pathogens. Also *Salmonella* enrichment was not recorded as included on 42 percent of submissions. The proportion of samples tested for all pathogens in each year is shown in Table 46 and it can be seen that this correlates to the proportion of positive diagnoses.

The proportion of submissions that were positive for coccidia was also higher than other data sets that had been analysed. Sixty percent of submissions from which coccidia were diagnosed came from New South Wales, compared with 28% from Victorian and 4% from each of South Australia, Tasmania and Western Australia. There was a significantly greater proportion of positive samples from New South Wales than Victoria (p=0.02). There was no difference in the proportion of diagnoses of the other pathogens between states.

Table 44: A summary of all diagnoses from submissions (and samples) for the different age groups

Diagnosis	Age of calves						Submission diagnosis as % of total submissions
	< 1 week	1-3 weeks	4-6 weeks	7-16 weeks	Multiple age groups	Unknown	
	Number of submissions (with number of samples in brackets)						
Coccidia		1 (3)	5 (27)	2 (11)	6		11%
Cryptosporidia	(3)	5 (28)	(5)	(2)	9		11%
Multiple Pathogens		5 (8)		3 (1)	11		16%
No diagnosis	5 (23)	34 (197)	11 (65)	2 (21)	10	2 (10)	52%
Rotavirus	(2)	5 (18)	(4)	(3)	5		8%
Salmonella		1 (2)	(1)				1%
Total	5 (28)	51 (256)	16 (102)	7 (39)	41	2 (10)	

Table 45: Variation in diagnoses between 1989 and 1995

	Year							
Diagnosis	1989	1990	1991	1992	1993	1994	1995	Total Diagnoses
	Number of submissions							
Coccidia				6	4	3	1	14
Cryptosporidia				3	7	1	3	14
Multiple Pathogens				4	6	3	6	19
No diagnosis	7	11	5	11	20	3	7	64
Rotavirus	1	1	1	1	1	1	4	10
Salmonella							1	1
Total	8	12	6	25	38	11	22	122
No diagnosis as % of total submissions	88%	92%	83%	44%	53%	27%	32%	

Table 46: Proportion of submission tested for all pathogens between 1989 and 1995

	Tested for all pathogens		% tested for all pathogens
Year	No	Yes	
1989	25	2	7%
1990	43	1	2%
1991	22	0	0%
1992	59	31	34%
1993	80	60	43%
1994	3	37	93%
1995	0	72	100%
Total	232	203	47%

9.5. Western Australian Laboratory Samples

Data from beef calf scour submissions was collected from Agriculture Western Australia Animal Health Laboratories in Albany, Busselton and Perth from 1994 to June 2003. A total of 83 submissions from 33 different postcodes were processed in this period (Table 47) with the majority of samples being submitted to the main Perth laboratory.

The age groups of the calves affected are shown in Table 48. The majority of the samples were submitted from calves that were 1-3 weeks of age. Epidemiological data was only available for submissions from 1994-2000. There was very little difference in the reported morbidity and mortality for any age group, although most age groups were only represented by a few submissions. The morbidity and mortality rates for all submissions and for the largest subgroup of calves aged 1 to 3 weeks of age are shown in Table 49 and Table 50.

Table 47: The number of beef calf scour submissions for each WA laboratory from 1994-June 2003

Year	Laboratory			
	Albany	Busselton	Perth	Total Samples
1994	2		5	7
1995			6	6
1996			3	3
1997		1	4	5
1998		1	6	7
1999	3		5	8
2000			8	8
2001	4		9	13
2002	2		14	16
2003	2		8	10
Total	13	2	68	83

Table 48: The distribution of submissions by calf age group

Age of calves (weeks)	Number of submissions	Percent of total submissions
< 1 week	8	10%
1-3	35	42%
4-6	22	27%
7-16	17	20%
Unknown §	1	

§ Assumed to be less than 4 months from history provided

Table 49: The range of morbidities reported in affected calves

Age of affected calves	Number of Submissions	Mean number at risk	Median & range of number at risk	Mean morbidity	Median & range of morbidity
All Submissions (0-4 months)	34	117	55 (10-800)	20%	12% (1-75%)
1-3 Weeks	19	123	75 (10-800)	14%	13% (1-75%)

Table 50: The range of mortalities reported in affected calves

Age of calves (weeks)	Number of Submissions	Mean number at risk	Median & range of number at risk	Mean mortality	Median & range of mortalities
All Submissions (0-4 months)	38	109	50 (10-800)	7%	6% (0-27%)
1-3 Weeks	22	111	60 (10-800)	6%	6% (0-25%)

Table 51: A summary of all diagnoses according to age groups affected

Diagnosis	Age of calves					Submission diagnosis as % of total submissions
	< 1 week	1-3 weeks	4-6 weeks	7-16 weeks	Unknown	
	Number of submissions					
Aspiration Pneumonia			1			1%
Attaching Effacing Enterotoxigenic *E. coli*		1				1%
Coccidia		1				1%
Colibacillosis		5[#]		3		10%
Cryptosporidia	2	5	1	1		11%
Miscellaneous			1	2		4%
Mucosal disease				2		2%
Multiple pathogens	1	5				7%
No Diagnosis	5	6	11	5	1	34%
Rotavirus		9	7	1		20%
Salmonellosis		1				1%
Selenium deficiency		1	1	3		6%
Viral enteritis		1				1%

2 cases confirmed by histology – all other *E. coli* diagnoses either K99 –ve or not tested for fimbriae

9.5.1. Diagnostic protocols

Seventy-six percent of samples had a culture and sensitivity carried out on them, and with further *Salmonella* isolation in 60% of submissions. Rotavirus and cryptosporidia in 63% and 54% of submissions respectively, and electron microscopy carried out on 33% of submissions. A faecal egg count was performed on 14 percent of submissions, and concentration flotation and identification of coccidia in 14% of submissions. The percentage of submissions tested for each pathogen, and variation with age group affected is shown in Table 52

Table 52: Variation in the percentage of submissions tested for a pathogen according to the age of animals affected

Age of calves (weeks)	Number of submissions	Percent of submissions tested for pathogen				
		Cryptosporidia	Rotavirus	Electron Microscopy	Coccidia	Faecal Egg Count
< 1 week	7	57%	86%	57%	14%	0%
1-3	36	64%	75%	31%	8%	11%
4-6	22	59%	68%	45%	14%	32%
7-16	17	29%	18%	6%	6%	6%

9.6. Beef and Dairy Comparison

127 known beef isolates were compared with 218 known dairy isolates from the 1998-99 Intervet database. There was no differentiation between cow-calf and "calf rearer" in the beef enterprises. The number of isolates from each group is shown in Table 53.

Table 53: Comparison of isolates between 127 beef calf faecal samples and 218 dairy calf faecal samples in the 1998-99 Intervet Database

	Beef		Dairy	
	Number	Percent	Number	Percent
Rotavirus	24	19%	38	17%
Cryptosporidia	39	31%	58	27%
Salmonella	16	13%	40	18%
Coccidia	3	2%	20	9%
Non-haemolytic *E. coli* (Not EAEEC)	95	75%	126	58%
Haemolytic *E. coli*	0	0%	2	0.9%
Y. pseudotuberculosis	0	0%	3	1.4%

There was no significant difference in the proportion of rotavirus, cryptosporidia or *Salmonella* between the two enterprise types. There was a significant difference in the proportion of coccidia isolated ($P < 0.05$). Consequently likely that data that does not differentiate the type of enterprise is likely to give an indication of the problems encountered in beef enterprises.

9.7. Report of <u>all</u> calf scours samples processed by D. N. R. E. Bendigo from 1998 until 2002

Due to the paucity of identifiable beef samples from any laboratory all calf scours samples (beef, dairy and unknown) processed at DNRE Bendigo from 14th January 1998 until 31st December 2002 were analysed to look for trends in the pathogens isolated. No age group was provided, however as the samples were submitted as "calf scours", it was assumed that the majority were less than four months of age.

Nine hundred and eighty six samples were analysed from 391 submissions. Samples were tested for rotavirus, cryptosporidia, coccidia and a culture and sensitivity was carried out. Seven hundred and sixty one samples (77%) had the complete panel of tests carried out on them. The most common diagnosis in all years was cryptosporidia. These were diagnosed from 32% of samples and 39% of submissions across the five years.

Table 54: The distribution of pathogens at a sample and farm level

Pathogen	No of each pathogen isolated‡	No (&%) of samples tested for this pathogen	No Submissions from which pathogen isolated	No (&%) of submission from tested for each pathogen
Rotavirus	131	822 (84%)	89	316 (81%)
Cryptosporidia	262	827 (84%)	152	318 (81%)
Coccidia	65	814 (83%)	40	316 (81%)
Salmonella	169	962 (98%)	87	385 (98%)
ETEC	47	962 (98%)	21	385 (98%)

‡ Multiple pathogens were isolated from some samples

Table 55: Variation in the proportions of major pathogens isolated between 1998 and 2002

Pathogen	Year	1998	1999	2000	2001	2002
	Total submissions	54	59	82	117	79
Rotavirus	No. positive submissions	15	18	17	24	15
	% positive submissions*	30%	33%	23%	25%	37%
	% submissions tested	93%	92%	91%	82%	52%
Cryptosporidia	No. positive submissions	21	25	42	47	17
	% positive submissions*	42%	46%	55%	48%	43%
	% submissions tested	93%	92%	93%	84%	51%
Coccidia	No. positive submissions	4	6	8	12	10
	% positive submissions*	8%	11%	11%	12%	27%
	% submissions tested	93%	92%	93%	85%	47%
Salmonella	No. positive submissions	5	13	25	34	10
	% positive submissions*	9%	22%	30%	30%	13%
	% submissions tested	100%	100%	100%	98%	95%
ETEC	No. positive submissions	3	0	6	12	11
(K99 & F41)	% positive submissions*	6%	0%	7%	10%	15%
	% submissions tested	100%	100%	100%	98%	95%

* The denominator for % positive submissions is the number of samples tested for that pathogen

Multiple pathogens were diagnosed from 116 faecal samples from calves on 82 properties. A single pathogen was diagnosed in 173 submissions, 2 pathogens in 83 submissions and between three and five pathogens in 23 submissions. No diagnosis was reached from 428 samples and from 112 submissions.

There was very little variation from year to year in the percentage of farms from which the two most common pathogens, rotavirus and cryptosporidia, were isolated (Table 55). There was an increase in the percentage of farms from which coccidia were isolated in 2002, however this may reflect the age of the animals tested, and a trend away from testing neonates for pathogens in order to develop on farm vaccination. It should be noted that there was also an increase in the percentage of farms from which enteropathogenic *E. coli* were isolated.

10. DISCUSSION

Efficient production of beef calves requires minimising losses from birth to the sale of the finished product. Any disease that causes losses greater than 2% is likely to have a significant economic impact on that enterprise. Calf diarrhoea has been identified as the most important disease of neonatal calves, resulting in greatest economic loss due to disease in that age group in both dairy and beef calves in United States[4] and Canada[5]. Mortality rates due to calf scours in beef enterprises reported from Europe and Canada vary from 4-7%[6, 7, 8], and similar levels have been demonstrated in this study. Calf scours is not an industry wide problem, and the severity of outbreaks varies from year to year. Moreover, many veterinarians report that often different farms within a district are seriously affected each year. However serious outbreaks can be devastating to the morale and profitability of enterprise and minimising the impact of calf scours should be a significant priority within the industry.

10.1. Impact of calf scours on cow calf enterprises

10.1.1. Morbidity and mortality

Data from the questionnaires of veterinarians and farmers, together with the submission histories available from laboratories demonstrated that some farms have an extremely high morbidity and mortality due to calf scours. The majority of producers that responded to the detailed survey had calves affected with scours between six days and six weeks of age. This was also the age at which most producers lost calves to diarrhoea. However mortality rates in the producer survey were generally low, and less than 70% of affected properties had calves die from the disease. A small proportion of herds had mortality rates greater than 2% in calves from birth to 6 weeks, and in these cases the effect of calf scours on the enterprise was significant. The mortality rates reported in the Tallangatta study was higher as were those reported by veterinarians and the New South Wales Regional Veterinary Laboratories, with the greatest mortality from birth until three weeks. The mean mortality rate in outbreaks reported by veterinarians and from which samples were submitted in New South Wales was greater than 2% for all age groups less than 16 weeks of age. However this sample is likely to be biased, as veterinary investigations and diagnostic tests are more likely to be carried out in serious outbreaks.

Herds where a high mortality occurs are distressing to the owner and should be a significant concern to the industry warranting further investigation into the underlying causes.

10.1.2. Management impacts

A calf diarrhoea outbreak can be an extremely time-consuming and frustrating event for beef farmers. Affecting calves are often in large paddocks making it challenging to treat them before they can be easily caught, by which point they are often severely affected. Moreover identification of individual calves is not often practised, making it difficult to ensure that calves receive a full course of treatment. The majority of respondents to the detailed survey check calves at least once a day when experiencing a calf scour outbreak, and 40% of respondents reported that it took between 40 and 60 minutes per day to treat each affected calf. Consequently a large outbreak can be an all consuming event, detracting from managing other aspects of the enterprise.

10.1.3. Economic impact

The cost of calf scours is far more than the cost of treatment and the replacement cost of any calves lost. The loss of income from dams whose calves die, the culling cost of those cows, the time to treat affected calves, the loss of genetic potential, the reduction in capacity to improve and maintain the herd, the biosecurity cost of purchasing replacement calves and any reduction in growth rate all need to be considered. The mean cost of calf scours to producers that responded to the detailed survey was estimated at $73 per affected calf, or $19 per breeding cow. The ABARE 1998-9 to 2001-2 three-year average figures for farm cash income and herd size[9] for specialist beef producers in NSW, SA, Tas and Vic were used to calculate the economic impact this figure would have on an average beef property for each state[ω]. This figure per adult cow across the southern states equates to between10 and 15% of average farm cash income. As this was not a random study it is likely that this figure does not represent

[ω] This figure was not calculated for WA as average number of breeding cows was much higher reflecting the influence of the northern beef industry in that state.

the average beef property, but many veterinarians reported that calf scours is a widespread problem in their district and the 1966 study of diseases affecting beef cattle in Victoria reported 80% of herds had calves affected with the scours[1]. Even if the actual effect on industry were half that calculated using the ABARE figures it would represent a significant economic impact to the industry.

10.2. Pathogens causing scours in beef calves in Southern Australia

The most common pathogens diagnosed across all laboratories were cryptosporidia, rotavirus and coccidia. Coccidiosis was diagnosed more frequently from samples from New South Wales. The high prevalence of rotavirus and cryptosporidia concurs with results from a study of diarrhoea in dairy calves in Victoria in 1981[10], and these pathogens were also diagnosed in the Tallangatta studies. In many samples these pathogens were found together or in conjunction with salmonella, ETEC or coccidia. Multiple pathogens were isolated form 42% of the submissions in the Intervet database where all submissions were tested for major pathogens.

Both the current study of available laboratory data, and the Tallangatta studies fail to demonstrate ETEC as a significant pathogen in beef calves in Australia. Not all laboratories are testing for pathogenic fimbriae, and where they are only tests for K99 have been carried out, with the exception of the DPI laboratory at Bendigo. However analysis of the Intervet/DNRE data for 1998-99 showed that there were only 4 submissions from which ETEC was diagnosed and these were all in dairy calves. More recent Bendigo data demonstrates an increase in the proportion of ETEC isolated, but there are no records as to whether this is in beef or dairy calves.

Comparison of laboratory data between states indicates that there is a significant difference in the ages of calves affected between New South Wales and other states, and that there is also a different distribution of pathogens. Calves with diarrhoea in New South Wales are most commonly affected at 7-16 weeks and the most common diagnosis is coccidia. Cryptosporidia and rotavirus are still significant pathogens, but enterotoxaemia, nematode infestation and BVD/Pestivirus are also commonly diagnosed. There is more testing for these pathogens in the New South Wales laboratories than in some other states, however this would also reflect the age of calves affected.

Selenium deficiency was diagnosed in one submission from New South Wales and is causing a significant problem in WA, where a syndrome causing diarrhoea in calves on selenium deficient soil has been recognised. In these cases the calves themselves may not be clinically selenium deficient. Selenium deficiency was diagnosed as the cause of scours in 6% of submission from WA, with calves affected from 1-16 weeks. More research is required to determine the underlying pathophysiology of scours in selenium deficient areas and whether this condition is more widespread than it is current diagnoses indicate.

Yersiniosis was diagnosed in 2 cases of scours from calves aged 7-16 weeks in Tasmania and New South Wales, and there was only a single diagnosis of coronavirus also reported from New South Wales.

10.3. Diagnosis of calf scours

Few veterinary practices have a standard investigation protocol or checklist for calf scours, and often cases are discussed over the counter without a visit to the farm. In general there appears to be a lack of recognition from both veterinarians and producers on the economic impact of calf scours on an enterprise, with the focus being on cost of individual calf compared with that of veterinary visit. Part of this reflects the lack of knowledge of good preventative strategies that could be recommended to producers to minimise an outbreak. Farm visits are more common in more intensive rural areas. There are a few practices that carry out a lot of farm visits and a lot of laboratory testing and seem to have a good understanding of the epidemiology and pathology of calf scours in their area.

The cost of testing diagnostic samples, the unreliability of a conclusive outcome and the difficulty in interpreting results mean that the pathogenesis of many calf scour outbreaks is not established. Even where tests are carried out this is generally only a “one off “ event. Knowledge of the pathogens involved has seldom changed the recommended treatments or preventative practices and consequently many producers and veterinarians have questioned the benefit of diagnostic procedures. To increase the benefit from diagnostic tests, strategies need to be put in place to ensure more reliable outcomes, and the benefit of differentiating pathogens in order to fine-tune treatment and control needs to be demonstrated.

The role of diagnostic procedures is fivefold: the first 3 are of benefit to the producer

1. To establish if the pathogen is bacterial and the appropriate treatment

2. To exclude the possibility that the pathogen is a bacteria that was not cultured, by confirming an infective organism against which generic preventative measures may be applied. Whilst at this stage there are no preventative vaccinations or therapies for cryptosporida and the enteric viruses, a positive diagnosis for one of these gives the producer and veterinarian a focus and an understanding of the problem

3. To rule out preventable diseases such as enterotoxaemia and nematode infections

The final 2 are of benefit to industry

4. Disease surveillance

5. Information on the prevalence of pathogens will ensure pharmaceutical companies have appropriate targets for the development of vaccines and therapeutic control.

However at present these objectives are not being achieved in many cases, and the situation has significantly deteriorated where full-cost recovery by laboratories has been introduced. Initial examination of available data indicates there is probably more benefit from complete testing of three to five samples, than partial testing of a greater number. Although the costs of a diagnostic workup has been estimated at between $500-$1000 for most states (without subsidisation of laboratory charges), this cost needs to be considered in the light of the potential cost of the disease outbreak to the enterprise. It is possible that pooling of samples may reduce some of these costs and appropriate testing strategies need to be developed and adopted by veterinarians and veterinary laboratories.

10.3.1. The role of E. coli

Evaluation of laboratory diagnoses shows that many cultures of E. coli are being reported without further serotyping or testing for pathogenic fimbriae. In some cases infections have been diagnosed on or confirmed with histology, but the majority of cases are reported at significant or pure growths. As E. coli is a normal faecal pathogen the significance of any growth of E. coli without further evidence of pathogenicity is dubious.

E. coli produces two distinct types of diarrhoeal disease. The most commonly recognised is associated with enterotoxigenic E. coli (ETEC) that has two virulence factors involved in the production of diarrhoea. The first are fimbrial adhesins that allow them to attach to the villi of the small intestine - in calves these are most commonly K99 or F41 fimbrial antigens. Some strains possess both. 987P is another fimbrial adhesin that has been associated with disease in calves, although it is generally found in combination with K99 or F41. K88 fimbriae have not being associated with disease in calves. ETEC also have a thermostable nonantigenic enterotoxin (Sta) that influences intestinal ion and fluid secretion to produce a non-inflammatory secretory diarrhoea. ETEC generally produce disease in calves less than six days old, however the age of susceptibility may be extended when other pathogens are present. Calves initially have a swollen abdomen then pass profuse amounts of liquid faeces rapidly becoming depressed and recumbent. Hypovolaemic shock and death may occur in 12-24 hr.

The second type of diarrhoeal disease is produced by enteropathogenic attaching and effacing E. coli (EAEEC) in calves from four days two-months of age. Isolates shown in Table 56 have all been associated with attaching and effacing lesions in calves[11], [12], [13], [14], [15]. These cases often present dysentery with mucus and blood. These have been associated with a multifactorial disease complex in which other diarrhoea causing pathogens may be isolated. The clinical case may be short.

Table 56: E. coli serotypes possessing attaching and effacing sequences and associated with diarrhoea or dysentry in calves

O5:H- or NM	O26:NM or H11 or K60
O103:H2	O111:H- or NM
O113:H21	O114:H- or H40
O118:H16	O119:K69
O126:K71	

The E. coli reference laboratory at DPI Bendigo has been routinely serotyping E coli isolates and testing for K99, K88, F41 and 987P. No other laboratories are routinely serotyping E. coli isolates, and the only fimbrial antigen that is tested for in some laboratories is K99. Moreover, DPI Bendigo have not been routinely testing for the serotypes associated with EAEEC. E. coli is considered a significant pathogen by many veterinary practitioners, especially in older age groups. However at present the significance of the isolation of E. coli from a faecal culture is generally unknown unless confirmed by histology, and in many cases this is not occurring. Consequently more investigation is required to elicit the role of E. coli in calf diarrhoea outbreaks in Australia.

10.3.2. Is coronavirus a significant pathogen in Australia?

Reports from overseas indicate that coronavirus is a significant cause of diarrhoea in calves accounting for between 4 and 26% of isolates[6, 20, 16, 17, 18], although it is also associated with healthy calves[6], [19]. In the analysis of laboratory data there was only a single isolate from beef calves across the 4 laboratories from which data was collected. This can be partially explained by the fact that only 2 laboratories were testing for it, and in these laboratories it was identified using electron microscopy, which is time consuming expensive and therefore not routinely carried out. Coronaviruses are fragile and can only be reliably diagnosed with electron microscopy when the number of virions is $>10^6$/g of faeces[20]. Whilst laboratory testing has shown that electron microscopy and ELISA yield similar results, it is possible that with field samples which may be taken several days before the sample is processed, coronaviruses are deteriorating in transit, making diagnosis difficult. Eight veterinarians had diagnosed coronavirus in beef calves across New South Wales, Victoria and Tasmania in the last 5 years and it is likely that the majority of these were using the one laboratory that has been testing for coronavirus using ELISA for some years.

It is possible that coronaviruses are not as prevalent in Australia as they are in other countries, and a study that was carried out in Tasmania in the 1990s failed to show coronavirus as significant pathogen in faecal samples from calves in that State. It is because of that study that coronavirus is no longer tested for at the Mount Pleasant laboratory. However coronaviruses ELISA kits are now available in Australia and some laboratories are including them as part of their routine calf diarrhoea diagnostic protocol. Whilst there is no vaccine or therapeutic control for this pathogen in Australia, positive identification of its involvement in a calf scour problem does allow for appropriate preventative strategies to be put in place. Consequently further monitoring need to be carried out using the ELISA test to specifically ascertain if it is a common pathogen in beef enterprises in Australia. This information would not only be useful in understanding the pathology of calf scour is in Australia, but should also be considered from a human health aspect, in the light of the recent SARS outbreak.

10.3.3. Interpretation of samples from which there is no diagnosis

The number of submissions from which there was no diagnosis varied between 25% and 52% depending on laboratory. A major determinant of the percentage of successful diagnoses was the proportion that was tested for all major pathogens. Although a MPSCP may be expensive, the cost of this must be weighed against the frustration of not achieving a diagnosis.

Many enteric pathogens cause clinical symptoms before infective stages are shed in the faeces and this would account for a proportion of samples from which nothing is isolated. Similarly certain bacteria such as salmonella can be difficult to isolate, or the calf may have previously been treated with antibiotics. Like any other biological sample it is also possible that the pathogen may deteriorate in transit.

It is also possible that other enteric pathogens that have not been identified in Australia. One virus that has been identified as a significant cause of calf diarrhoea overseas is bovine torovirus (Breda virus)[21, 22,

[23]. This has been isolated from up to 26% of calves with diarrhoea, with the majority of animals affected at less than 3 weeks of age[23]. This has not been observed using electron microscopy in New South Wales or Western Australia, but diagnoses from abroad have used ELISA and RT-PCR. Further studies are required to determine the significance of bovine torovirus in the pathogenesis of calf scours in Australia.

10.4. Using management to control calf scours

Management of cows and calves around the time of calving has long been known to have a significant role in managing calf diarrhoea. Much of this research has been done overseas, and a significant proportion in housed cattle[2, 24]. There are no studies published in refereed journals that have established management strategies to minimise calf scours in Australia.

Consequently there was a huge range of recommendations from veterinarians to their clients in a calf scour outbreak. Producers also used an enormous range of management strategies for their cows and calves. Many of the strategies would have been determined by other factors such as the layout of their farm, and their nutritional management. The only factor that was shown to be associated with calf scours from the data provided in the detailed producer survey was time of calving. Herds that calved in spring had a higher proportion of calves affected with scours.

Vaccination has been advocated to control calf scours. Only a few respondents were using the available vaccines against E. coli and salmonella and in many cases this was without confirmation of the pathogen as an aetiological agent on their farm. Although vaccination is a beneficial tool when targeting the appropriate pathogens the data collected in this study did not allow assessment of the usefulness of vaccination.

It is likely that there are many more management factors that will influence the severity of calf scours on a property, however the data collected in the detailed producer survey was not precise enough to show any other statistically significant associations. A prospective study on farmers where exact details of how calves are affected, and exact measurements of parameters on the farm is more likely to show how management is influencing calf scour outbreaks.

Veterinarians have indicated that there is a significant need for increased understanding of the epidemiology and pathology of calf scours in southern Australia. This would result in them being better able to recommend appropriate preventative strategies, and also may promote the development and increased use of appropriate vaccination. It would also allow for an increased knowledge base for farmer extension.

10.4.1. Biosecurity

Sixteen farmers purchased young calves to put on cows, and further nine purchased replacement breeding stock. There were several properties that purchased a large number of calves to run as extra calves on dairy cross dams. Although there was no statistically significant association between buying calves and percentage of animals affected with calf scours, there were some properties that purchased calves that had severe outbreaks. There were also several reported instances of outbreaks after purchasing replacement calves. Biosecurity is an issue that is often not adequately addressed within the beef industry, and certainly several veterinarians commented that they had seen more outbreaks in the past year with animals being moved around in the drought. Purchasing of replacement stock can lead to exposure of cattle already on a property to new pathogens, and this, as well as purchasing calves need to be considered in any control strategy.

10.5. Management of sick calves

Management of sick calves is another area in which there is conflicting procedures and advice. One of the first hurdles on a beef property is catching and managing affected calves. There is no simple solution as either catching calves within a paddock or bringing affected calves and their dams in to treat them are time consuming. Separating the calf from the dam may be another option, but also has problems with the calf being accepted by the mother after treatment, and the increased risk of decreased milk production from the mother. Consequently on many farms effective treatment is probably not carried out well. Sick calves are often not recognised quickly enough to ensure good outcomes from treatment, they may not be individually identified and consequently may not receive a full course of treatment.

Although electrolytes are used extensively on most properties that reported a calf scour problem, often than inadequate amount is given. Electrolytes containing bicarbonate are also given on some properties when the calf is on the dam. If they calf suckles within two hours of the electrolyte feed it is possible that the milk may not form an clot in the abomasum, resulting in undigested milk passing into small intestine and exacerbating the problem.

The majority of farmers have consulted their veterinarians and are using an appropriate range of treatments. Many farms are using electrolytes in conjunction with an oral scour antibiotic, although 10% of farms are using oral scour antibiotics by themselves. Oral scour antibiotics are recognised as an "effective" method of controlling calf scours by producers, even though the survey has shown that the majority of outbreaks are not due to a bacterial course. Over half the producers are using injectable antibiotics on some calves, although the antibiotic used is not always appropriate for enteric disease. On many properties there is significant under-dosing of calves with antibiotic therapies, mainly because animals are not receiving a full course of treatment.

The most significant observation on how sick calves are treated is the large variation from property to property even when similar disease presentations are described. A goal for the Australian industry must be to determine cost-effective and practical methods of treating scouring calves.

10.6. Areas for further research and clarification

This report has shown that there are significant areas that need to be addressed by further research into the epidemiology and control of scours within Australia. The survey also revealed some specific topics that need to be clarified.

The exact impact of calf scours on the subsequent growth rate of calves needs to be determined. A survey of 70 calves in the second Tallangatta study showed no difference in weaning weights, but information is needed across a broader base.

The relationship between cow production and calf scours required clarification. Should farmers restrict feed, calve at a time of year when there is a feed shortage or select breeds that do not have abundant milk, to ensure that calves do not initially receive an unlimited amount of milk, or does this strategy limit calves growth not calf scours?

One third of the respondents to the detailed producer survey bred Angus cattle. Whilst recognising that there has been significant increase in the prevalence of this breed in Australia in the last 10 years, this seems to be a disproportionate number. In a case control study in Switzerland 67% of the calves were Angus or Angus crossbreds[25]. Whilst there are many other factors that will influence the prevalence of severity of calf diarrhoea, any increased predisposition of Angus cattle needs to be established due to the rapid increase of popularity of this breed.

11. CONCLUSIONS

This study has demonstrated that calf scours is the most significant and time-consuming disease problem on many beef properties. Calves are most severely affected between one and six weeks of age. The disease is multifactorial and in many cases several pathogens are found concurrently. The most common pathogens are cryptosporidia and rotavirus, however, coccidiosis has a significant role especially in New South Wales. Diagnosis is frustrating, because it is relatively expensive and results are not guaranteed. Moreover cost constraints and diagnostic protocols are resulting in incomplete testing of specimens and consequently a higher rate of no diagnosis.

A higher prevalence of calf scours is associated with herds that calve in spring, but no other significant association between management and herd prevalence was shown by this study. Producers are employing a large and contradictory range of management practices to control and treat calf scours, indicating that there is little clear and consistent advice available. The establishment of key management strategies at a herd level is essential to minimise calf scours in Australia.

11.1. Success in achieving objectives

The multi-faceted design of the project has resulted in a good overview of the issues relating to calf scours in cow calf enterprises in Australia. Although issues pertaining to calf rearers have been not documented as thoroughly, the initial questionnaire received few responses from producers involved in this aspect of the industry. It is likely that these producers are based in dairy areas where there is better veterinary servicing and extension. It is also probable that there is better understanding of the management issues involved in the control of calf scours in housed calves. The analysis of data from different veterinary laboratories has given a good picture of the common pathogens that are being diagnosed, the variation from state to state and also the issues involved in achieving a satisfactory diagnosis.

The producer questionnaires have allowed a thorough assessment of the impact of calf scours on cow calf enterprises. Unfortunately it was not possible to statistically show how variation in management between farms affected the prevalence of calf scours. In order to achieve this, better definition of different management strategies than is allowed by a telephone survey is required, together with exact records of stock affected and stock losses together with their date of birth. Many beef producers do not to document this information to the detail required.

11.2. Impact on Meat and Livestock industry - now and in five years time

Scours in beef calves has been an ongoing issue for the producers for many years. Little research has been carried out in Australia and where it has been no satisfactory strategies to minimise the impact have been demonstrated. In order for this project to have impact on the meat and livestock industry, a whole of industry approach is required to implement the recommendations. The goal for the industry in five years time is to have a clear and consistent approach to calf scours documented and adopted by producers, advisers, veterinarians and veterinary pathology laboratories. It is unlikely that in the foreseeable future, effective control methods will be available to minimise the impact of calf scours on all properties, but successful strategies need to be put in place to minimise the frustration associated with this problem, enable good therapeutic outcomes and provides preventative strategies to minimise ongoing problems on affected properties.

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APPENDIX 1: INITIAL PRODUCER QUESTIONNAIRE

1. How would you rate calf scours as a problem on your farm?

Major □ Minor □ Don't see □ Used to be □

2. Is your beef operation:

Cow / calf □

Calf rearing (Bull beef / vealers) □

Other _____

3. How many calves do you rear each year? _____

4. Which months do your cows calve in? _____

5. How many hectares is your beef operation? _____

6. What is the average make up of your beef herd?

Adult cows: _____ Yearlings _____

Bulls: _____ Calves _____

7. Have you consulted your veterinarian about calf scours?

Yes □ No □

8. Do you vaccinate your cows for:

Salmonella □ E.coli □ 5 in 1 / 7 in 1 □

9. What percentage of your calves are affected by scours in the following age groups?

	Affected	Die
0-5 days	_____%	_____%
6-21 days	_____%	_____%
3-6 weeks	_____%	_____%
7-16 weeks	_____%	_____%

10. Which pathogens have been isolated from faecal samples taken from scouring calves?

E. coli □ Rotavirus □ Coronavirus □ Cryptosporidium □ Coccidiosis □

Salmonella □ Yersina □

Other (please specify) _____

11. What treatments work on your farm?

Oral fluids Yes / No / Don't use

Scour tablets/liquid Yes / No / Don't use

IV Fluids Yes / No / Don't use

Injectable antibiotics Yes / No / Don't use

Other _____

12. Can we contact you for more details? Y / N

Name: _____

Address: _____

State: _____ Postcode _____

Phone: _____ Fax: _____

E-mail: _____

APPENDIX 2: MLA DETAILED CALF SCOUR SURVEY

Cow calf enterprises
Name ID

Enterprise overview

1. How many breeding cows did you calve in the last year? ☐

2. a) How many calves did you rear in the last year? ☐

2 b) How many calves did you buy in to rear on cows? ☐

3. In the past 3 years has your number of breeders
   - Increased by more than 20% ☐
   - Decreased by more than 20% ☐
   - Stayed about the same ☐

4. In the past 3 years has your stocking rate
   - Increased ☐
   - Decreased ☐
   - Stayed about the same ☐

5. What is the market for your cattle?
   - Vealers ☐
   - Stores ☐
   - Feedlot ☐
   - Replacement heifers ☐
   - Other ☐

6. What breed of cattle you have?

   _____

7. Dou you routinely purchase
   - Calves/ unjoined heifers ☐
   - Mated Heifers ☐
   - Adult cows ☐

8. Do you pregnancy test? Y / N

9. How many cows calved in the last calving period? ☐

10. How many cows and heifers did you join to calve in this calving period? ☐

11. a) How many calves did you wean from this calving period? ☐

or

b) *If they haven't weaned the calves yet - how many did they brand?* ☐

or

c) If not branded yet how many did they wean from the last mob? ☐

How many did they calve down in this mob ☐

Risk Factors

Calving management

12. Which month do the majority of your cows calve in

Jan	Feb	Mar	Apr
May	Jun	Jul	Aug
Sep	Oct	Nov	Dec

13. What percentage of calvings do you have to assist?

    < 5% 5-10% 10-20% >20%

14. What % of calves are born dead or die within 48 hours of calving?

    < 2% 2-5% 5-10% >10%

15. Do you routinely drench your cows for worms around the time of calving? Y / N

Colostrum

16. Do you supplement any of your calves with colostrum or colostrum substitutes (Biocol). Y / N

17. Do you routinely monitor colostrum intake by:

a) Testing the colostrum with a colostrometer Y / N

b) Blood sampling calves when they are a few days old to check for antibody levels Y / N

First calf heifers

18. How many first calf heifers do you calve each year? ☐

19. Is there any difference in % of calves that scour between 1st calf heifers and older cows?
    - No Difference ☐
    - Calves from heifers scour more ☐
    - Calves from older cows scour more ☐

Don't Know ☐

Environment

Calving Paddocks

20. Do you:

Rotate calving cows through several calving paddocks ☐

Set stock with the calving group split between one or more paddocks ☐

Other_____

_____

21. What % of the paddocks where you calve cows are sheltered from the prevailing wind?

Not sheltered ☐
<25% shelter ☐
25-50% shelter ☐
50-75% shelter ☐
> 75% shelter ☐

22. Do your calving paddocks have shade? Y / N

23. *If yes is there*?

No shade ☐
Occasional tree ☐
Large areas of shade ☐
Other:_____

24. How often are the calving paddocks muddy at calving time?

Never ☐
Only after heavy rain ☐
In the last ½ of calving ☐
10% - 50 % of the time ☐
More than 50 % of the time ☐
Always ☐

Paddocks where calves are reared

25. Do you use the same paddocks every year for cows with young calves? Y / N

26. What % of the paddocks where you run cows with young calves are sheltered from the prevailing wind?

Not sheltered ☐
<25% shelter ☐
25-50% shelter ☐
50-75% shelter ☐
> 75% shelter ☐

27. Is there water in all paddocks? Y / N

28. What are the sources of water?

River/creek/channel ☐
Water trough ☐
Dam ☐
Bore ☐
Other _____

29. Does your water supply originate from run-off water from paddocks? Y / N

30. If only some of your water originates from paddock run-off do you get more calf scours in the paddocks where the calves drink this water? Y / N

31. How far do the cows have to walk between water and shade?

< 99 m ☐
100 -199 m ☐
200 - 499 m ☐
500 – 999 m ☐
1-2 km ☐
> 2km ☐

32. Are there any physical barriers such as high troughs, steep banks or mud that limit the calves access to water. Y / N

Nutrition

Pastures

33. Do you:

Set stock ☐
Rotational graze ☐
Cell graze ☐
Other _____

34. Which months would you expect to have rapidly growing lush grass?

Jan	Feb	Mar	Apr
May	Jun	Jul	Aug
Sep	Oct	Nov	Dec

35. Which months do you apply fertiliser?

Jan	Feb	Mar	Apr
May	Jun	Jul	Aug
Sep	Oct	Nov	Dec

Supplementary feed

36. Can you estimate for an **average** year

a) What is the total tonnes of hay that you would feed to your herd per year _____

b) What is the total tonnes of silage that you would feed to your herd per year _____

c) What is the total tonnes of grain that you would feed to your herd per year _____

37. Do you routinely condition score your cows Y / N

38. Do more calves scours in years when cows calve in light condition Y / N / Not sure

Minerals

39. In the last 10 years have blood tests for mineral deficiency in cows shown
    - Copper deficiency ☐
    - Cobalt deficiency ☐
    - Selenium deficiency ☐
    - Other_____
    - Not tested ☐

40. Do you supplement breeders with:
    - Copper ☐
    - Cobalt ☐
    - Selenium ☐
    - Magnesium ☐

Other diseases

41. What percentage of your cows get grass tetany

    0 < 5% 5-10% 10-20% >20%

42. What percentage of your cows get milk fever

    0 < 5% 5-10% 10-20% >20%

43. What percentage of your calves less than 4 months get pneumonia

    0 < 5% 5-10%

    10-20% 20-50% >50%

44. What percentage of your calves get infected navels

    0 < 5% 5-10%

    10-20% 20-50% >50%

45. What percentage of your calves get "joint ill" (lameness from infected joints)

    0 < 5% 5-10%

    10-20% 20-50% >50%

46. Have you ever had pestivirus diagnosed on your farm? Y / N

47. Do you have any other major metabolic or disease problem affecting cows or calves on your farm? Please detail

_____

_____

_____

Calf management

48. At what age do you first drench your calves for worms?

- < 4 weeks ☐
- 4-8 weeks ☐
- 8-12 weeks ☐
- 12-16 weeks ☐
- > 16 weeks ☐
- Never ☐

49. At what age do you disbud/dehorn your calves

- Have polled cattle ☐
- < 4 weeks ☐
- 4-8 weeks ☐
- 8-16 weeks ☐
- 4-12 months ☐
- > 1 year ☐
- Leave horns on ☐

50. When do you castrate calves?

- < 4 weeks ☐
- 4-16 weeks ☐
- > 4 months ☐
- Don't castrate ☐

The problem

What is the problem?

1. How old are your calves when you first see signs?
   - 0-5 days ☐
   - 6-21 days ☐
   - 3-6 weeks ☐
   - 7-16 weeks ☐
   - > 16 weeks ☐

2. What was the total number of calves that were born in the past 12 months ☐

3. a) How many calves (in numbers) were affected by scours in the following age groups in the past 12 months?

   b) How many calves (in numbers) died of scours in the following age groups in the past 12 months?

	Affected	Die
0-5 days	_____	_____
6-21 days	_____	_____
3-6 weeks	_____	_____
7-16 weeks	_____	_____
> 16 weeks	_____	_____

4. Do the calves show the following symptoms? (Tick all that apply)

Soft faeces	Y / N	Lethargy	Y / N
Watery diarrhoea	Y / N	Distended abdomen	Y / N
Blood in the faeces	Y / N	Kicking at belly	Y / N
Straining	Y / N	Coughing	Y / N
Dehydration	Y / N	Death	Y / N
Panting	Y / N		

5. Do you notice more calf scours with any of the following situations (tick all that apply)
   - Wet weather ☐
   - Cold weather ☐
   - Windy weather ☐
   - Introduction of calf pellets ☐
   - Change in calf pellets ☐
   - Spring/ autumn flush ☐
   - Feed shortage for cows ☐

6. Have faecal tests been carried out to determine the cause of the calf scours on your farm? Y / N

If answer to 6 is no go to Q 8

7. Was anything found on these tests? Y / N

If answer is yes go to Q 9a) If answer to 7 is no go to Q 9b

8. *Has your veterinarian suggested faecal tests should be taken?* Y / N

Go to Q 9b

9. **

	a)	b)	c) Ask the series of Q's below if answer to a) or b) is yes				
Disease	a) Which of the following have been diagnosed from faeces samples on your farm?	b) Is there a suspicion that any of the following diseases may be present?	What age group of calves are affected?	How many calves have been affected by this in the past year	Have you had more calves affected in previous years? If yes please put the year and how many were affected	How many calves died from this in the past year?	Have you had more calves die in previous years? If yes please put the year and how many were affected
E. Coli	Y / N	Y / N					
Salmonella	Y / N	Y / N					
Yersinia	Y / N	Y / N					
Cryptosporidium	Y / N	Y / N					
Coccidiosis	Y / N	Y / N					
Rotavirus	Y / N	Y / N					
Coronavirus	Y / N	Y / N					
Intestinal worms	Y / N	Y / N					
Pestivirus	Y / N	Y / N					

Prevention of calf scours

10. Do you vaccinate for *Salmonella (Bovilis S)*? Y / N

If answer is no go to 13

11. How many years have you vaccinated for *Salmonella (Bovilis S)*?

1 year ☐
2-3 years ☐
4-5 years ☐
> 5 years ☐

12. What difference has vaccination with Salmonella vaccine made to the number of calves

	No Difference	Less	More
Scouring in the first week of life			
Dying in the first week of life			
Scouring after the first week of life			
Dying after the first week of life			

13. Do you vaccinate for E coli (Bovac)? Y / N

If answer is no go to 16 if they who isolated E coli in Q 9. If they have not isolated E coli go to Q 17

14. How many years have you vaccinated for *E. coli (Bovac)*?

1 year ☐
2-3 years ☐
4-5 years ☐
> 5 years ☐

15. What difference has vaccination with Bovac made to the number of calves

	No Difference	Less	More
Scouring in the first week of life			
Dying in the first week of life			
Scouring after the first week of life			
Dying after the first week of life			

16. *****If E. coli has been isolated from calves on your farm, but you are not vaccinating why not?

Not suggested by my veterinarian ☐
Discussed the possibility with my veterinarian but didn't think the problem was severe enough to warrant it ☐
Too expensive ☐
Will take too much time ☐
Don't have good enough facilities ☐
Tried vaccinating but it made no difference ☐
Tried vaccinating but the results weren't good enough to warrant the time and expense ☐

17. Did you previously vaccinate for Rotavirus? Y / N

If answer to 17 is no go to Q 19

18. Did the Rotavirus vaccine

Reduce the number of scouring calves Y / N
Reduce the number of dead calves Y / N

Management of sick calves

Please give answers for your average case: obviously there will be exceptions for extremely severe or very mild cases

19. How often do you look for sick calves?

Twice a day ☐
Once a day ☐
Every second day ☐
Every 3-4 days ☐
Every 5-7 days ☐
Less than once a week ☐

20. Do you have an isolation area for sick calves? Y / N

21. Do you remove the calves from their mothers to treat them Y / N

22. If yes, how long do you remove them for

12 hours or less ☐
12-24 hours ☐
25-48 hours ☐
> 48 hours ☐
Until they have stopped scouring ☐

23. How long do you isolate the cow and the calf from other cows with calves?

- Don't isolate them ☐
- 24 hours or less ☐
- 1-3 days ☐
- 3-7 days ☐
- > 1 week ☐
- Until the calf has stopped scouring ☐

24. How many litres of electrolytes do you feed each day to a scouring calf

- Don't feed electrolytes ☐
- 2 litres or less ☐
- 2.1 - 4 litres ☐
- 4 .1 - 6 litres ☐
- > 6 litres ☐

25. If you feed electrolytes which brands do you use (Tick all that apply)?

Hydrate Liquid	☐	Lactolyte	☐
Lectade	☐	Scourlyte	☐
Scourproof	☐	Vytrate	☐

Other _____

26. Do you use any electrolytes with extra energy such as Albicalb or Diarrest? Y / N

27. a)*** Which Scour tablets/liquid do you use (fill in 1st column)?
b) **** Which injectable antibiotics do you use? (Continue in first column)

c) for each drug in first column ask the dose they would use and the number of days they would treat for (If they are not sure of the dose ask if it is as prescribed by your veterinarian if yes put "AP" in the dose box)

Drug	Dose	Number of days you treat for

28. Do you use other supplements such as probiotics or Biocol Y / N
29. Do you treat everything that scours? Y / N

30. If no which scouring calves do you treat (Pease tick all appropriate)

- Calves that are dehydrated ☐
- Calves that look sick ☐
- Calves that have blood in their faeces ☐
- Calves with very watery scours ☐

Other _____

Ask question below for each option unless have indicated they don't use the treatment in the last section

If the answer is no put a 0 in this column, if yes ask questions below

31. Do you treat scouring calves with :	Percent of scouring calves treated in this way	Percent of treated calves that recover
Electrolytes only		
Scour tablet/liquid only		
Injectable antibiotic only		
Scour tablet/liquid plus electrolytes		
Scour tablet/liquid plus injectable antibiotics		
Veterinary "intensive care " - IV Fluids etc		
No treatment		
Other:		

Interaction with your veterinarian

32. Who is your veterinarian?

Name: _____

Practice: _____

Address _____

_____

Phone: _____

33. At what point would you contact your vet with a scour problem?

- When you first see scours ☐
- When at least 5% of the group are affected ☐
- If the treatment that you usually use isn't working ☐
- When calves start dying ☐
- When you have lost at least 2% of the group ☐
- Never ☐

34. What is your vet likely to do?

- Visit the farm ☐
- Get you to bring calves in ☐
- Get you to bring faeces samples in ☐
- Prescribe you drugs over the counter ☐

Other_____

_____

35. Has you veterinarian carried out any post-mortems? Y / N

Effect of calf scours on the profitability of your enterprise

36. What effect does the disease have on calf growth? (Please tick **one** box)

- No effect ☐
- Can pick calves that scoured at weaning ☐
- Can pick calves that scoured 2 months after outbreak ☐
- Can pick calves that scoured 1 month after the outbreak ☐

37. How much time is involved in treating each sick calf per day on average?

- Less than 10 minutes ☐
- 10-20 minutes ☐
- 20-40 minutes ☐
- 40-60 minutes ☐

38. Have you estimated the cost of calf scours to your enterprise? Y / N

39. **If yes** what is the cost per sick calf? $_____

40. **If yes** what is the cost to you per year? $_____

41. Is there anything else relevant to your calf scour problem that we haven't asked you about?

_____

_____

_____

_____

_____

42. Where do you see the main areas of further research and /or product development need to be to minimise the impact of scours in beef enterprises?

_____

_____

_____

_____

_____

Thank you for your time

APPENDIX 3: MLA CALF SCOURS PROJECT VETERINARY SURVEY

Code no: X0NN

Practice background

1. How many beef farms in your area? _____
2. What % of these do you service? _____%

3. What are the main types of beef enterprises in your region? (please give approximate proportion)

Cow/calf _____% Bull beef _____% Steer rearing _____% Feedlot _____% Other _____%

Information on calf scours

4. In your practice what percentage of calf scour outbreaks between birth and 4 months of age are reported in:

- Cow/calf operations _____%
- Beef calf rearing operations _____%
- Other (name if > 20%) _____%

5. Please estimate what % of beef cow/calf operations serviced by your practice would vaccinate for

- Salmonella _____%
- *E. coli* _____%

6. Please indicate what percentage of outbreaks would be in each of the following age groups

0-5 days _____%

6-21 days _____%

3-6 weeks _____%

7-16 weeks _____%

7. Please give an indication of the typical problem that you treat in each age group:

	Mean Group Size	% Affected	% Mortality
0-5 days	_____	_____	_____
6-21 days	_____	_____	_____
3-6 weeks	_____	_____	_____
7-16 weeks	_____	_____	_____
> 16 weeks	_____	_____	_____

Laboratory testing

8. Which laboratory do you send faecal samples to?_____

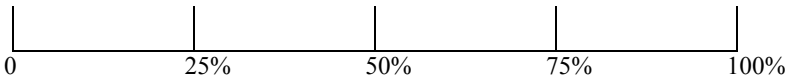
9. Do you ask for a calf scour package (if available) ☐ or specific tests? ☐

10. If specific tests, which of the following would you routinely include– please indicate all appropriate:

- Faecal float ☐
- Protozoan smear ☐
- Bacterial culture & sensitivity ☐
- Viral isolation ☐
- E. coli typing ☐
- Salmonella phage typing ☐

11. From what proportion of beef calf scour problems would you send away faecal samples?

(Please put a cross on the line in the appropriate place)



12. If you send away samples how many are sent for the average outbreak? _____

13. Please indicate the approximate numbers of the following that you would have isolated in the last 5 years:

Isolate	Number	%
Salmonella		
E. Coli		
Yersinia		
Rotavirus		
Coronavirus		
Cryptosporidia		
Coccidiosis		
Pestivirus		
No growth		
Other		

Isolation of *E. coli*

14. Please indicate the age groups in which your laboratories isolating *E. coli* from faecal samples

0-5 days	Y / N
6-10 days	Y / N
11-21 days	Y / N
> 3 weeks	Y / N

15. In which age groups are you attributing isolation of *E. coli* to significant clinical disease.

0-5 days	significant	/	not significant
6-10 days	significant	/	not significant
11-21 days	significant	/	not significant
> 3 weeks	significant	/	not significant

16. Are you finding resistant strains of *E. coli*? Y / N

If you are finding resistant strains please detail the antibiotics to which *E. coli* is resistant

_____

Isolation of Salmonella

17. Are you finding resistant strains of Salmonella? Y / N

If you are finding resistant strains please detail the antibiotics to which *Salmonella* is resistant

_____

Recommendations to farmers

Approach to an outbreak

18. If a beef farmer contacts you with a calf scour problem:

a) Does your practice have a standard protocol / checklist to work up a calf scour problem Y / N

b) What % of these inquiries would you visit the farm? _____%

c) For those cases where you don't visit the farm, what % of the time would the farmer bring faeces samples in? _____%

d) What % of these inquiries would you dispense the farmer treatment without a visit? _____%

e) What % of the time would you insist on a visit before giving prescription drugs and have the farmer refuse this offer _____%

Control and Prevention

19. Do you recommend management changes to control an outbreak of calf scours? Y / N

20. What changes have you recommended? Please indicate how successful have they been

Management Change	Very Successful	Moderately successful	Little Success	Don't recommend

Cow calf operations

Provide additional shelter	☐	☐	☐	☐
Change paddock that affected herd is running in	☐	☐	☐	☐
Fence of muddy areas +/- areas where calf "creches" are located	☐	☐	☐	☐
Vaccinate cattle for *E. coli* before calving	☐	☐	☐	☐
Vaccinate cattle for *Salmonella* before calving	☐	☐	☐	☐
Alter timing of calving – different season	☐	☐	☐	☐
Manage 1st calvers separately	☐	☐	☐	☐
Check colostrum quality of heifers	☐	☐	☐	☐
Check colostrum quality of all age groups, either every cow or selected animals	☐	☐	☐	☐
Monitor serum protein or antibody levels in calves	☐	☐	☐	☐
Others – please detail				
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐

Calf rearing operations

Introduce incentives to ensure that calves get adequate colostrum at birth	☐	☐	☐	☐
Feed calves electrolytes for 1st 24 hours on the farm	☐	☐	☐	☐
Ensure calves are fed twice a day for first 2 weeks	☐	☐	☐	☐
Change the milk powder formulation so that calves are getting more total powder	☐	☐	☐	☐
Change the milk powder formulation so that calves are getting less total powder	☐	☐	☐	☐
Change from powdered milk to whole milk	☐	☐	☐	☐
Change from whole milk to powdered milk	☐	☐	☐	☐

Calf rearing operations continued	Very Successful	Moderately successful	Little Success	Don't recommend
Ensure calves have access to fresh water at all times	☐	☐	☐	☐
Improve hygiene	☐	☐	☐	☐
Decrease number of calves in the pen	☐	☐	☐	☐
Rear calves in individual pens for 1st 2 weeks	☐	☐	☐	☐
Introduce an "all in all out" policy	☐	☐	☐	☐
Ensure that calves from different sources are kept in separate groups	☐	☐	☐	☐
Others – please detail				
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐

Treatment

General

21. If you only have a clinical history what of the following treatments are you likely to use (please tick as appropriate):

	Calf bright and alert	Calf depressed and dehydrated
• Isolation of calf? ☐	☐	
• Isolation of dam and calf	☐	☐
• Oral electrolytes ☐	☐	
• Oral fluid therapy with additional energy supplement – eg Albicalb®	☐	☐
• S/C fluids	☐	☐
• Scour tablets/liquid?	☐	☐
• Injectable antibiotics – which one? _____	☐	☐

22. What percentage of cases would receive IV fluid? _____%

23. Is there any other treatment that you might use? _____

_____

Specific cases

24. What would be your specific recommendations for outbreaks of the following (Please tick as appropriate):

	Salmonella	E. Coli	Yersinia	Rotavirus	Coronavirus	Cryptosporidia	Coccidiosis
Isolation of calf?							
Isolation of dam and calf							
Oral electrolytes							
Oral fluid therapy with additional energy							
S/C fluids							
Scour tablets/liquid							
Parenteral antibiotics Oxytetracycline							
Amoxil							
Trimethoprim/Sulphur							
Apramycin							
Other: Please state what							
IV fluid							
Others: Please detail							

Feedback on the project:

25. Do beef scours have a significant economic impact on producers in your area? Y / N

26. What assistance does your practice need to overcome scour problems on beef farms?

- Information packages for farmers ☐
- Newsletter "grabs" ☐
- Farmer workshops ☐
- Information on "best practice" investigation protocols ☐
- Information on appropriate laboratory work-up ☐
- Information on effective preventative strategies ☐
- Regular updates form local laboratories on most common isolates and resistance patterns ☐
- Interactive website for farmers ☐
- Interactive website for veterinarians ☐
- Educational videos ☐
- Other (Please detail) _____
- _____

27. Where do you see the main areas of further research and /or product development need to be to minimise the impact of scours in beef enterprises?

_____

_____

_____

Other comments

_____

_____

_____

Thank you very much for your help