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Authors

Maier, Gabriele
Gomez, Jose P
Breitenbuecher, Jefferson GC
et al.

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Protocol for a Scoping/Systematic Review: Scoping Review of Vaccination for the Prevention of Calf Scours in Cow-Calf Operations

Maier, G.¹, Gomez, J. P. P.¹, Breitenbuecher, J. G. C.², Fausak, E. D.³, and Van Noord, M. G.³

1. Department of Population Health and Reproduction, School of Veterinary Medicine, University of California Davis
2. Center for Comparative Medicine, University of California, Davis
3. University Library, University of California, Davis

Abstract

Background: The use of antimicrobials in the livestock industry has been a topic of increasing concern in the last few years. Calf scours is one of the main causes of mortality among calves younger than 1 month and affects the development of the animal, representing severe economic losses to the producers. The causes of the disease include a variety of viral, bacterial and protozoal pathogens, and other non-infectious causes. The treatment efficacy, in particular of antimicrobial therapy, depends on the type of infection. Blanket antimicrobial treatment for calf scours without identification of the pathogen may contribute to antimicrobial resistance. In this review we explore the available literature for evidence of effective methods to prevent calf scours in cow-calf operations in California through the use of vaccination.

Objectives: The objective of this scoping review is to examine and describe the existing literature on vaccination for the prevention of calf scours that might reduce the incidence of calf scours by different causes, and therefore reduce the use of antimicrobials due to calf scours.

Design: Primary research on vaccination for pathogens that cause calf scours will be considered for inclusion, such as studies conducted in pre-weaned calves that report the efficacy of vaccines for the prevention of calf scours. The process for selection and inclusion of the studies will be reported in a flow chart according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). The results will be summarized in tables and charts describing study types, interventions and outcomes.

Introduction

Rationale

Calf scours (also known as calf diarrhea or enteritis) is a gastrointestinal disease that affects pre-weaned calves. The disease can be fatal to young calves due to loss of fluids and acidosis that may result in anorexia and ataxia ¹. Calf scours can be economically devastating for the producers due to the high mortality and the decrease of development in infected animals ². The disease can be attributed to both infectious and non-infectious causes. Non-infectious causes include vitamin deficiency or an abrupt change in the diet. Infectious causes involve a variety of pathogens including viral, protozoal and bacterial pathogens, where one or more can be involved ³.

The diagnosis of the disease-causing pathogen requires laboratory examination of samples from diseased animals, and effective treatment depends on the type of pathogen the animal is infected with. In a case of viral infection, treatment with antimicrobials will not be effective as opposed to some cases of bacterial infection¹⁰. The standard treatment of affected animals includes fluid therapy, isolation of infected animals, supportive care and may include the use of antimicrobials^{4,5}. Prevention of calf scours can be achieved via management practices and biosecurity⁶, immunization by vaccination⁷ and a high quality colostrum supply^{8,9}. During many years, one of the practices most commonly used to prevent calf diarrhea was to provide oral antibiotics in the diet, which has been prohibited in many countries in order to reduce antimicrobial resistance development. Currently, commercial vaccines for most of the pathogens that cause calf diarrhea are available, targeting either the dam or the calf. For this scoping review we will focus on vaccination as a prevention method for calf scours.

California Department of Food and Agriculture's Antimicrobial Use and Stewardship group (CDFA-AUS) conducts a statewide program to promote actions that reduce the use of antimicrobials and therefore reduce the development of resistant bacteria associated with livestock and poultry that can have negative public health impacts. Although general recommendations of prevention methods such as vaccination and biosecurity exist, it is unclear what information is available in the literature on these topics, which is why we decided on a scoping review for this project.

The proposed scoping review is part of the effort by CDFA-AUS to develop best practices for California cow-calf operations. It is expected that the usefulness of the resulting tools and documents will expand beyond the state boundaries. Although the scoping review will be conducted with practices and conditions in California in mind, the information gained may be applicable to a much broader audience. The proposed scoping review addresses the need for information on ways to prevent or treat this disease using non-antimicrobial approaches.

Objectives

The primary objective of this scoping review is to provide a comprehensive overview on the use of vaccines to prevent calf scours relevant to California cow-calf operations. We aim to identify the existing literature and describe the methods, interventions used, and outcomes reported. Further objectives are to identify the need for systematic reviews in specific areas with abundant information or further research in areas with lacking information.

Methods

Eligibility criteria

The following studies will be included:

- Original scientific reports
- All study designs (observational and experimental) except case studies.
- Study population restricted to pre-weaned calves or calves less than 6 months of age., i.e. domesticated members of the genus *Bos*
- Intervention described is applicable to cow-calf operations
- Published in English language in or after 1950
- No geographical restrictions

- Study compares a vaccination regime for the prevention of calf scours to either a placebo or other intervention.
- Contains a quantifiable outcome including but not limited to incidence of disease, cause-specific mortality, duration of disease, weight gain.
- Study design includes diagnosis for any of the causative agents of calf scours: Bovine rotavirus, Bovine coronavirus, Bovine viral diarrhea virus, Torovirus, Norovirus, Neboviruses, Salmonella, E. coli, Clostridium perfringens, Shigella, Yersinia, or Cryptosporidium parvum, Giardia lamblia or a clinical diagnosis.
- Peer-reviewed or conference proceedings of >500 words.

All study designs except case series or case studies will be considered as these latter study types do not include hypothesis testing. The publication “California Agriculture” as well as conference proceedings for the American Association of Bovine Practitioners, the World Buriatrics Association, American College of Veterinary Internal Medicine, American Veterinary Medical Association and the Conference of Research Workers in Animal Diseases will be reviewed for the last 20 years. “California Agriculture” is a publication specifically for research conducted through scientists that are part of University of California’s Agriculture and Natural Resources framework and all research published is highly relevant to systems in the state. The conference proceedings mentioned are the most likely sources for unpublished research abstracts we are interested in. In addition, the bibliographies of studies fitting the search criteria will be examined for studies not captured by the search. Webpages of vaccine manufacturers will be explored for information on relevant studies. The decision to limit publications to English language only was made so that interested veterinarians or producers would be able to look up and read all studies included. 1950 was chosen as the earliest timepoint for study publication in order to limit the oldest included studies to a timeframe where at least some antimicrobials were already available.

Information sources

A literature search using the following databases and interfaces will be designed and conducted through the Carlson Health Library at the School of Veterinary Medicine at the University of California Davis with input from other study team members.

Database	Interface
Medline	PubMed
CAB Abstracts	CAB Direct
Biosis	Web of Science

Search strategy:

Research Question: Which vaccines given to calves or dams may lead to a decrease in calf scours in beef calves?

Databases and Interfaces Searched:

Database	Interface	Date Coverage	Date Searched
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Medline	Pubmed	1966 to Current	11.22.2019
CAB Abstracts	CAB Direct	1972 - Current	11.22.2019
Biosis	Web of Science	1926 - Current	11.22.2019

Full Search Strategy:

Searcher: Megan Van Noord

Peer Reviewer: Erik Fausak

PubMed

Search	Query	Items Found
#1	((("Cattle"[Mesh] OR cattle[tiab] OR cow[tiab] OR cows[tiab] OR bos[tiab] OR bovine[tiab] OR bovines[tiab] OR bovinae[tiab] OR heifer[tiab] OR heifers[tiab] OR bullocks[tiab] OR oxen[tiab] OR steer[tiab] OR steers[tiab] OR Angus[tiab] OR Ayrshire[tiab] OR Boran[tiab] OR Brahman[tiab] OR Brangus[tiab] OR Braunvieh[tiab] OR Charolais[tiab] OR Fleckvieh[tiab] OR Friesian[tiab] OR Gelbvieh[tiab] OR Gir[tiab] OR Hereford[tiab] OR Holstein[tiab] OR Jersey[tiab] OR Limousin[tiab] OR Longhorn[tiab] OR Nellore[tiab] OR Ongole[tiab] OR Sahiwal[tiab] OR Sanga[tiab] OR Shorthorn[tiab] OR Simmental[tiab] OR Wagyu[tiab] OR beef[ti] OR herd[ti]) AND (calf[tiab] OR calves[tiab] OR calving[tiab])) OR ((calf[tiab] OR calves[tiab] OR calving[tiab]) AND ("Animals, Newborn"[Mesh] OR "Animals, Suckling"[Mesh] OR neonatal[tiab] OR newborn[tiab] OR newborns[tiab] OR "pre-wean"[tiab] OR prewean[tiab] OR "pre-weaning"[tiab] OR preweaning[tiab] OR "pre-weaned"[tiab] OR preweaned[tiab] OR nursing[tiab] OR suckling[tiab] OR "after birth"[tiab] OR "before weaning"[tiab] OR young[tiab])) OR (calf[ti] OR calf[ot] OR calves[ti] OR calves[ot]))	48,504
#2	"Bovine Virus Diarrhea-Mucosal Disease"[Mesh] OR "Gastroenteritis/veterinary"[Mesh] OR "Diarrhea"[Mesh] OR diarrhea[tiab] OR diarrheic[tiab] OR diarrheal[tiab] OR diarrhoea[tiab] OR diarrhoeal[tiab] OR scour[tiab] OR scours[tiab] OR scouring[tiab] OR "fecal score"[tiab] OR "faecal score"[tiab] OR "watery feces"[tiab] OR "watery faeces"[tiab]	122,664
#3	"Escherichia coli"[Mesh] OR "Escherichia coli"[tiab] OR "E coli"[tiab] OR "Escherichia coli Infections"[Mesh] OR "Salmonella"[Mesh] OR Salmonella[tiab] OR Salmonellosis[tiab] OR Salmonellosis[tiab] OR "Salmonella Infections"[Mesh] OR "Clostridium"[Mesh] OR clostridium[tiab] OR clostridiales[tiab] OR clostridiaceae[tiab] OR clostridia[tiab] OR "Clostridium Infections"[Mesh] OR "Shigella"[Mesh] OR shigella[tiab] OR shigellosis[tiab] OR "shiga bacillus"[tiab] OR "Dysentery, Bacillary"[Mesh] OR "Yersinia"[Mesh:NoExp] OR "Yersinia enterocolitica"[Mesh] OR yersinia[tiab] OR yersiniosis[tiab] OR yersinioses[tiab] OR "Yersinia Infections"[Mesh] OR "Coronavirus, Bovine"[Mesh] OR coronavirus[tiab] OR coronaviruses[tiab] OR "Coronaviridae"[Mesh:NoExp] OR "Torovirus"[Mesh] OR "Torovirus Infections"[Mesh] OR toroviridae[tiab] OR torovirus[tiab] OR toroviruses[tiab] OR "Breda Virus"[tiab] OR "Berne Virus"[tiab] OR "Rotavirus"[Mesh] OR rotavirus[tiab] OR rotaviruses[tiab] OR "Rotavirus Infections"[Mesh] OR "Caliciviridae"[Mesh:NoExp] OR nebovirus[tiab] OR Neboviruses[tiab] OR "Norovirus"[Mesh:NoExp] OR norovirus[tiab] OR	599,188

	Noroviruses[tiab] OR "Diarrhea Viruses, Bovine Viral"[Mesh] OR "Bovine Viral Diarrhea Virus"[tw] OR "Bovine Viral Diarrhea Viruses"[tiab] OR "Bovine Diarrhea Virus"[tiab] OR "Bovine Diarrhea Viruses"[tiab] OR "Bovine Pestivirus"[tiab] OR "Bovine Pestiviruses"[tiab] OR BVDV[tiab] OR "Cryptosporidium"[Mesh] OR cryptosporidium[tw] OR cryptosporidiums[tiab] OR "Cryptosporidiosis"[Mesh] OR cryptosporidiosis[tiab] OR cryptosporidioses[tiab] OR cryptosporidium[tiab] OR "Giardia"[Mesh] OR giardia[tw] OR giardias[tiab] OR lamblia[tiab] OR lamblias[tiab] OR lambliasis[tiab] OR lamblias[tiab] OR "Giardiasis"[Mesh] OR "fecal pathogens"[tiab] OR "fecal pathogen"[tiab] OR "faecal pathogens"[tiab] OR "faecal pathogen"[tiab]	
#4	#1 AND (#2 OR #3)	6,678
#5	"Vaccines"[Mesh] OR vaccine[tiab] OR vaccines[tiab] OR "Immunization"[Mesh] OR vaccination[tiab] OR vaccinations[tiab] OR immunization[tiab] OR immunizations[tiab] OR injection[tiab] OR injected[tiab] OR injections[tiab] OR inoculation[tiab] OR inoculations[tiab] OR inoculate[tiab] OR inoculates[tiab] OR inoculated[tiab] OR ScourGuard[tiab] OR ScourBos[tiab] OR Bovilis[tiab] OR Rotavec[tiab] OR Ecolizer[tiab]	1,190,152
#6	#4 AND #5	1,489
#7	((calf[tiab] OR calves[tiab] OR calving[tiab]) AND "Diarrhea/prevention and control"[Mesh])	179
#8	#6 OR #7	1,582
#9	#8 AND English[lang]	1,457
#10	#9 NOT ("Letter" [Publication Type] OR "Editorial" [Publication Type] OR "Case Reports" [Publication Type]) AND Filters: Publication date from 1950/01/01	1,443

CAB Abstracts

Search	Search Term	Results
#1	(od:("Bos") OR up:(bos)) AND (neonatal OR newborn OR newborns OR "pre-wean" OR prewean OR "pre-weaning" OR preweaning OR "pre-weaned" OR preweaned OR nursing OR suckling OR "after birth" OR "before weaning" OR young OR calf OR calves OR calving)	121,297
#2	title:((cattle OR cow OR cows OR bos OR bovine OR bovines OR bovinæ OR heifer OR heifers OR bullocks OR oxen OR steer OR steers OR Angus OR Ayrshire OR Boran OR Brahman OR Brangus OR Braunvieh OR Charolais OR Fleckvieh OR Friesian OR Gelbvieh OR Gir OR Hereford OR Holstein OR Jersey OR Limousin OR Longhorn OR Nellore OR Ongole OR Sahiwal OR Sanga OR Shorthorn OR Simmental OR Wagyu)) OR ab:((cattle OR cow OR cows OR bos OR bovine OR bovines OR bovinæ OR heifer OR heifers OR bullocks OR oxen OR steer OR steers OR Angus OR Ayrshire OR Boran OR Brahman OR Brangus OR Braunvieh OR Charolais OR Fleckvieh OR Friesian OR Gelbvieh OR Gir OR Hereford OR Holstein OR Jersey OR Limousin OR Longhorn OR Nellore OR Ongole OR Sahiwal OR Sanga OR Shorthorn OR Simmental OR Wagyu))	545,153
#3	title:((neonatal OR newborn OR newborns OR "pre-wean" OR prewean OR "pre-weaning" OR preweaning OR "pre-weaned" OR preweaned OR nursing OR suckling OR "after birth" OR "before weaning" OR young OR calf OR calves OR calving)) OR ab:((neonatal OR newborn OR newborns OR "pre-wean" OR prewean OR "pre-weaning" OR preweaning OR "pre-weaned" OR preweaned OR nursing OR suckling OR "after birth" OR "before weaning" OR young OR calf OR calves OR calving))	505,311

#4	#2 AND #3	98,302
#5	#1 OR #4	129,504
#6	diarrhea OR diarrheic OR diarrheal OR diarrhoea OR diarrhoeal OR scour OR scours OR scouring OR "fecal score" OR "faecal score" OR "watery feces" OR "watery faeces"	86,879
#7	#5 AND #6	10,571
#8	"Escherichia coli" OR "E coli" OR Salmonella OR Salmonellosis OR Salmonellosis OR clostridium OR clostridiales OR clostridiaceae OR clostridia OR shigella OR shigellosis OR "shiga bacillus" OR yersinia OR yersiniosis OR yersinioses OR coronavirus OR coronaviruses OR toroviridae OR torovirus OR toroviruses OR "Breda Virus" OR "Berne Virus" OR rotavirus OR rotaviruses OR nebovirus OR Neboviruses OR norovirus OR Noroviruses OR "Bovine Viral Diarrhea Virus" OR "Bovine Viral Diarrhea Viruses" OR "Bovine Diarrhea Virus" OR "Bovine Diarrhea Viruses" OR "Bovine Pestivirus" OR "Bovine Pestiviruses" OR BVDV OR cryptosporidium OR cryptosporidiums OR cryptosporidiosis OR cryptosporidioses OR cryptosporidium OR giardia OR giardias OR lamblia OR lamblias OR lambliasis OR lambliasis OR giardiasis OR "fecal pathogens" OR "fecal pathogen" OR "faecal pathogens" OR "faecal pathogen"	298,904
#9	#5 AND #8	11,628
#10	#7 OR #9	15,948
#11	vaccine OR vaccines OR vaccination OR vaccinations OR immunization OR immunizations OR inoculation OR inoculations OR inoculate OR inoculates OR inoculated OR ScourGuard OR ScourBos OR Bovilis OR Rotavec OR Ecolizer	428,505
#12	#10 AND #11 AND yr:[1950 TO 2019] AND Language: English	2,209
#13	#12 AND Document type: Journal article OR Journal issue OR Conference proceedings OR Conference paper OR Miscellaneous OR Abstract only	2,044

BIOSIS

Search	Query	Items Found
#1	TI=(cattle OR cow OR cows OR bos OR bovine OR bovines OR bovinæ OR heifer OR heifers OR bullocks OR oxen OR steer OR steers OR Angus OR Ayrshire OR Boran OR Brahman OR Brangus OR Braunvieh OR Charolais OR Fleckvieh OR Friesian OR Gelbvieh OR Gir OR Hereford OR Holstein OR Jersey OR Limousin OR Longhorn OR Nellore OR Ongole OR Sahiwal OR Sanga OR Shorthorn OR Simmental OR Wagyu) OR TS=(cattle OR cow OR cows OR bos OR bovine OR bovines OR bovinæ OR heifer OR heifers OR bullocks OR oxen OR steer OR steers OR Angus OR Ayrshire OR Boran OR Brahman OR Brangus OR Braunvieh OR Charolais OR Fleckvieh OR Friesian OR Gelbvieh OR Gir OR Hereford OR Holstein OR Jersey OR Limousin OR Longhorn OR Nellore OR Ongole OR Sahiwal OR Sanga OR Shorthorn OR Simmental OR Wagyu)	591,045
#2	TI=(neonatal OR newborn OR newborns OR "pre-wean" OR prewean OR "pre-weaning" OR preweaning OR "pre-weaned" OR preweaned OR nursing OR suckling OR "after birth" OR "before weaning" OR young OR calf OR calves OR calving) OR TS=(neonatal OR newborn OR newborns OR "pre-wean" OR prewean OR "pre-weaning" OR preweaning OR "pre-weaned" OR preweaned OR nursing OR suckling OR "after birth" OR "before weaning" OR young OR calf OR calves OR calving)	991,373
#3	#1 AND #2	67,252

#4	TI=(diarrhea OR diarrheic OR diarrheal OR diarrhoea OR diarrhoeal OR scour OR scours OR scouring OR "fecal score" OR "faecal score" OR "watery feces" OR "watery faeces" OR "Escherichia coli" OR "E coli" OR Salmonella OR Salmonellosis OR Salmonelloses OR clostridium OR clostridiales OR clostridiaceae OR clostridia OR shigella OR shigellosis OR "shiga bacillus" OR yersinia OR yersiniosis OR yersinioses OR coronavirus OR coronaviruses OR toroviridae OR torovirus OR toroviruses OR "Breda Virus" OR "Berne Virus" OR rotavirus OR rotaviruses OR nebovirus OR Neboviruses OR norovirus OR Noroviruses OR "Bovine Viral Diarrhea Virus" OR "Bovine Viral Diarrhea Viruses" OR "Bovine Diarrhea Virus" OR "Bovine Diarrhea Viruses" OR "Bovine Pestivirus" OR "Bovine Pestiviruses" OR BVDV OR cryptosporidium OR cryptosporidiums OR cryptosporidiosis OR cryptosporidioses OR cryptosporidium OR giardia OR giardias OR lamblia OR lamblias OR lambliasis OR lambliasies OR giardiasis OR "fecal pathogens" OR "fecal pathogen" OR "faecal pathogens" OR "faecal pathogen") OR TS=(diarrhea OR diarrheic OR diarrheal OR diarrhoea OR diarrhoeal OR scour OR scours OR scouring OR "fecal score" OR "faecal score" OR "watery feces" OR "watery faeces" OR "Escherichia coli" OR "E coli" OR Salmonella OR Salmonellosis OR Salmonelloses OR clostridium OR clostridiales OR clostridiaceae OR clostridia OR shigella OR shigellosis OR "shiga bacillus" OR yersinia OR yersiniosis OR yersinioses OR coronavirus OR coronaviruses OR toroviridae OR torovirus OR toroviruses OR "Breda Virus" OR "Berne Virus" OR rotavirus OR rotaviruses OR nebovirus OR Neboviruses OR norovirus OR Noroviruses OR "Bovine Viral Diarrhea Virus" OR "Bovine Viral Diarrhea Viruses" OR "Bovine Diarrhea Virus" OR "Bovine Diarrhea Viruses" OR "Bovine Pestivirus" OR "Bovine Pestiviruses" OR BVDV OR cryptosporidium OR cryptosporidiums OR cryptosporidiosis OR cryptosporidioses OR cryptosporidium OR giardia OR giardias OR lamblia OR lamblias OR lambliasis OR lambliasies OR giardiasis OR "fecal pathogens" OR "fecal pathogen" OR "faecal pathogens" OR "faecal pathogen")	772,099
#5	#3 AND #4	6,433
#6	TI=(vaccine OR vaccines OR vaccination OR vaccinations OR immunization OR immunizations OR inoculation OR inoculations OR inoculate OR inoculates OR inoculated OR ScourGuard OR ScourBos OR Bovilis OR Rotavec OR Ecolizer) OR TS=(vaccine OR vaccines OR vaccination OR vaccinations OR immunization OR immunizations OR inoculation OR inoculations OR inoculate OR inoculates OR inoculated OR ScourGuard OR ScourBos OR Bovilis OR Rotavec OR Ecolizer)	936,885
#7	#5 AND #6	1,489
#8	#7 AND LANGUAGE: (English) Indexes=BIOSIS Previews Timespan=1950-2019	1,333

Study Records:

Search results will be imported into EndNote™ (Clairvate Analytics, Philadelphia, USA) and duplicate entries removed. Resulting references will be imported into DistillerSR™ (Evidence Partners, Ottawa, Canada) where they undergo a second screen for duplicate entries, a 2-level screen for inclusion and data extraction.

Selection Process:

We apply a 2-level screen for study inclusion to references identified in the initial search.

Level 1 will evaluate the title/abstract for the inclusion and level 2 will be at the full text level. Publications where disagreement exist or reviewers choose “unable to decide”, consensus will be sought with the help of a third reviewer.

The criteria for passing level 1 at the title/abstract level will consist of the following questions:

- Is the study in English?
- Has the study been published in 1950 or later?
- Does the study compare a vaccination regime for the prevention of scouring, diarrhea or enteritis in pre-weaned calves or calves 6-month-old or younger?
- Is there a concurrent comparison group?

Two reviewers (JG and PG) will be evaluating the references independently. In order to consider the citations for level 2 review, all the questions for level one should be answered “yes”, otherwise the citation will be removed. For publications where there is disagreement between reviewers or where one of the reviewers chooses “unable to decide” consensus will be sought with the help of a third reviewer (GM). Studies where no consensus can be reached will be labelled as “unable to decide” and be evaluated at the full text level. Pre-testing of a random sample of 20 studies at level 1 will be completed by all reviewers to validate screening questions and reach consensus on wording and interpretation of criteria.

The criteria to pass level 2 screening at the full text level are the following questions that will be answered with “yes”, “no” or “unable to decide”:

- Is the full text available in English?
- Is the study an observational or experimental study?
- Does the study compare a vaccination regime between groups for the prevention of calf scours?
- Is there a concurrent comparison group?
- Does the study diagnose the pathogen (viral, protozoal or bacterial) based on a test or clinical diagnosis?
- Is the study population pre-weaned calves or calves younger than 6 months old?
- Can the intervention tested be generalized to cow-calf operations in California (i.e. not only specific for dairies or calf ranches)?
- Does the study report a quantifiable outcome to evaluate the efficacy (i.e. incidence of diarrheic calves, cause specific mortality due to gastrointestinal disease)?
- Is the study published in a peer-reviewed journal or conference proceedings >500 words?

In order to be included in the data extraction step, both reviewers must have answered “yes” for all the questions above, if there are discrepancies between the two reviewers, consensus will be sought by a third reviewer. Pre-testing for a randomly selected subset of 10 studies will be performed to validate the questions and reach consensus on wording and interpretation criteria.

Data Charting Process:

Full text publications will be acquired and uploaded into the review management software DistillerSR. Data extraction will be performed by using structured pre-tested forms in DistillerSR that will include:

Study characteristics:

- Publication year, year of study conduct
- Region and country where study was performed
 - California
 - United States or Canada
 - Other Western hemisphere
 - Europe
 - Asia
 - Africa
 - Australia/New Zealand
- Study population:
 - production system (beef, dairy)
 - Age groups
 - Breeds
 - Sex
 - Herd type
 - Housing
- How has diagnosis of scours been established?
 - Laboratory test (PCR, ELISA, culture)
 - Experimentally Induced
 - Clinical diagnosis
- Publication type:
 - Peer reviewed journal
 - Conference abstract
- Study type
 - Descriptive
 - Observational
 - Cohort
 - Case-control
 - Cross sectional
 - Experimental
 - Does group allocation was randomized?
 - There was a control group?
 - Does the researchers were blinded?

Study Group

- Study Groups
 - Intervention 1
 - MLV
 - Attenuated

- Other
 - Comparison
 - Placebo
 - No intervention
 - Other
- Sample size
 - Equal group allocation
 - Sample size per group

Intervention

- Prevention intervention type:
 - Vaccine (MLV, Attenuated)
 - Was a particular pathogen targeted?

Results

- Outcome
 - Incidence of the disease
 - Disease severity (severity score, duration of illness)
 - Weight gain
 - Mortality
 - Other
- Association between interventions and outcome
 - Intervention 1
 - Intervention 2, if applicable, etc.
- Significance of results
 - significant
 - which direction
 - non-significant

The standardized data abstraction tool will be calibrated by testing it on the first 10 studies by and any issues concerning ambiguity or inconsistency will be resolved by revising the data abstraction tool accordingly.

Results

Descriptive figures for the process of screening and the studies selected will be created. To illustrate the inclusion process of the studies, we will create a flow chart that includes the number of studies identified in the initial search, number of duplicates eliminated, number and reasons of citations eliminated in the 2 levels of screening and final number of studies included in the review.

Figures describing the targeted population of the study, types of vaccines by pathogen, number of studies per pathogen and types of studies per pathogen will be created.

A table summarizing the interventions, the significance and the direction of the effect (if it was favorable for the prevention or not) will be reported. We will consider the 95% confidence intervals including the null value or p-values > 0.05 as non-significant.

Confidence in Cumulative Evidence:

Quality of evidence will not be evaluated as part of this scoping review.

Discussion

Limitations:

In this scoping review we aim to provide a broad overview of a body of research. Our goal is to provide most of the information available without excluding sources of information based on the quality of research performed, we expect that our review will be limited in the assessment of the quality of studies presented. The conclusions drawn from this review must be considered with this caveat in mind.

This review is focused on vaccination for prevention only, we are not considering other interventions or treatment, which could also provide valuable information for reducing the use of antimicrobials in calf scours.

Conclusions:

This scoping review will provide a summary of primary research investigating vaccination for the prevention of calf scours that can be generalized to different cow-calf operations. Results will inform on the necessity to perform systematic reviews, uncover future research needs, or help inform best practices on the judicious use of antimicrobials surrounding this disease.

References:

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6. Curtis, G., Argo, C. M. G., Jones, D. & Grove-White, D. The impact of early life nutrition and housing on growth and reproduction in dairy cattle. *PLoS One* **13**, 1–20 (2018).
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8. Al-Alo, K. Z. K., Nikbakht Brujeni, G., Lotfollahzadeh, S., Moosakhani, F. & Gharabaghi, A. Correlation between neonatal calf diarrhea and the level of maternally derived antibodies. *Iran. J. Vet. Res.* **19**, 3–8 (2018).
 9. Abb-Schwedler, K. *et al.* Feeding mastitis milk to organic dairy calves: Effect on health and performance during suckling and on udder health at first calving. *BMC Vet. Res.* **10**, 1–11 (2014).
 10. Smith, G. Antimicrobial decision making for enteric diseases of cattle. *Vet. Clin. North Am. - Food Anim. Pract.* **31**, 47–60 (2015).