

Title

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Publication Date

2020-07-15

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Protocol for a Scoping/Systematic Review: Non-antimicrobial approaches for the prevention or treatment of infectious bovine keratoconjunctivitis applicable to cow-calf operations

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Author Contributions: Gabriele Maier drafted the review protocol with input from John Angelos, Festus Samah, and Emmanuel Okello; Erik Fausak and Megan van Noord developed the search strategy.

Abstract:

Background: Antimicrobial stewardship promotes best practices for the prevention, treatment and control of diseases that require antimicrobial treatment such that development of antimicrobial resistance is prevented and/or reduced. Infectious bovine keratoconjunctivitis (IBK, pinkeye) is one of the most important diseases requiring use of antimicrobials in cow-calf operations in California according to a recent survey of ranchers in this state conducted by the California Department of Food and Agriculture. The efficacy of antimicrobial treatments for the disease have been well documented and summarized. However, less information is available on non-antimicrobial measures to prevent, control or treat the disease. In order to inform best practices for the judicious use of antimicrobials on cow-calf operations, this review explores the literature for evidence of effective methods to prevent pinkeye as well as of effective non-antimicrobial treatments.

Objectives: The objective of this scoping review is to examine and describe the existing literature on methods to prevent, treat, or control bovine infectious keratoconjunctivitis in cattle using non-antimicrobial approaches that may reduce antimicrobial use, improve animal welfare and/or animal health outcomes. A further objective of this review is to assess the need for a systematic review on an intervention, such as vaccine efficacy for IBK, as well as assess the need for further research into any of the areas explored.

Design: Inclusion criteria will be primary research conducted in cattle populations that describe an IBK diagnosis and evaluate a primary outcome such as incidence of disease, severity of lesions, duration until healing, or a secondary outcome such as weight gain or feed efficiency. The process for selection and inclusion of studies will be reported in a flowchart according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)[1]. Results

will be summarized in tables and charts describing study types, interventions and outcomes. The review will follow the methods described in the PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation.[2]

Registration: This review has been submitted to SYREAF on this date, and eScholarship, University of California (<https://escholarship.org/>) on this date.

Amendments from Original Protocol:

Date of Amendment and rationale.

Funding and Support:

This work has been funded by the California Department of Food and Agriculture.

Role of Sponsor or Funder:

The sponsor takes part in a focus group advising the PI on inclusion criteria and scope of the review.

Introduction

Rationale

California Department of Food and Agriculture's Antimicrobial Use and Stewardship group (CDFA-AUS) oversees a statewide program intended to promote actions that may help to slow the emergence and spread of resistant bacteria associated with livestock and poultry that have negative public and animal health impacts. The program is tasked with developing antimicrobial stewardship guidelines and other tools to help enhance decision-making processes of the state's livestock producers relative to antimicrobial use and animal health. The goal is to eliminate inappropriate uses of antibiotics and reduce development of resistance, while maintaining a standard of animal health and welfare.

Infectious bovine keratoconjunctivitis (IBK), commonly known as pinkeye, is an infectious ocular disease of cattle with extensive impact on productivity and welfare in cow-calf operations[3-6]. Its importance specifically to California cow-calf producers is underscored by being on the California Cattlemen's Association's list of highest priority diseases of beef cattle [7]. The efficacies of antimicrobial treatments for pinkeye have already been well documented and summarized [8, 9], however, reviews on non-antimicrobial approaches to prevention, control, and treatment of pinkeye are still lacking. Although general recommendations about risk factors and a number of commercial and non-commercial non-antimicrobial treatments exist, it is unclear what information is available in the literature on these topics, which is why a scoping review format was chosen. In order to develop a set of recommendations or best practices for the judicious use of antimicrobials in the treatment of pinkeye, information on non-

antimicrobial approaches needs to be assessed and included as appropriate. The goal is not to eliminate the use of antimicrobials, which have shown to be effective in the treatment of the disease, but rather to preserve their efficacy by employing ways to prevent the disease or to use antimicrobials strategically or in conjunction with supportive or ancillary treatments.

The proposed scoping review is part of the effort by CDFA-AUS to develop best practices for California ranchers. 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 identify and describe the existing literature on non-antimicrobial approaches to prevent or treat IBK in cattle populations that are relevant or applicable to California cow-calf operations. Studies evaluating the use of vaccines and control measures such as - but not limited to - fly control, non-antimicrobial treatments and supportive therapies and their effects on incidence, disease severity, welfare, or weight gain will be categorized and summarized. Further objectives are to identify the need for systematic reviews – in case of an abundance of information - or further research - in case of sparse information - on more specific topics related to pinkeye control in cattle.

Methods

Eligibility Criteria:

The following studies will be included:

- Original scientific reports, i.e. primary research studies of cattle at individual or herd level
- All study designs (observational and experimental) except case studies or case series
- Study populations restricted to cattle, i.e. domesticated members of the genus *Bos*
- Intervention described is applicable to cow-calf operations (e.g. cannot be highly invasive or cannot only be applied in a dairy setting).
- Published in the English language in or after 1950
- No geographical restrictions
- Study compares a non-antimicrobial intervention, such as a vaccine, to either a placebo or other intervention or antimicrobial intervention
- Contains a quantifiable outcome including but not limited to incidence of disease, severity score, weight gain, pain score

- Study design includes a diagnosis for IBK, either by culture of causative agent *Moraxella* spp., *Neisseria* spp. or *Branhamella catarrhalis* 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 University of California Davis with input from other study team members.

Database	Interface
Medline	Pubmed
CAB Abstracts	CAB Direct
Scopus	Scopus
Biosis	Web of Science

Search Strategy:

PRISMA-S Template (based on v1.0 retrieved from <https://osf.io/2ybwn/>)

Research Question: Which Practices including vaccines or antimicrobial alternatives may lead to a decrease in antimicrobial use in the treatment of pinkeye in cattle?

Databases and Interfaces Searched:

Database	Interface	Date Coverage	Date Searched
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Medline	Pubmed	1966 to Current	12.8.2019
CAB Abstracts	CAB Direct	1972 - Current	16.8.2019
Scopus	Scopus	1970 - Current	16.8.2019
Biosis	Web of Science	1926 - Current	16.8.2019

Item 2: Other Online Resources (As Needed):

Conference Proceeding/Registry/ Web Sites or Engine	Coverage Dates	Membership Required?	URL	Date Searched :
S-PAC (Searchable Proceedings of Animal Conferences)	1935 - Current	Yes	https://spac.adsa.org/index.asp	23.8.2019 70 results
VIN (Veterinary Information Network)	1970 - Current	Yes	https://www.vin.com	23.8.2019 99 results

Citation Searching And Text Analysis:

Article Citation:
Cullen, J., Yuan, C., Totton, S., Dzikamunhenga, R., Coetzee, J., Da Silva, N., . . . O'Connor, A. (2016). A systematic review and meta-analysis of the antibiotic treatment for infectious bovine keratoconjunctivitis: An update. <i>Animal Health Research Reviews</i> , 17(1), 60-75. doi:10.1017/S1466252316000050 PMID: 22092641
O'Connor, A. , Brace, S. , Gould, S. , Dewell, R. and Engelken, T. (2011), A Randomized Clinical Trial Evaluating a Farm-of-Origin Autogenous <i>Moraxella bovis</i> Vaccine to Control Infectious Bovine Keratoconjunctivitis (Pinkeye) in Beef Cattle. <i>J Vet Intern Med</i> , 25: 1447-1453. doi: 10.1111/j.1939-1676.2011.00803.x PMID: 22092641
Funk, L., et al. "A randomized and blinded field trial to assess the efficacy of an autogenous vaccine to prevent naturally occurring infectious bovine keratoconjunctivitis (IBK) in beef calves." <i>Vaccine</i> 27.34 (2009): 4585-4590. PMID: 19531391
Angelos, J. A., Lane, V. M., Ball, L. M., & Hess, J. F. (2010). Recombinant <i>Moraxella bovoculi</i> cytotoxin-ISCOM matrix adjuvanted vaccine to prevent naturally occurring infectious bovine keratoconjunctivitis. <i>Veterinary research communications</i> , 34(3), 229-239. PMID: 20217228

Gard, J., Taylor, D., Maloney, R., Schnuelle, M., Sue Duran, R. P. H., Moore, P., ... & DeGraves, F. Preliminary evaluation of hypochlorous acid spray for treatment of experimentally induced infectious bovine. *THE BOVINE PRACTITIONER*, 50(2).

Process: Key articles were identified by Principal Investigator and keywords were mined by finding references in PubMed, CAB Direct, Biosis and Scopus. Keywords were collected and compared with keywords already utilized. Yale MeSH analyzer was also utilized to compare common Medical Subject Headings across articles.

Additional Methodologies Not Listed Above:

Process:

Limits and Restrictions

Date and Time Period: 1950 to current

Language: English

Publication status: Proceedings and published literature

Species Included: Cattle/Bovine

Study Design: Observational and experimental studies

Database Subset

Pre-specified cut-off or saturation point for results:

Other Restrictions:

Full Search Strategy:

Searcher: Erik Fausak
Peer Reviewer: Megan Van Noord

Date Reviewed: 12.8.2019

Database	Interface	Date Coverage	Date Searched(d.m.yr)
Medline	Pubmed	1966 to Current	12.8.2019

CAB Abstracts	CAB Direct	1972 - Current	16.8.2019
Scopus	Scopus	1970 - Current	16.8.2019
Biosis	Web of Science	1926 - Current	16.8.2019

Citations/Analysis:

Article Citation:
Cullen, J., Yuan, C., Totton, S., Dzikamunhenga, R., Coetzee, J., Da Silva, N., . . . O'Connor, A. (2016). A systematic review and meta-analysis of the antibiotic treatment for infectious bovine keratoconjunctivitis: An update. <i>Animal Health Research Reviews</i> , 17(1), 60-75. doi:10.1017/S1466252316000050 PMID:
O'Connor, A. , Brace, S. , Gould, S. , Dewell, R. and Engelken, T. (2011), A Randomized Clinical Trial Evaluating a Farm-of-Origin Autogenous <i>Moraxella bovis</i> Vaccine to Control Infectious Bovine Keratoconjunctivitis (Pinkeye) in Beef Cattle. <i>J Vet Intern Med</i> , 25: 1447-1453. doi: 10.1111/j.1939-1676.2011.00803.x PMID: 22092641
Funk, L., et al. "A randomized and blinded field trial to assess the efficacy of an autogenous vaccine to prevent naturally occurring infectious bovine keratoconjunctivitis (IBK) in beef calves." <i>Vaccine</i> 27.34 (2009): 4585-4590. PMID: 19531391
Angelos, J. A., Lane, V. M., Ball, L. M., & Hess, J. F. (2010). Recombinant <i>Moraxella bovoculi</i> cytotoxin-ISCOM matrix adjuvanted vaccine to prevent naturally occurring infectious bovine keratoconjunctivitis. <i>Veterinary research communications</i> , 34(3), 229-239. PMID: 20217228
Gard, J., Taylor, D., Maloney, R., Schnuelle, M., Sue Duran, R. P. H., Moore, P., ... & DeGraves, F. Preliminary evaluation of hypochlorous acid spray for treatment of experimentally induced infectious bovine. <i>THE BOVINE PRACTITIONER</i> , 50(2).
Content Expert: Gaby Maier list of commonly used vaccines, preventive strategies and antibiotics: Licensed vaccines for pinkeye in cattle in the U.S.: <ul style="list-style-type: none"> · Clostridium Chauvoei-Septicum-Novyi-Sordellii-Perfringens Types C & D-Moraxella Bovis Bacterin-Toxoid: o Boehringer Ingelheim (Alpha7/MB-1) o Merck Animal Health (Piliguard Pinkeye +7) · Moraxella Bovis Bacterin o Boehringer Ingelheim (Ocu-guard) o Addison (Maxiguard) o Elanco (Pnkeye Shield XT4) o Merck Animal Health (Piliguard) · Moraxella Bovis Killed Culture o Huvepharma (I-Site XP) · Moraxella bovoculi bacterin o Addison (Moraxella bovoculi bacterin) Alternative treatment for pinkeye in cattle: <ul style="list-style-type: none"> · Eye patches · tarsorrhaphy (suturing eyelids shut) · Vetericyn spary (hypochlorous acid) · Manna Pro Theracyn Pink Eye Spray (hypochlorous acid) · Curicyn pinkeye solution (Purified anolyte, hypochlorous acid) · Anti-inflammatories (flunixin meglumine, meloxicam, aspirin) · Skim milk, condensed milk · non injectable antimicrobials: mastitis tubes, eye ointments · possibly homeopathic treatments, vitamins · Colloidal silver (someone on youtube recommends it) · salt water solution, apple cider vinegar

Antibiotics used for treatment:

Injectables labelled for use in the U.S.

Liquamycin = LA200 = oxytetracycline

tulathromycin = Draxxin

Other antibiotics used in clinical trials: (according to O'Connor paper):

- Cloxacillin (topical)
- Aureomycin (topical)
- Penicillin
- Florfenicol
- Tilmicosin
- Ceftiofur
- Clindamycin

Methods to prevent / control pinkeye

- fly control
- pasture clipping of plant awns
- genetic selection
- mineral supplementation / good nutrition / good immunity
- dust control
- Shade

Search:

Search Database: Pubmed

Search ID	Terms (copy and paste)	Results
#1 Population	"Cattle"[Mesh] OR cattle[tiab] OR calf[tiab] OR calves[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]	465,804
#2 Disease	"Keratoconjunctivitis"[Mesh:NoExp] OR "Keratoconjunctivitis, Infectious"[Mesh] OR Keratoconjunctivitis[tiab] OR Keratoconjunctivitides[tiab] OR "keratis conjunctivitis"[tiab] OR "kerato conjunctivitis"[tiab] OR "pink eye"[tiab] OR "pinkeye"[tiab] OR "IBK"[tiab]	8,972
#3	#1 AND #2 with English filter	384

Search Database: CAB Direct

Search ID	Terms (copy and paste)	Results

#1 Population	<u>title:(cattle OR calf OR calves 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 title:(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 calf OR calves 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 title:(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 de:(calves OR "cattle breeds") OR od:(cattle)</u>	662,396
#2 Disease`	<u>title:("Keratoconjunctivitis" OR "Keratoconjunctivitis, Infectious" OR Keratoconjunctivitis OR Keratoconjunctivitides OR "keratis conjunctivitis" OR "kerato conjunctivitis" OR "pink eye" OR "pinkeye" OR "IBK") OR Ab: ("Keratoconjunctivitis" OR "Keratoconjunctivitis, Infectious" OR Keratoconjunctivitis OR Keratoconjunctivitides OR "keratis conjunctivitis" OR "kerato conjunctivitis" OR "pink eye" OR "pinkeye" OR "IBK") de:(keratoconjunctivitis OR conjunctiva) OR od:(Moraxella)</u>	6,005
#3 Language	<u>la:(english)</u>	8,201,629
#4	<u>#1 AND #2 AND #3</u>	849

Search Database: Scopus

Search ID	Terms (copy and paste)	Results
#1	<u>(TITLE-ABS-KEY (cattle OR calf OR calves OR cow OR cows OR bos OR bovine OR bovines OR bovinæ OR heifer OR heifers OR bullocks OR oxen) OR TITLE-ABS-KEY (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 TITLE-ABS-KEY (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 TITLE-ABS-KEY (nellore OR ongole OR sahiwal OR sanga OR shorthorn OR simmental OR wagyu))</u>	722,617
#2	<u>(TITLE-ABS-KEY ("Keratoconjunctivitis" OR "Keratoconjunctivitis, Infectious" OR keratoconjunctivitis OR keratoconjunctivitides OR "keratis conjunctivitis" OR "kerato conjunctivitis" OR "pink eye" OR "pinkeye" OR "IBK") OR TITLE-ABS-KEY (moraxella))</u>	18,384
#3	<u>#1 AND #2 with English Filter</u>	573

Search Database: Biosis

Search ID	Terms (copy and paste)	Results
#1	TOPIC: (cattle OR calf OR calves 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 TOPIC: (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)	643,608
#2	TOPIC:("Keratoconjunctivitis" OR "Keratoconjunctivitis, Infectious" OR keratoconjunctivitis OR keratoconjunctivitides OR "keratis conjunctivitis" OR "kerato conjunctivitis" OR "pink eye" OR "pinkeye" OR "IBK") OR TOPIC:(Moraxella)	10,725
#3	#1 AND #2 with English Filter	512

Search Designers: Gaby Maier, DVM, PhD, DACVPM; Erik Fausak, MSLIS; Megan Van Noord, MIS; Festus Samah.

Peer Review:

Librarian had their search strategy checked by another librarian assigned to the project and a content expert in the field.

Results:

Database	Total Records	Total Records after deduplication	Deduplication software/methodology
	2,318	1200	Endnote (does not include grey literature)

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:

A 2-level screen for study inclusion will be applied to references identified in the search and de-duplicated. Level 1 screen will be at the title/abstract level and level 2 screen will be at the full text level.

Criteria to pass **level 1** screen at the title/abstract level are the following questions that will be answered with “yes”, “no” or “unable to decide”:

- Is this study in English?
- Has this study been published in 1950 or later?
- Is this study a primary research report involving cattle of the genus *Bos*?
- Does this study report evaluate a non-antimicrobial intervention for the prevention or treatment of IBK?

Two reviewers (FS and AG) will be evaluating references independently and all citations where one of the questions is answered with “no” by both reviewers 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.

Criteria to pass **level 2** screen 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?
- Has this study been published in 1950 or later?
- Is this study a primary research report involving cattle of the genus *Bos*?
- Is the intervention applicable to cow-calf operations?
- Does this study report evaluate a non-antimicrobial intervention to prevent or treat IBK?
- Is this study a case study or case series?
- Does this study compare a non-antimicrobial intervention, such as a vaccine, to either a placebo or other non-antimicrobial intervention or antimicrobial intervention?
- Does this study describe a quantifiable outcome including but not limited to incidence of disease, severity score, weight gain, or pain score?
- Does this study define a diagnosis for IBK, either by culture of a causative agent *Moraxella* spp., *Neisseria* spp. or *Branhamella catarrhalis* or clinical diagnosis?
- Is this study a peer-reviewed journal article or a conference proceedings of > 500 words?

In order to be included in the data extraction step, both reviewers must answer all questions with “yes” except the question “Is this study a case study or case series?”, which both reviewers have to answer with “no”. If there are discrepancies between the two reviewers, consensus will be sought with the help of a third reviewer (GM). Pre-testing of the first 20 studies will be completed by all reviewers to validate screening questions and reach consensus on wording and interpretation of criteria. The question “Is the intervention

applicable to cow-calf operations?” will be the most ambiguous and is expected to trigger the most discrepancies and discussion. Once a list of studies is available and are started to be evaluated, this item may be modified to come up with a less ambiguous criterion.

Data Charting Process:

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

- 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 (preweaned, weaned, breeding/milking)
 - breeds
 - Sex
- How has diagnosis of IBK been established?
 - culture
 - induced
 - clinical diagnosis
- Publication type:
 - Peer reviewed journal
 - Conference abstract
- Study type
 - Descriptive
 - Observational
 - study type
 - Experimental
 - randomized?
 - control group?
 - blinded?
- Sample size
 - per group
- Intervention type:

- Prevention
 - what is the prevention?
- Treatment
 - what is the treatment?
- Outcome
 - Incidence
 - Disease severity (severity score, duration of illness)
 - Weight gain
 - Other
- Study Groups
 - Intervention 1
 - Intervention 2, if applicable, etc.
 - Comparison
- 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 all three reviewers and any issues concerning ambiguity or inconsistency will be resolved by revising the data abstraction tool accordingly.

Results

A flow chart depicting the study inclusion process will be created using DistillerSR software. The chart will include the number of studies identified during the 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.

Graphs describing the types of interventions, number of studies per intervention and types of studies per intervention will be created.

A table listing interventions and summarizing whether outcomes were favorable (decreased incidence, increased weight gain, decreased severity score, etc.), unfavorable or neutral will be prepared. We will consider 95% confidence intervals including 1 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:

Although scoping reviews provide a broad overview of a body of research, they are limited in their assessment of the quality of studies presented. It is the goal of this type of review to be as inclusive as possible and to provide all information available without excluding sources of information based on the quality of research performed. As such, any conclusions drawn from scoping reviews must be considered with this caveat in mind.

Conclusions:

This scoping review will provide a summary of primary research investigating ways to prevent or treat IBK with non-antimicrobial interventions. Results will inform on the necessity to perform systematic reviews on any of the intervention types studied, uncover future research needs, or help inform best practices on the judicious use of antimicrobials surrounding this disease.

References:

1. Moher, D., et al., *Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement*. PLoS Med, 2009. **6**(7): p. e1000097.
2. Tricco, A.C., et al., *PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation*. Ann Intern Med, 2018. **169**(7): p. 467-473.
3. Williams, D.L., *Welfare issues in farm animal ophthalmology*. Vet Clin North Am Food Anim Pract, 2010. **26**(3): p. 427-35.
4. Thrift, F.A. and J.R. Overfield, *Impact of pinkeye (infectious bovine kerato-conjunctivitis) on weaning and postweaning performance of Hereford calves*. J Anim Sci, 1974. **38**(6): p. 1179-84.
5. Funk, L.D., et al., *Associations between infectious bovine keratoconjunctivitis at weaning and ultrasonographically measured body composition traits in yearling cattle*. J Am Vet Med Assoc, 2014. **244**(1): p. 100-6.
6. Killinger, A.H., et al., *Economic impact of infectious bovine keratoconjunctivitis in beef calves*. Vet Med Small Anim Clin, 1977. **72**(4): p. 618-20.
7. Association, C.C.s., *California Cattlemen's Association 2018-2019 Policy Resolutions*. 2019: Sacramento, Ca 95814.
8. Cullen, J.N., et al., *A systematic review and meta-analysis of the antibiotic treatment for infectious bovine keratoconjunctivitis: an update*. Anim Health Res Rev, 2016. **17**(1): p. 60-75.
9. Angelos, J.A., *Infectious bovine keratoconjunctivitis (pinkeye)*. Vet Clin North Am Food Anim Pract, 2015. **31**(1): p. 61-79, v-vi.