Protocol of the scoping review on the impact of bovine paratuberculosis on production parameters and economic effects

This protocol is structured according to the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) (Shamseer et al., 2015). Certain parts are adapted according to the extension checklist for a scoping review (Tricco et al., 2018).

Administrative Information

Title

A scoping review on the impact of bovine paratuberculosis on production parameters and economic effects

Registration

This protocol will be registered at SYREAF (Systematic Reviews for Animals & Food): https://syreaf.org/

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Contributions:

Table 1 Contributions of authors

Contribution	Author
Drafting protocol	SG, TK, BT, LC
Development selection criteria	SG, TK, BT, LC, MO
Development search strategy	SG, TK, BT, LC, MO
Development data extraction criteria	SG, TK, BT, LC, MO
Title and abstract screening	SG, TK
Full-text screening	SG, TK
Data extraction	SG, TK
Data analysis and synthesis of results	SG, TK
Expertise input	MO, MM
Drafting manuscript	SG, TK
Reviewing final manuscript	GS, BT, LC, SG, TK, MO

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Introduction

Rationale

Mycobacterium avium subsp. paratuberculosis (MAP) is a pathogen that occurs worldwide. It causes a chronic enteritis primarily in ruminants (e.g. cattle, sheep, goats), known as paratuberculosis or Johne's disease (McAloon et al., 2019). Due to the long incubation period of 2 to 7 years, many animals in an infected herd are asymptomatic, while only a few show the typical clinical signs of diarrhea and weight loss. However, even subclinical infection significantly reduces the performance of the animals and consequences of the disease lead to high direct and indirect economic losses for the cattle industry (Hasonova & Pavlik, 2006). Reasons for the economic losses are diverse and include, reduced milk yield and quality, decreased slaughter weight and value, decreased fertility and increased susceptibility to other chronic diseases, among others.

To estimate the economic burden of bovine paratuberculosis and to evaluate the benefits of a potential control program, accurate estimates of the production effects associated with the disease are required (McAloon et al., 2016). Therefore, a scoping review on this topic will be useful to identify and summarize economic impacts of the disease and to provide a range of values to be used for economic models on disease impact estimations.

Objectives
The overall aim of this scoping review is to investigate on the economic impact of bovine paratuberculosis in cattle herds.
Specifically, the aims are:

I. to identify factors that must be considered for economic impact estimation of bovine paratuberculosis in cattle
II. to define the extent of the losses for each production impact based on results from multiple research studies
III. to provide evidence-based inputs for the development of future economic models for bovine paratuberculosis impact estimations

The specific PICo elements are:

I. **P**roblem: Paratuberculosis
II. **I**nterest: Economic impact
III. **C**ontext: Cattle

Methods

Eligibility criteria

Table 2 Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
- Cattle - Economic impact of bovine paratuberculosis - Primary research (Observational, cross-sectional studies, cohort-studies, case-control studies, randomized control trials, experimental trials) - Languages: English, German, Slovenian, French	- Any other species than cattle - Economic consequences of paratuberculosis control programs - Reviews

No time or geographical restrictions will be imposed.

Information Sources

Three electronic databases will be searched for eligible studies: PubMed, CAB Direct (CAB) and Web of Science. Additionally, the references lists of relevant reviews on this topic will be scanned for further relevant articles.

Search strategy
The proposed search terms relevant to the PICo of this review are included in Table 3. On the search string, terms on different columns are separated by an "AND", while terms within the same columns are linked by an "OR". If possible, subject heading search will be used, such as for example Medical Subject Headings (MeSH) from Pubmed. The concept of the search strategy will be the following:

[Paratuberculosis] AND **[Economic impact]** AND **[Cattle]**

Table 3 Search terms according to PICo

Problem	**Interest**	**Context**
Paratuberculosis	Milk production	Cows[§]
Mycobacterium avium subspecies paratuberculosis	Milk quality	Cow
Johne's disease	Milk yield	Heifers[§]
Mycobacterium avium paratuberculosis[§]	Milk parameter[§]	Heifer[§]
Mycobacterium avium subsp paratuberculosis[§]	Somatic cell count	Calf[§]
	Milk fat	Calves
	Milk protein	Dam
	Slaughter weight	Dams[§]
	Slaughter value[§]	Herd
	Weaning weight	Herds
	Feed conversion[§]	Farm
	Feed consumption[§]	Farms
	Culling rate	Ruminant
	Mortality	Cattle
	replacement	Bovine
	Production age[§]	Dairy
	infertility	Beef
	Genetic value	Ruminants[§]
	Reproductive dysfunction[§]	
	Pregnancy rate	
	Abortion	
	Post-partum complications[§]	
	Calving interval[§]	
	Calf mortality[§]	
	Calf morbidity[§]	
	Non-return rate	
	Mastitis	
	Trade restriction*[§]	
	Economic	
	Economics	
	Economic impact[§]	
	Economic loss*[§]	
	Economic aspect*[§]	
	Economic value*[§]	
	Production effect*	
	Production impact[§]	
	Production loss*	
	Meat quality	
	cull	
	Conception rate	
	Metritis[§]	
	Cost	
	Costs	

	emaciation	
	Rumen acidosis[§]	
	Ruminal acidosis[§]	
	Disease impact[§]	
	Disease effect[§]	

[§]words are not in the final search string as they do not add results

Selection of Sources of Evidence

All papers from the literature search will be uploaded into Covidence, to facilitate collaboration among reviewers during the selection process. Two independent reviewers (SG & TK) will then screen all the papers based on information available in the title or abstract. The review process will be tested with the first 10% of items and modified as needed to ensure consistency. Any disagreement will be resolved using a third reviewer. This process will be repeated for the full text screening.

The title and abstract screening will comprise the following questions:

1. Is the abstract of the study available?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]
2. Does the study concern bovine paratuberculosis/ Johne's disease?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]
    c. UNCLEAR [INCLUDE]
3. Does the study concern disease impact on production parameters of bovine paratuberculosis?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]
    c. UNCLEAR [INCLUDE]
4. Does the study concern cattle?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]
    c. UNCLEAR [INCLUDE]
5. Is the study original research?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]
    c. UNCLEAR [INCLUDE]

Full text screening will be performed on all papers, meeting the criteria from above and will compromise the following questions:

1. Is a full text available?
    a. YES [INCLUDE
    b. NO [EXCLUDE]
2. Is the full text available in English, German, French or Slovenian?
    a. YES [INCLUDE
    b. NO [EXCLUDE]
3. Is any disease impact on production parameters quantified?
    a. YES [INCLUDE]
    b. NO [EXCLUDE]

Data Charting Process

Data extraction will be performed in Covidence by the same two independent reviewers (SG, TK). The data charting process will be tested with five randomly selected papers to ensure clarity and consistency. Conflicts will be discussed with the other authors and if necessary the data charting form will be modified. Data extraction will include general information, population data and disease impact on production parameters, as described below.

Data items

The following data items will be extracted from the literature:

General information

- Bibliographic details
- Country of study
- Study designs (cross-sectional studies, cohort-studies, case-control studies etc.)

Population data

- Production type (dairy or meat)
- Herd size
    - If more than 1 herd: Average of all herds and in brackets the range
- Animal age category (calves, heifers, adult cattle)
- Number of studied farms
    - thereof: number of paratuberculosis positive and negative farms
- Number of studied animals
    - thereof: number of paratuberculosis positive and negative animals
- MAP within herd and/or between herd prevalence and definition of positive animal/herd

Interest data

- Production parameters investigated (e.g. milk yield, milk quality, slaughter weight, slaughter value, mortality, fertility etc.)
- Economic values (delta between paratuberculosis positive animals or herds compared to paratuberculosis negative animals or herds for a given production parameter)
- Unit of parameters (, e.g. $, liter/ kg/ % etc.)
- Measurement cycle of production parameters (e.g. per lactation, per day, per production life)
- Measurement unit (e.g. per infected cow, per clinical cow, per farm, per cow per farm)
- Test method for paratuberculosis (e.g. individual blood ELISA, pooled (how many animals) blood ELISA, individual milk ELISA, pooled (how many animals) milk ELISA, bulk-tank milk ELISA, individual fecal PCR, individual fecal culture, pooled (how many animals) fecal PCR, environmental fecal testing etc.)

Synthesis of Results

Results of the literature search, including number of screened papers at each stage will be reported. To summarize the findings for the economic impact of paratuberculosis, descriptive statistics will be used. The summaries will be presented using a combination of tables, figures, and narrative text. A range of standardized values for each economic impact will be presented in a table. If present, research gaps will be identified and discussed.

References

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