A protocol for a systematic review and meta-analysis

Title: Level of biosecurity implementation in poultry farms across COST Global networking countries: a protocol for a systematic review and meta-analysis.

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Author contributions

The review (PICO) question and protocol described in this document were developed with the contribution and final approval of all co-authors. Ronald Vougat Ngom and Marta Leite drafted the protocol and all authors provided their input.

Registration

This protocol is archived at the Padua Research Archive (https://hdl.handle.net/11577/3511729) and published online with Systematic Reviews for Animals and Food (SYREAF) available at: http://www.syreaf.org/. This protocol is reported using the items (headings) recommended in the PRISMA-P guidelines (Moher et al., 2015).

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Amendments

This review is not an amendment of a previously completed or published protocol. In case any amendments are made to this protocol after its registration, they will be adequately documented in the systematic review as Protocol Deviations.

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1. Introduction

1.1. Rationale

Biosecurity is a powerful strategy/tool for preventing and controlling diseases, reducing antimicrobial usage and increasing financial resources of livestock farmers (Dewulf et al., 2018; Fountain et al., 2022; Dhaka et al., 2023; Mallioris et al., 2023). In Europe, one of the world's largest producers of poultry meat (https://agriculture.ec.europa.eu), biosecurity measures in the poultry sector vary across countries, since there are no standardized regulations (Dewulf et al., 2018; Mallioris et al., 2023). In the same country, many rules of biosecurity measures which are mandatory or not by law at national level are in force. In addition, the implementation of biosecurity measures depends on many factors, including geographical location, farm characteristics (size, production type and category, etc.), epidemiological situation, financial resources, stakeholders' awareness and knowledge about biosecurity, etc. A recent study provided an overview of the implementation of biosecurity in seven European countries, from the poultry farmers perspective (Souillard et al., 2024). However, there is a scarcity of data regarding the implementation level of biosecurity in poultry farms in European countries (Delpont et al., 2021; Tilli et al., 2022; Maletic et al., 2023).

In this regard, identification of knowledge gaps has led to the need of gathering knowledge on a first basis concerning biosecurity regulatory frameworks, which comprises the background of the COST Action CA20103 - Biosecurity Enhanced Through Training Evaluation and Raising Awareness. The fulfillment of a database as a response to eventual barriers of effective biosecurity within the countries encompassing this COST Action network, gave rise to a systematic review work as an important output for biosecurity implementation, specifically in the poultry category. In this matter, the protocol established will be an essential and basic tool to perform this work on the level of biosecurity implementation in poultry farms across key countries belonging to this global network, which includes European countries, and Turkey as Full COST member, Tunisia as Near Neighbour Country, and Israel as Cooperating Member, fulfilling a network of internationalization and global cooperation within this area.

1.2. Objectives

The objective of this protocol is to describe the methods to review and summarize the available information on biosecurity implementation in poultry farms across European countries, Turkey, Tunisia, and Israel. The PICO elements are:

1. **P**opulation: Poultry (limited to broilers, layers, ducks, geese, turkeys)
2. **I**nterest: Biosecurity implementation in poultry farms
3. **C**ontext: European Countries, Israel, Tunisia and Turkey
4. **O**utcomes: Implementation level (%)

2. Methods

2.1 Eligibility criteria

1. Criteria related to the elements of the PICO question.
2. Language: Publications in English, French and Spanish.
3. Publication types: Journal articles that provide results of original research, fulfills the study design eligibility criteria.
4. Publication date: No limits.
5. Geographical location of studies: All European countries, including Israel, Tunisia and Turkey.
6. Only observational studies.

2.2. Information sources

Bibliographic databases that provide a high level of article recall across biomedical articles (Bramer *et al.*, 2017) will be used. Table 1 lists the databases to be searched. CAB abstracts and Agricola will be searched via the University of Bern (Switzerland) and Pubmed and Web of Science will be conducted via the University of Padova (Italy).

Table 1: List of databases to be searched.

Database	**Interface**	**URL**
MEDLINE	PubMed	https://pubmed.ncbi.nlm.nih.gov/
CAB abstracts	Ovid	https://www.wolterskluwer.com/en/solutions/ovid/cab-abstracts-31
Web of science	Web of Science	http://webofknowledge.com/
AGRICOLA	Proquest	https://www.proquest.com/

2.3. Search strategy

The search strategy will involve a multi-stranded approach that uses a series of searches, with different combinations of concepts to gather all possibly related researches and thus achieve high sensitivity (Higgins et al., 2021). If only few papers (<10) are found to be relevant to this review, in addition to the databases, citations will be extracted from included papers and important reviews identified. In the event of using search reviews, Web of Science will be used for backward searching.

The concept of the search strategy will be the following:
[**Poultry**] AND [**Biosecurity**] AND [**Implementation**] AND [**European Countries OR Turkey OR Tunisia OR Israel**]

Search terms will be amended appropriately to reflect the functionality differences in each database.
The general search strategy to identify studies relevant to the PICO of this review will be the following:

#1 (chicken* OR poultry* OR gallus OR broiler* OR layer* OR turkey OR meleagri* OR duck* OR anas OR breeders* OR geese OR goose OR fowl* OR avian* OR bird* OR hen OR hens OR flock*)

#2 (biosecurity OR "farm biosecurity" OR "animal biosecurity" OR "preventive veterinary medicine" OR "flock health management")

#3 (assess* OR level* OR implement* OR measure* OR scor* OR questionnaire* OR checklist* OR practice* OR compliance OR adopt*)

#4 (Europe* OR EU OR Austria* OR Belgium OR Bulgaria* OR Croatia* OR Cypr* OR Czech* OR Denmark OR Estonia OR Finland OR France OR German* OR Gree* OR Hungar* OR Ireland OR Israel OR Ital* OR Kosovo OR Latvia OR Lithuania* OR Luxembourg OR Malt* OR Montenegro OR Netherlands OR Macedonia* OR Norway OR Poland OR Portug* OR Romania* OR Serbia* OR Slovakia OR Slovenia* OR Spain OR Sweden OR Belarus OR Moldova OR Bosnia and Herzegovina OR Ukraine OR Andorra OR Liechtenstein OR Monaco OR Switzerland OR "United Kingdom" OR Tunisi* OR Turkey OR Türkiye)

#1 AND #2 AND #3 AND #4

2.4. Study Records

Data management

All citations retrieved from the databases will be imported into Zotero for deduplication. The file obtained after deduplication will be uploaded in Rayyan for the screening process.

Selection process

The records will be screened in two phases by four independent reviewers working in pairs. This will guarantee that each reference is screened by two independent reviewers. During both title and abstract and full text screening, each pair of reviewers will screen half of the citations. Conflicts among each pair will be resolved by a third reviewer if consensus will not be reached. At the beginning of each screening phase, a calibration exercise will be conducted to enable discussion and solve disagreements before carrying out the full selection process (Sanguinetti *et al*., 2021). This test will consist of screening by all the reviewers at least 5% of the total number of papers available.

For the two phases screening, eligibility of studies will be assessed with the following questions:

1. Is the publication language in English or French or Spanish? Yes [Include], No [Exclude], Unclear [Include]
2. Is the full text available? Yes [Include], No [Exclude]

3. Is the publication an original research article? Yes [Include], No [Exclude], Unclear [Include]
4. Is the study concerning broilers, layers, turkeys, breeders, ducks, geese? Yes [Include], No [Exclude]
5. Does the study concern intensive poultry farms? Yes [Include], No [Exclude]
6. Is the study assessing the implementation of biosecurity measure(s) at the farm? Yes [Include], No [Exclude]
7. Is the study performed in Europe or Israel or Tunisia or Turkey? Yes [Include], No [Exclude]

Data extraction

Six independent reviewers will carry out the data extraction by using a Microsoft Excel® spreadsheet created by two reviewers and validated by all. Data extraction will be performed after a calibration exercise consisting in data extraction from at least 5% of the selected papers. After calibration, data from the remaining papers will be extracted by the reviewers working in pairs. If consensus between a pair will not be reached, conflicts will be solved by a third reviewer.

In addition to the papers selected after full text screening, data from the Biocheck.UGent® database will be collected. These data will concern the level of biosecurity implementation in poultry farms of countries where not data were found in the searched databases. To be include in this review, the number of farms of a country should be at least 50.

General information and context

Data to be extracted from eligible studies will include the following:
- Country where the study took place. If not stated, contact study authors (if many countries, put the result of each country in one line)
- Geographical coverage (national, or regional)
- Time-frame of the study
- Duration of the study (number of days/months)
- Study design (cross-sectional, longitudinal study, etc.)

Population data

- Poultry category: broilers, layer, turkeys, ducks, etc.
- Type of production system (conventional, commercial, etc.)
- Number of farms
- Number of animals in the farm

Interest and outcomes

- Methods of biosecurity assessment (scoring, percentage, etc.)
- Number of biosecurity measures evaluated
- Level of implementation for each biosecurity measure (percentage)

2.5. Risk of Bias Assessment

According to the study design, the following tools will be used for the risk of bias in individual studies: risk of bias in non-randomised studies of interventions for non-randomised trials and the appraisal tool for cross-sectional and ecological studies (Downes et al., 2016; Sterne et al., 2016).

2.6. Data synthesis

The systematic review will be reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines (Page et al., 2020). A flowchart will be used to synthesize the result of the selection process and if necessary a map will be used to present the geographical distribution of the studies included in the review. The characteristics of the included studies will be summarized in a table. The intention of this review is to conduct a quantitative synthesis of results *via* a meta-analysis if an adequate number of studies will be included after the selection process. The meta-analysis will be performed for each biosecurity measure or group of biosecurity. For a specific biosecurity measure, a pooled level of implementation will be obtained by calculating the mean difference and the corresponding 95% confidence interval (CI). The random-effects model will be applied if a limited number of studies is included in the meta-analysis. Forest plot will be used for the presentation of the pooled result. In addition, the Cochrane's Q test and I^2 will be used to evaluate the heterogeneity among studies, and the sensibility test to evaluate the possible sources of heterogeneity. When at least 10 studies are included in the meta-analysis (Mavridis et al., 2013; Marvridis et al., 2014), publication bias will be assessed by using both funnel plots and Egger's weighted regression tests. A $p<0.05$ will be considered statistically significant for all the tests.

Conclusions

This systematic review and meta-analysis will provide a synthesis of the current level of biosecurity implementation in poultry farms across Europe, Turkey, Tunisia and Israel. Results will be helpful for researchers and police-makers to address gaps in knowledge on biosecurity implementation that will require further research in the future.

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