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Protocol for a Scoping Review

Biosecurity Practices in Small-scale and Backyard Farms Raising Livestock and/or Poultry in Developed Countries: A Scoping Review

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Author Contributions (Current and Future):

JDF: Study conceptualization, title/abstract and full-text screening, data extraction, formal analysis, data visualization, and writing of future publication. EI: Title/abstract and full-text screening, and review and editing of future publication. EDF: Development and documentation of search strategy, download of search results to citation management software and removal of duplicates, protocol registration, co-author training on citation and scoping review management software, and review and editing of future publication. NSDR: Provision of content and method expertise, study conceptualization, and review and editing of future publication. AFAP (Principal Investigator): Study conceptualization, funding acquisition, and review and editing of future publication.

Abstract:

Background: Information regarding the biosecurity practices implemented in small-scale and backyard farms is lacking, and the potential spillover of diseases from these operations to commercial facilities represents a serious risk from a food security and economic perspective.

Objectives: We will undertake a scoping review to identify the biosecurity practices implemented in small-scale and backyard farms raising livestock and/or poultry in developed countries, as well as to summarize and discuss the current literature on the subject.

Design: Eligibility criteria for inclusion of studies will be based on population (backyard and/or small-scale farms raising livestock and/or poultry), geographical location (developed countries), outcome (assessment/description of implementation of biosecurity practices), and study type (peer-reviewed primary research articles). Searched databases included PubMed, CAB Abstracts, Scopus, AGRIS, and AGRICOLA.

Keywords: Biosecurity, small-scale, backyard, livestock, poultry, scoping review.

Registration: This scoping review protocol has also been submitted to eScholarship, University of California (<https://escholarship.org/>) on 20 January 2023.

Amendments from Original Protocol: Any amendments to this protocol will be documented and justified in the final review.

Funding and Support: Funding support was provided by the US Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) National Animal Disease Preparedness and Response Program through Cooperative Agreement #AP21VSSP0000C034.

Role of Sponsor or Funder: The USDA had no role in the creation of this protocol or in the scoping review. The contents of this scoping review are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

Introduction

Rationale

Small-scale and backyard farms are often considered a high-risk sector, posing a threat to commercial operations for the introduction and spread of endemic and newly-introduced diseases (e.g., foreign animal diseases in the United States [US], Category A diseases according to Regulation 2016/429 on transmissible animal diseases [“Animal Health Law”] in the European Union [EU]), which represent a serious concern from a food security and economic perspective [1–3]. In fact, both the 2018-2019 outbreak of virulent Newcastle disease in California and the 2015 outbreak of highly pathogenic avian influenza (HPAI) in the US originated in backyard poultry and spread to commercial flocks, resulting in severe economic and trade consequences for the poultry industry [4–6]. Additionally, in affected EU countries, most African swine fever (ASF) notifications in domestic pigs have occurred in backyard farms [7].

To inform the design of emergency response plans to control disease outbreaks (e.g., HPAI, ASF), as well as the development of successful educational programs targeting small-scale and backyard farmers, it is necessary to have a good understanding of current biosecurity practices and to identify knowledge gaps. Over the last decades, several studies have focused on describing the biosecurity measures implemented in small-scale and backyard operations in developed countries (e.g., [8–10]); however, this literature has yet to be summarized.

Scoping reviews are a type of evidence synthesis used to provide a broad overview of the data (quantitative and/or qualitative) available on a specific topic [11,12]. A scoping review of the biosecurity practices implemented in small-scale and backyard farms raising livestock and/or poultry in developed countries is, therefore, an adequate method to better understand biosecurity measures implemented in these farming systems.

Objectives

The overall goal of the proposed scoping review is to identify and describe the biosecurity practices implemented in small-scale and backyard farms raising livestock and/or poultry in developed countries, as well as to summarize and discuss the current literature on the subject.

More specifically, this scoping review will be undertaken: (1) as a precursor to conducting subsequent systematic reviews, to determine their feasibility or relevance; (2) to identify and analyze knowledge gaps on biosecurity in small-scale and backyard farms raising livestock and/or poultry in developed countries; and (3) to clarify key concepts and definitions (i.e., definitions of

“small-scale” and “backyard” used in the primary literature, definitions of the various biosecurity practices).

Research question

“What are the biosecurity practices implemented in small-scale and backyard farms raising livestock and/or poultry in developed countries?”

Methods

This study consists of a scoping review of the biosecurity practices implemented in small-scale and backyard farms raising livestock and/or poultry in developed countries. We will follow the Joanna Briggs Institute guidelines for scoping reviews and the future scoping review will be reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [12].

Eligibility Criteria for Inclusion of Studies

Population: Eligible studies must pertain to backyard and/or small-scale farms, as indicated by the authors. Studies including small-scale and/or backyard farms among farms of other sizes will also be eligible. The term “hobby” has been used as synonym of small-scale and/or backyard in various studies (e.g., [13,14]), and we will, therefore, consider it as such in this scoping review. Farms must raise common livestock and/or poultry species. Livestock species will include cattle, goats and sheep raised for beef or dairy, and swine. Studies reporting biosecurity practices for other livestock species (i.e., horses, rabbits, llamas, alpacas, elk, etc.) will be excluded. Poultry species will include, as defined by the USDA, any domesticated bird used for food (i.e., chicken, turkey, goose, duck, Rock Cornish hens, game birds such as pheasant, squab and guinea fowl, and huge birds such as ostrich, emu and rhea [ratites]); exotic pet birds will be excluded.

Geographical location/country of population: Eligible studies must include farms located in countries classified as “developed economies” in the United Nations World Economic Situation and Prospects 2022 report (i.e., the 27 EU member states, Iceland, Norway, Switzerland, the United Kingdom, Canada, the US, Australia, Japan, and New Zealand) [15].

Outcome: Eligible studies must have examined biosecurity or hygiene practices and described or assessed their implementation by farmers/workers. Practices considered will comprise both “external biosecurity measures,” which prevent the introduction of infectious agents into farms and their spread from the farms (i.e., introduction of new animals or animal products [e.g., sperm, embryos], vehicle and equipment movement, access of personnel and visitors, transport of animals, feed and water supply, manure removal, carcass disposal, wildlife and pest control) and “internal biosecurity measures,” which prevent the spread of infectious agents within the farm (i.e., farm management [disease management [isolation and vaccination], all in/all out, stocking density, compartmentalization, working flow], cleaning and disinfection, measures related to personnel [personal protective equipment, hygiene]) [16,17].

Publication types: The proposed scoping review will include published peer-reviewed primary research articles with no restrictions on study design. Consequently, descriptive studies (e.g., case reports and series, cross-sectional studies such as surveys), analytic observational studies (e.g., cohort, case control), and analytic experimental studies (e.g., randomized control trials) will all be eligible. Review studies (e.g., traditional, scoping, and systematic reviews) and non-peer-reviewed literature will be excluded. This scoping review will limit inclusion to studies written in English and publication year will be restricted to 2000 onward.

Information Sources

Database	Interface	Date Coverage	Date Searched
CAB Abstracts (included products: CAB ABSTRACTS, VetMed Resource, CABI Full Text, Global Health, Animal Health and Production Compendium (AHPC))	CABDirect	1966 to Present	3 Nov 2022
Medline (Included products: Medline, in process citations, “ahead of print” citations, out-of-scope citations, journals indexing prior to Medline inclusion, pre-1966 citations, PubMed Central, author manuscripts NIH funding, NCBI Bookshelf)	PubMed	1902 to Present	3 Nov 2022
AGRICOLA	Ovid	1970 to Present	3 Nov 2022
Scopus	Scopus	1996 to Present	3 Nov 2022
AGRIS	FAO	1965 to Present	5 Nov 2022

Search Strategy

The search strategy (i.e., key words and indexing) for the various databases was developed with the assistance of a health and veterinary science academic librarian (EDF) using 12 calibration papers identified by the researchers (see PRISMA-S Template, section *Citation Searching and Text Analysis* below). The tools used for developing the search were the Yale MeSH analyzer [18] and Systematic Review Accelerator [19]. The databases searched included PubMed, CAB Abstracts, Scopus, AGRIS, and AGRICOLA. Duplicates were eliminated sequentially using Systematic Review Accelerator [19] and Covidence [20].

All citations included for data extraction will go through both backward (i.e., identification of references that are cited in the study) and forward (i.e., identification of studies that cite the source study using a citation index) citation searching. All citations retrieved through this “snowballing” process will then go through title and abstract screening, and all subsequent steps.

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

Simultaneous Searches: N/A

Item 2: Other Online Resources (As Needed):

Conference Proceeding/Registry/ Web Sites or Engine	Coverage Dates	Membership Required?	URL	Date Searched
None used	N/A	N/A	N/A	N/A

Manual Searching (searching relevant journals Table of Contents):

Journal Title	Print or Online?	Coverage Dates
None used	N/A	N/A

Citation Searching and Text Analysis:

Article Citation:
Burns TE, Kelton D, Ribble C, Stephen C. Preliminary Investigation of Bird and Human Movements and Disease-management Practices in Noncommercial Poultry Flocks in Southwestern British Columbia. <i>Avian Dis.</i> 2011;55(3):350-357. doi:10.1637/9646-010411-Reg.1
Derksen T, Lampron R, Hauck R, Pitesky M, Gallardo RA. Biosecurity Assessment and Seroprevalence of Respiratory Diseases in Backyard Poultry Flocks Located Close to and Far from Commercial Premises. <i>Avian Dis.</i> 2018;62: 1–5. doi:10.1637/11672-050917-Reg.1
Elkhoraibi C, Blatchford RA, Pitesky ME, Mench JA. Backyard Chickens in the United States: A Survey of Flock Owners. <i>Poult Sci.</i> 2014;93(11):2920-2931. doi:10.3382/ps.2014-04154
Garber L, Hill G, Rodriguez J, Gregory G, Voelker L. Non-commercial Poultry Industries: Surveys of Backyard and Gamefowl Breeder Flocks in the United States. <i>Prev Vet Med.</i> 2007;80(2-3):120-128. doi:10.1016/j.prevetmed.2007.01.012
Karabozhilova I, Wieland B, Alonso S, Salonen L, Häsler B. Backyard Chicken Keeping in the Greater London Urban Area: Welfare Status, Biosecurity and Disease Control Issues. <i>Br Poult Sci.</i> 2012;53: 421–430. doi:10.1080/00071668.2012.707309
Kauber K, Fowler H, Lipton B, Meschke JS, Rabinowitz P. <i>Salmonella</i> Knowledge, Attitudes and Practices: A Survey of Backyard Poultry Owners Residing in Seattle, Washington and the Surrounding Metropolitan Area. <i>Zoonoses Public Health.</i> 2017;64(1):21-28. doi:10.1111/zph.12274
Nöremark M, Frössling J, Lewerin SS. Application of Routines that Contribute to On-farm Biosecurity as Reported by Swedish Livestock Farmers. <i>Transbound Emerg Dis.</i> 2010;57: 225–236. doi:10.1111/j.1865-1682.2010.01140.x.
Pires AFA, Peterson A, Baron JN, Adams R, Martínez-López B, Moore D. Small-scale and Backyard

Livestock Owners Needs Assessment in the Western United States. PLOS ONE. 2019;14: e0212372. doi:10.1371/journal.pone.0212372
Schembri N, Hernandez-Jover M, Toribio JA, Holyoake PK. On-farm Characteristics and Biosecurity Protocols for Small-scale Swine Producers in Eastern Australia. Prev Vet Med. 2015;118(1):104-116. doi:10.1016/j.prevetmed.2014.11.008
Smith EI, Reif JS, Hill AE, et al. Epidemiologic Characterization of Colorado Backyard Bird Flocks. Avian Dis. 2012;56(2):263-271. doi:10.1637/9865-072811-Reg.1
Yendell SJ, Rubinoff I, Lauer DC, Bender JB, Scheftel JM. Antibody Prevalence of Low-pathogenicity Avian Influenza and Evaluation of Management Practices in Minnesota Backyard Poultry Flocks. Zoonoses Public Health. 2012;59(2):139-143. doi:10.1111/j.1863-2378.2011.01427.x
Zheng T, Adlam B, Rawdon T, Stanislawek W, Cork S, Hope V, et al. A Cross-sectional Survey of Influenza A Infection, and Management Practices in Small Rural Backyard Poultry Flocks in two Regions of New Zealand. N Z Vet J. 2010;58: 74–80. doi:10.1080/00480169.2010.65086

Process: Key articles were identified by researchers and keywords were mined by finding references in PubMed and CABDirect. Keywords were collected and compared with keywords already utilized. Yale MeSH analyzer (<https://mesh.med.yale.edu/>) and SR-Accelerator (<https://sr-accelerator.com/>) Search Refinery were used to compare common Medical Subject Headings across articles. SR-Accelerator Wordfreq was also utilized to identify more keywords.

Contacts (Researchers contacted for additional information):

Contact Type: Industry/author/experts	Method of contact:
None used	N/A

Process: N/A

Additional Methodologies Not Listed Above: Citation tracking

Process: Forward and backward (snowballing) citation tracking performed in Scopus on articles that make it into extraction.

Extraction Records 8 May 2023	38
Extraction Records located in Scopus 12 May 2023	37
Backward Citations 12 May 2023	852
Forward Citations 12 May 2023	366

Total Records	Deduplicated	Citation Manager
1218	985	Covidence

Limits and Restrictions

Date and Time Period: 2000 onwards.

Language: English.

Publication status: Published.

Species Included: Swine, cattle, goats, sheep, poultry (USDA definition: chicken, turkey, goose, duck, Rock Cornish hens, game birds such as pheasant, squab and guinea fowl, and huge birds such as ostrich, emu and rhea [ratites]).

Study Design: Published peer-reviewed articles, no restrictions on study design.

Database Subset: None.

Geographic: Countries classified as “developed economies” in the United Nations World Economic Situation and Prospects 2022 report (i.e., the 27 European Union member states, Iceland, Norway, Switzerland, the United Kingdom, Canada, the United States, Australia, Japan, and New Zealand).

Pre-specified cut-off or saturation point for results: None used.

Other Restrictions: None.

Search Filters:

Database	Interface	Search Filters Applied
AGRIS	FAO	Country (Data provider), language and years
CAB	CABDirect	Language and years
Medline	PubMed	Language and years
Scopus	Elsevier	Language and years

Full Search Strategy:

Search Database: CAB Direct

Search ID	Terms (copy and paste)	Results
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#1 Biosecurity	title:("Biosecurity" OR "hygiene" OR "disease prevention") OR ab:("Biosecurity" OR "hygiene" OR "disease prevention") OR de:("disease%20prevention") OR id:("biosecurity")	602,521
#2 Small stakeholder	(title:("Small farm*" OR "small scale" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard*" OR "hobby" OR "urban" OR "small rural") OR ab:("Small farm*" OR "small scale" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard*" OR "hobby")) OR (de:("urban%20areas"))	137,331
#3 Developed country index	title:("Ireland" OR "Irish Republic" OR "Italy" OR "Latvia" OR "Lithuania" OR "New Zealand" OR "Australia" OR "Japan" OR "Switzerland" OR "Norway" OR "Iceland" OR "UK" OR "United Kingdom" OR "England" OR "Nordic Countries" OR "European Union" OR "Europe" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Republic of Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden") OR ab:("New Zealand" OR "Australia" OR "Japan" OR "Switzerland" OR "Norway" OR "Iceland" OR "UK" OR "United Kingdom" OR "England" OR "Nordic Countries" OR "European Union" OR "Europe" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Republic of Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Irish Republic" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden") OR id:("United%20Kingdom" or "Britain" OR "ireland" OR "Eire" OR "Rumania") OR gl:("New%20Zealand"OR "Australia" OR "Japan" OR "Switzerland" OR "Norway" or "Sweden" or "Nordic%20Countries" or "Iceland" or "UK" or "Austria" or "Belgium" or "Bulgaria" OR "Croatia" OR "Cyprus" OR "Czech%20Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Northern%20Ireland" OR "Irish%20Republic" or "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain") OR up:("European%20Union%20Countries" OR "very%20high%20Human%20Development%20Index%20countries" OR "Western Europe" OR "Northern%20Europe" OR "British%20Isles" or "Great%20Britain" or "UK" or "Benelux")	963,248
#4 US/Canada	title:("United States" OR "US" OR "USA" OR "Canada") OR ab:("United States" OR "US" OR "USA" OR "Canada") OR gl:("USA" OR "Canada") OR id:("United States of America")	1,668,890
#5 Animals	title:(“Goat” OR “capra” OR “sheep” OR “ovis” OR “cow” OR “cattle” OR “bos” OR “swine” OR “sus” OR “pig” OR “pigs” OR “hog” OR “hogs” OR “small ruminants” OR “livestock” OR “poultry” OR “chickens” OR “gallus” OR “turkeys” OR “meleagris” OR “geese” OR “ducks” OR “hen” OR “hens” OR “pheasants” OR “squabs” OR “fowl” OR “fowls” OR “ostrich” OR “emu” OR “rhea” OR “Dromaius” OR “Struthio”) OR ab:(“Goat” OR “capra” OR “sheep” OR “ovis” OR “cow” OR “cattle” OR “bos” OR “swine” OR “sus” OR “pig” OR “pigs” OR “hog” OR “hogs” OR “small ruminants” OR “livestock” OR “poultry” OR “chickens” OR “gallus” OR “turkeys” OR “malleagris” OR “geese” OR	1,186,285

	<p>“ducks” OR “hen” OR “hens” OR “pheasants” OR “squabs” OR “fowl” OR “fowls” OR “ostrich” OR “emu” OR “rhea” OR “Dromaius” OR “Struthio”) OR de:(“cows” or “goat%20keeping” or “dairy%20cows” or “dairy%20cattle” or “cattle%20housing” or “animal%20housing” or “cow%20housing” or “pig%20housing” or “pig%20farmers”) or od:(“goats” or “sheep” or “cattle” OR “pigs” OR “poultry” or “poultry%20farming” OR “fowls” OR “geese” OR “ducks” OR “hens” OR “pheasants” OR “fowls” OR “ostriches” OR “emus” OR “Rhea”) OR up:(“Capra” or “sheep” or “Ovis” or “Bos” OR “Sus scrofa” OR “livestock” OR “Gallus%20gallus” OR “Dromaius” OR “Struthio”) or (id:(“swine” or “hogs” or “swine%20housing” OR “chickens”))</p>	
#6	#3 OR #4	2,569,669
#7	#6 AND #1 AND #2 AND #5	1,669
#8	#7 AND ((language:(“English”)) (year:(“2022” OR “2020” OR “2018” OR “2016” OR “2014” OR “2012” OR “2010” OR “2008” OR “2006” OR “2004” OR “2002” OR “2000” OR “2001” OR “2003” OR “2005” OR “2007” OR “2009” OR “2011” OR “2013” OR “2015” OR “2017” OR “2019” OR “2021”))))	690
Copy and paste	<p>((title:(“Small farm*” OR “small scale” OR “small-scale” OR “smallholder” OR “small holder” OR “backyard*” OR “hobby” OR “urban” OR “small rural”) OR ab:(“Small farm*” OR “small scale” OR “small-scale” OR “smallholder” OR “small holder” OR “backyard*” OR “hobby”)) OR (de:(“urban areas”)))) AND ((title:(“Ireland” OR “Irish Republic” OR “Italy” OR “Latvia” OR “Lithuania” OR “New Zealand” OR “Australia” OR “Japan” OR “Switzerland” OR “Norway” OR “Iceland” OR “UK” OR “United Kingdom” OR “England” OR “Nordic Countries” OR “European Union” OR “Europe” OR “Austria” OR “Belgium” OR “Bulgaria” OR “Croatia” OR “Republic of Cyprus” OR “Czech Republic” OR “Denmark” OR “Estonia” OR “Finland” OR “France” OR “Germany” OR “Greece” OR “Hungary” OR “Luxembourg” OR “Malta” OR “Netherlands” OR “Poland” OR “Portugal” OR “Romania” OR “Slovakia” OR “Slovenia” OR “Spain” OR “Sweden”) OR ab:(“New Zealand” OR “Australia” OR “Japan” OR “Switzerland” OR “Norway” OR “Iceland” OR “UK” OR “United Kingdom” OR “England” OR “Nordic Countries” OR “European Union” OR “Europe” OR “Austria” OR “Belgium” OR “Bulgaria” OR “Croatia” OR “Republic of Cyprus” OR “Czech Republic” OR “Denmark” OR “Estonia” OR “Finland” OR “France” OR “Germany” OR “Greece” OR “Hungary” OR “Ireland” OR “Irish Republic” OR “Italy” OR “Latvia” OR “Lithuania” OR “Luxembourg” OR “Malta” OR “Netherlands” OR “Poland” OR “Portugal” OR “Romania” OR “Slovakia” OR “Slovenia” OR “Spain” OR “Sweden”) OR id:(“United Kingdom” or “Britain” OR “ireland” OR “Eire” OR “Rumania”) OR gl:(“New Zealand”OR “Australia” OR “Japan” OR “Switzerland” OR “Norway” or “Sweden” or “Nordic Countries” or “Iceland” or “UK” or “Austria” or “Belgium” or “Bulgaria” OR “Croatia” OR “Cyprus” OR “Czech Republic” OR “Denmark” OR “Estonia” OR “Finland” OR “France” OR “Germany” OR “Greece” OR “Hungary” OR “Northern Ireland” OR “Irish Republic” or “Italy” OR “Latvia” OR “Lithuania” OR “Luxembourg” OR “Malta” OR “Netherlands” OR “Poland” OR “Portugal” OR “Romania” OR “Slovakia” OR “Slovenia” OR “Spain”) OR up:(“European Union Countries” OR “very high Human Development Index countries” OR “Western Europe” OR “Northern</p>	

	<p>Europe" OR "British Isles" or "Great Britain" or "UK" or "Benelux")) OR (title:(("United States" OR "US" OR "USA" OR "Canada") OR ab:(("United States" OR "US" OR "USA" OR "Canada") OR gl:(("USA" OR "Canada") OR id:(("United States of America")))) AND (title:(("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR "hogs" OR "small ruminants" OR "livestock" OR "poultry" OR "chickens" OR "gallus" OR "turkeys" OR "meleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio") OR ab:(("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR "hogs" OR "small ruminants" OR "livestock" OR "poultry" OR "chickens" OR "gallus" OR "turkeys" OR "malleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio") OR de:(("cows" or "goat keeping" or "dairy cows" or "dairy cattle" or "cattle housing" or "animal housing" or "cow housing" or "pig housing" or "pig farmers") or od:(("goats" or "sheep" or "cattle" OR "pigs" OR "poultry" or "poultry farming" OR "fowls" OR "geese" OR "ducks" OR "hens" OR "pheasants" OR "fowls" OR "ostriches" OR "emus" OR "Rhea") OR up:(("Capra" or "sheep" or "Ovis" or "Bos" OR "Sus scrofa" OR "livestock" OR "Gallus gallus" OR "Dromaius" OR "Struthio") or (id:(("swine" or "hogs" or "swine housing" OR "chickens")) AND (title:(("Biosecurity" OR "hygiene" OR "disease prevention") OR ab:(("Biosecurity" OR "hygiene" OR "disease prevention") OR de:(("disease prevention") OR id:(("biosecurity")))) AND ((language:(("English"))) (year:(("2022" OR "2020" OR "2018" OR "2016" OR "2014" OR "2012" OR "2010" OR "2008" OR "2006" OR "2004" OR "2002" OR "2000" OR "2001" OR "2003" OR "2005" OR "2007" OR "2009" OR "2011" OR "2013" OR "2015" OR "2017" OR "2019" OR "2021"))))</p>	
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Search Database: PubMed

Search ID	Terms (copy and paste)	Results
#1 Biosecurity	"Biosecurity"[tiab] OR "hygiene"[tiab] OR "disease prevention"[tiab] OR "Poultry Diseases/prevention and control"[Mesh] OR "Cattle Diseases/prevention and control"[Mesh] OR "Swine Diseases/prevention and control"[Mesh] OR "Animal Diseases/prevention and control"[Mesh] OR "Biosecurity"[Mesh]	137,545
#2 Small Animal Farms	"Small farm*"[tiab] OR "small scale"[tiab] OR "small-scale"[tiab] OR "smallholder"[tiab] OR "small holder"[tiab] OR "backyard*"[tiab] OR "hobby"[tiab]	23,412
#3 Species	"Goat"[tiab] OR "capra"[tiab] OR "Goats"[Mesh] OR "sheep"[tiab] OR "ovis"[tiab] OR "Sheep, Domestic"[Mesh] OR "Cattle"[Mesh] OR "cow"[tiab] OR "cattle"[tiab] OR "bos"[tiab] OR "swine"[tiab] OR "sus"[tiab] OR "pig"[tiab] OR "pigs"[tiab] OR "hog"[tiab] OR "hogs"[tiab] OR "Swine"[Mesh] OR "small ruminants"[tiab] OR "livestock"[tiab] OR "Livestock"[Mesh] OR "poultry"[tiab] OR "chickens"[tiab] OR "gallus"[tiab] OR "Poultry"[Mesh] OR "turkeys"[tiab] OR "meleagris"[tiab] OR "Turkeys"[Mesh] OR "geese"[tiab] OR "Geese"[Mesh] OR "ducks"[tiab] OR "hen"[tiab] OR "hens"[tiab] OR "Ducks"[Mesh] OR "pheasants"[tiab] OR "squabs"[tiab] OR "Galliformes"[Mesh] OR "fowl"[tiab] OR	1,064,996

	"fowls"[tiab] OR "ostrich"[tiab] OR "emu"[tiab] OR "rhea"[tiab] OR "Dromaius"[tiab] OR "Struthio"[tiab] OR "Rheiformes"[Mesh]	
#4 US + Canada	"United States"[tiab] OR "US"[tiab] OR "North America"[tiab] OR "USA"[tiab] OR "Canada"[tiab] OR "United States"[Mesh] OR "Canada"[Mesh]	2,287,934
#5 Developed country index	"New Zealand"[tiab] OR "New Zealand"[Mesh] OR "Australia"[tiab] OR "Australia"[Mesh] OR "Japan"[tiab] OR "Japan"[Mesh] OR "Switzerland"[tiab] OR "Switzerland"[Mesh] OR "Norway"[tiab] OR "Norway"[Mesh] OR "Iceland"[tiab] OR "Iceland"[Mesh] OR "UK"[tiab] OR "United Kingdom"[tiab] OR "England"[tiab] OR "United Kingdom"[Mesh] OR "European Union"[Mesh] OR "European Union"[tiab] OR "Europe"[tiab] OR "Europe"[Mesh] OR "Austria"[tiab] OR "Austria"[Mesh] OR "Belgium"[tiab] OR "Belgium"[Mesh] OR "Bulgaria"[tiab] OR "Bulgaria"[Mesh] OR "Croatia"[tiab] OR "Croatia"[Mesh] OR "Republic of Cyprus"[tiab] OR "Cyprus"[Mesh] OR "Czech Republic"[tiab] OR "Czech Republic"[Mesh] OR "Denmark"[tiab] OR "Denmark"[Mesh] OR "Estonia"[tiab] OR "Estonia"[Mesh] OR "Finland"[tiab] OR "Finland"[Mesh] OR "France"[tiab] OR "France"[Mesh] OR "Germany"[tiab] OR "Germany"[Mesh] OR "Greece"[tiab] OR "Greece"[Mesh] OR "Hungary"[tiab] OR "Hungary"[Mesh] OR "Ireland"[tiab] OR "Ireland"[Mesh] OR "Northern Ireland"[Mesh] OR "Irish Republic"[tiab] OR "Italy"[tiab] OR "Italy"[Mesh] OR "Latvia"[tiab] OR "Latvia"[Mesh] OR "Lithuania"[tiab] OR "Lithuania"[Mesh] OR "Luxembourg"[tiab] OR "Luxembourg"[Mesh] OR "Malta"[tiab] OR "Malta"[Mesh] OR "Netherlands"[tiab] OR "Netherlands"[Mesh] OR "Poland"[tiab] OR "Poland"[Mesh] OR "Portugal"[tiab] OR "Portugal"[Mesh] OR "Romania"[tiab] OR "Romania"[Mesh] OR "Slovakia"[tiab] OR "Slovakia"[Mesh] OR "Slovenia"[tiab] OR "Slovenia"[Mesh] OR "Spain"[tiab] OR "Spain"[Mesh] OR "Sweden"[tiab] OR "Sweden"[Mesh]	412,928
#6	#5 OR #4	2,675,971
#7	#6 AND #1 AND #2 AND #3	90
#8	#7 AND ((english[Filter]) AND (2000:2022[pdat]))	83
Copy and paste:	(((((("New Zealand"[Title/Abstract] OR "New Zealand"[MeSH Terms] OR "Australia"[Title/Abstract] OR "Australia"[MeSH Terms] OR "Japan"[Title/Abstract] OR "Japan"[MeSH Terms] OR "Switzerland"[Title/Abstract] OR "Switzerland"[MeSH Terms] OR "Norway"[Title/Abstract] OR "Norway"[MeSH Terms] OR "Iceland"[Title/Abstract] OR "Iceland"[MeSH Terms] OR "UK"[Title/Abstract] OR "United Kingdom"[Title/Abstract] OR "England"[Title/Abstract] OR "United Kingdom"[MeSH Terms] OR "European Union"[MeSH Terms] OR "European Union"[Title/Abstract] OR "Europe"[Title/Abstract] OR "Europe"[MeSH Terms] OR "Austria"[Title/Abstract] OR "Austria"[MeSH Terms] OR "Belgium"[Title/Abstract] OR "Belgium"[MeSH Terms] OR "Bulgaria"[Title/Abstract] OR "Bulgaria"[MeSH Terms] OR "Croatia"[Title/Abstract] OR "Croatia"[MeSH Terms] OR "Republic of Cyprus"[Title/Abstract] OR "Cyprus"[MeSH Terms] OR "Czech	

Republic"[Title/Abstract] OR "Czech Republic"[MeSH Terms] OR
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OR "France"[MeSH Terms] OR "Germany"[Title/Abstract] OR "Germany"[MeSH
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"Hungary"[Title/Abstract] OR "Hungary"[MeSH Terms] OR
"Ireland"[Title/Abstract] OR "Ireland"[MeSH Terms] OR "Northern
Ireland"[MeSH Terms] OR "Irish Republic"[Title/Abstract] OR
"Italy"[Title/Abstract] OR "Italy"[MeSH Terms] OR "Latvia"[Title/Abstract] OR
"Latvia"[MeSH Terms]) AND "Lithuania"[Title/Abstract] OR "Lithuania"[MeSH
Terms] OR "Luxembourg"[Title/Abstract] OR "Luxembourg"[MeSH Terms])
AND "Malta"[Title/Abstract] OR "Malta"[MeSH Terms] OR
"Netherlands"[Title/Abstract] OR "Netherlands"[MeSH Terms] OR
"Poland"[Title/Abstract] OR "Poland"[MeSH Terms] OR
"Portugal"[Title/Abstract] OR "Portugal"[MeSH Terms] OR
"Romania"[Title/Abstract] OR "Romania"[MeSH Terms] OR
"Slovakia"[Title/Abstract] OR "Slovakia"[MeSH Terms] OR
"Slovenia"[Title/Abstract] OR "Slovenia"[MeSH Terms] OR
"Spain"[Title/Abstract] OR "Spain"[MeSH Terms] OR "Sweden"[Title/Abstract]
OR "Sweden"[MeSH Terms] OR ("United States"[Title/Abstract] OR
"US"[Title/Abstract] OR "North America"[Title/Abstract] OR
"USA"[Title/Abstract] OR "Canada"[Title/Abstract] OR "United States"[MeSH
Terms] OR "Canada"[MeSH Terms])) AND ("Goat"[Title/Abstract] OR
"capra"[Title/Abstract] OR "Goats"[MeSH Terms] OR "sheep"[Title/Abstract] OR
"ovis"[Title/Abstract] OR "sheep, domestic"[MeSH Terms] OR "Cattle"[MeSH
Terms] OR "cow"[Title/Abstract] OR "Cattle"[Title/Abstract] OR
"bos"[Title/Abstract] OR "Swine"[Title/Abstract] OR "sus"[Title/Abstract] OR
"pig"[Title/Abstract] OR "pigs"[Title/Abstract] OR "hog"[Title/Abstract] OR
"hogs"[Title/Abstract] OR "Swine"[MeSH Terms] OR "small
ruminants"[Title/Abstract] OR "Livestock"[Title/Abstract] OR "Livestock"[MeSH
Terms] OR "Poultry"[Title/Abstract] OR "chickens"[Title/Abstract] OR
"gallus"[Title/Abstract] OR "Poultry"[MeSH Terms] OR "Turkeys"[Title/Abstract]
OR "meleagris"[Title/Abstract] OR "Turkeys"[MeSH Terms] OR
"Geese"[Title/Abstract] OR "Geese"[MeSH Terms] OR "Ducks"[Title/Abstract]
OR "hen"[Title/Abstract] OR "hens"[Title/Abstract] OR "Ducks"[MeSH Terms]
OR "pheasants"[Title/Abstract] OR "squabs"[Title/Abstract] OR
"Galliformes"[MeSH Terms] OR "fowl"[Title/Abstract] OR "fowls"[Title/Abstract]
OR "ostrich"[Title/Abstract] OR "emu"[Title/Abstract] OR "rhea"[Title/Abstract]
OR "Dromaius"[Title/Abstract] OR "Struthio"[Title/Abstract] OR
"Rheiformes"[MeSH Terms]) AND ("small farm*"[Title/Abstract] OR "small-
scale"[Title/Abstract] OR "small-scale"[Title/Abstract] OR
"smallholder"[Title/Abstract] OR "small holder"[Title/Abstract] OR
"backyard*"[Title/Abstract] OR "hobby"[Title/Abstract]) AND
("Biosecurity"[Title/Abstract] OR "hygiene"[Title/Abstract] OR "disease
prevention"[Title/Abstract] OR "poultry diseases/prevention and control"[MeSH
Terms] OR "cattle diseases/prevention and control"[MeSH Terms] OR "swine
diseases/prevention and control"[MeSH Terms] OR "animal diseases/prevention
and control"[MeSH Terms] OR "Biosecurity"[MeSH Terms])) AND
((english[Filter]) AND (2000:2022[pdat]))

Search Database: Scopus

Search ID	Terms (copy and paste)	Results
#1 Biosecurity	TITLE-ABS-KEY ("Biosecurity" OR "hygiene" OR "disease prevention")	209,560
#2 Small farms	TITLE-ABS-KEY ("Small farm*" OR "small scale" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard*" OR "hobby")	199,315
#3 US + Canada	TITLE-ABS-KEY ("United States" OR "US" OR "USA" OR "Canada")	4,079,816
#4 Developed country index	TITLE-ABS-KEY ("New Zealand" OR "Australia" OR "Japan" OR "Switzerland" OR "Norway" OR "Iceland" OR "UK" OR "United Kingdom" OR "England" OR "Nordic Countries" OR "European Union" OR "Europe" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Republic of Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Irish Republic" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden")	5,995,888
#5 Animals	TITLE-ABS-KEY ("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR "hogs" OR "small ruminants" OR "livestock" OR "poultry" OR "chickens" OR "gallus" OR "turkeys" OR "meleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio")	1,839,651
#6	#3 OR #4	9,638,381
#7	#1 AND #2 AND #6 AND #5	143
#8	#7 AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008) OR LIMIT-TO (PUBYEAR , 2007) OR LIMIT-TO (PUBYEAR , 2006) OR LIMIT-TO (PUBYEAR , 2005) OR LIMIT-TO (PUBYEAR , 2004) OR LIMIT-TO (PUBYEAR , 2003) OR LIMIT-TO (PUBYEAR , 2001)) AND (LIMIT-TO (LANGUAGE , "English"))	135
Copy and paste	(TITLE-ABS-KEY ("Biosecurity" OR "hygiene" OR "disease prevention")) AND (TITLE-ABS-KEY ("Small farm*" OR "small scale" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard*" OR "hobby")) AND (TITLE-ABS-KEY ("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR	

	"hogs" OR "small ruminants" OR "livestock" OR "poultry" OR "chickens" OR "gallus" OR "turkeys" OR "meleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio")) AND ((TITLE-ABS-KEY ("United States" OR "US" OR "USA" OR "Canada")) OR (TITLE-ABS-KEY ("New Zealand" OR "Australia" OR "Japan" OR "Switzerland" OR "Norway" OR "Iceland" OR "UK" OR "United Kingdom" OR "England" OR "Nordic Countries" OR "European Union" OR "Europe" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Republic of Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Irish Republic" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden")))	
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Search Database: AGRICOLA (Ovid)

Search ID	Terms (copy and paste)	Results
#1 Biosecurity	("Biosecurity" or "hygiene" or "disease prevention").mp or ("Biosecurity--United States").de or "disease prevention"/	28,626
#2 Small farm	("Small farm*" or "small scale" or "small-scale" or "smallholder" or "small holder" or "backyard*" or "hobby").mp	32,200
#3 US + Canada	("United States" or "US" or "USA" or "Canada").mp	505,988
#4 Developed country index	("New Zealand" or "Australia" or "Japan" or "Switzerland" or "Norway" or "Iceland" or "UK" or "United Kingdom" or "England" or "Nordic Countries" or "European Union" or "Europe" or "Austria" or "Belgium" or "Bulgaria" or "Croatia" or "Republic of Cyprus" or "Czech Republic" or "Denmark" or "Estonia" or "Finland" or "France" or "Germany" or "Greece" or "Hungary" or "Ireland" or "Irish Republic" or "Italy" or "Latvia" or "Lithuania" or "Luxembourg" or "Malta" or "Netherlands" or "Poland" or "Portugal" or "Romania" or "Slovakia" or "Slovenia" or "Spain" or "Sweden").mp	740,219
#5 species	("Goat" or "capra" or "sheep" or "ovis" or "cow" or "cattle" or "bos" or "swine" or "sus" or "pig" or "pigs" or "hog" or "hogs" or "small ruminants" or "livestock" or "poultry" or "chickens" or "gallus" or "turkeys" or "meleagris" or "geese" or "ducks" or "hen" or "hens" or "pheasants" or "squabs" or "fowl" or "fowls" or "ostrich" or "emu" or "rhea" or "Dromaius" or "Struthio").mp	626,414
#8	#3 OR #4	1,211,365
#9	#8 AND #1 AND #2 AND #5	95
Copy and paste	((("United States" or "US" or "USA" or "Canada").mp or ("New Zealand" or "Australia" or "Japan" or "Switzerland" or "Norway" or "Iceland" or "UK" or "United Kingdom" or "England" or "Nordic Countries" or "European Union" or "Europe" or "Austria" or "Belgium" or "Bulgaria" or "Croatia" or "Republic of Cyprus" or "Czech Republic" or "Denmark" or "Estonia" or "Finland" or "France" or "Germany" or "Greece" or "Hungary" or "Ireland" or "Irish Republic" or "Italy" or "Latvia" or "Lithuania" or "Luxembourg" or "Malta" or "Netherlands" or "Poland" or "Portugal" or "Romania" or "Slovakia" or "Slovenia" or "Spain" or	

	"Sweden").mp) and (("Biosecurity" or "hygiene" or "disease prevention").mp or ("Biosecurity--United States").de or "disease prevention"/) and ("Small farm*" or "small scale" or "small-scale" or "smallholder" or "small holder" or "backyard*" or "hobby").mp and ("Goat" or "capra" or "sheep" or "ovis" or "cow" or "cattle" or "bos" or "swine" or "sus" or "pig" or "pigs" or "hog" or "hogs" or "small ruminants" or "livestock" or "poultry" or "chickens" or "gallus" or "turkeys" or "meleagris" or "geese" or "ducks" or "hen" or "hens" or "pheasants" or "squabs" or "fowl" or "fowls" or "ostrich" or "emu" or "rhea" or "Dromaius" or "Struthio").mp	
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Search Database: AGRIS

Search ID	Terms (copy and paste)	Results
#1 Biosecurity	("Biosecurity" OR "hygiene" OR "disease prevention") AND ("Small farm" OR "small farms" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard" OR "hobby") AND ("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR "hogs" OR "small ruminants" OR "livestock" OR "poultry" OR "chickens" OR "gallus" OR "turkeys" OR "meleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio")	1,609
#2	#1 AND English AND 2000-Current	851
#2	#1 AND Australia	0
#3	#1 AND Austria	0
#4	#1 AND Belgium	12
#5	#1 AND Bulgaria	2
#6	#1 AND Canada	11
#7	#1 AND Croatia	0
#8	#1 AND Cyprus	0
#9	#1 AND Czechia	15
#10	#1 AND Denmark	0
#11	#1 AND Estonia	0
#12	#1 AND Finland	0
#13	#1 AND France	53
#14	#1 AND Germany	0
#15	#1 AND Greece	0

#16	#1 AND Hungary	0
#17	#1 AND Ireland	0
#18	#1 AND Italy	14
#19	#1 AND Latvia	33
#20	#1 AND Lithuania	1
#21	#1 AND Luxembourg	0
#22	#1 AND Malta	0
#23	#1 AND Netherlands	34
#24	#1 AND New Zealand	0
#25	#1 AND Poland	8
#26	#1 AND Portugal	0
#27	#1 AND Romania	1
#28	#1 AND Slovakia	1
#29	#1 AND Slovenia	0
#29	#1 AND Spain	4
#30	#1 AND Sweden	427
#31	#1 AND Switzerland	0
#32	#1 AND Iceland	0
#32	#1 AND Norway	5
#33	#1 AND United Kingdom	14
#34	#1 AND United States	23
#35	#1 AND Japan	4
#36	#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35	662
Copy and paste	("Biosecurity" OR "hygiene" OR "disease prevention") AND ("Small farm" OR "small farms" OR "small-scale" OR "smallholder" OR "small holder" OR "backyard" OR "hobby" OR "urban" OR "small rural") AND ("Goat" OR "capra" OR "sheep" OR "ovis" OR "cow" OR "cattle" OR "bos" OR "swine" OR "sus" OR "pig" OR "pigs" OR "hog" OR "hogs" OR "small ruminants" OR "livestock" OR	

	"poultry" OR "chickens" OR "gallus" OR "turkeys" OR "meleagris" OR "geese" OR "ducks" OR "hen" OR "hens" OR "pheasants" OR "squabs" OR "fowl" OR "fowls" OR "ostrich" OR "emu" OR "rhea" OR "Dromaius" OR "Struthio")	
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Updates: Not applicable

Search Designers:

Information Specialist or Librarian involved in process: Erik Fausak.

Additional input from content experts in the project: Dr. Juliette Di Francesco, Dr. Noelia Silva Del Rio, and Dr. Alda Pires.

Peer Review:

Librarian had their search strategy checked by another librarian on the UC Davis Systematic Review Service using the PRESS checklist and content expert in the field. Validation measures were used to pick up *a priori* selected relevant articles in search strategies in PubMed and CABDirect.

Total Records	Total Records after deduplication	Deduplication software/methodology
1,665	1,484	SR-Accelerator
1,484	1,481	Covidence

Records to screen: 1,481

Study Records – Data Management

Citations retrieved after conducting the search strategy will be imported into Zotero reference management software [21]. Covidence will be used for the various steps of the scoping review process (i.e., title and abstract screening, creation of flow diagram, full-text screening) [27]. Data extraction will be done using Microsoft Excel.

Selection Process

To select the studies to include in the scoping review, two independent researchers (JDF and EI) will screen all the titles and abstracts retrieved from the proposed search approaches by answering the following questions: 1) Does the title or abstract indicate the study included small-scale, backyard, or hobby farms raising livestock and/or poultry? 2) Does the title or abstract indicate the study was done in a developed country? 3) Does the title or abstract indicate the study assessed or described the implementation of biosecurity or hygiene practices [16,17]? 4) Is the study primary research, excluding reviews, written in English? In the title and abstract screening, the available answers will be “no,” “maybe,” and “yes.” Citations will be excluded if the two reviewers answer “no” to one of the questions, whereas citations with "yes" or “maybe” answers to all questions will be retained for full-text screening.

During full-text screening, the same two researchers (JDF and EI) will answer identical questions to those used for title and abstract screening. Available answers will be “no” and “yes.” Only citations with “yes” answers for all the questions will be included in the scoping review.

All screening questions will be tested on 20 papers to evaluate agreement among the two reviewers, and these will be adjusted where needed. Conflicts between reviewers will be solved through discussion and, if necessary, consulted with a third researcher (NSDR or AFAP). All reviewers will be trained on scoping review methods and have domain-specific knowledge in the veterinary field. Journal and author names will not be blinded to the reviewers. A PRISMA flow diagram will be created to display the included and excluded studies [12].

Data Extraction

Data extraction will be performed by a single researcher (JDF). All relevant data from the included full-texts will be extracted and entered into data extraction forms, which will be designed using Microsoft Excel, pre-tested using the 12 calibration papers, and will consist of: (1) the study details (i.e., publication year, authors, journal, geographical location/country of population); (2) the definitions of “small-scale,” “backyard,” and/or “hobby” indicated in the study; (3) the study characteristics (i.e., study type, number of participants, livestock and/or poultry species raised); and (4) the biosecurity and hygiene practices assessed, their definitions, and how their implementation on farms was investigated (i.e., self-reporting or other, measurement scale used).

Data Analysis and Description of Results

Data will be summarized and presented through descriptive methods using R [22]. Data will be plotted using frequency bar graphs, scatter plots, box plots, pie charts, heat maps, and other data representation methods. Tables reporting means or medians, ranges, percentages, and/or coefficients of variation will be prepared where applicable.

Risk of bias in Individual Studies

Not applicable, as scoping reviews aim to provide a broad overview of the evidence available on a subject, and the methodological limitations and risk of bias of the included studies are, therefore, generally not assessed [12].

Data Synthesis

Not applicable for this scoping review.

Confidence in Cumulative Evidence

Not applicable for this scoping review.

Discussion

This scoping review will present an overview of the literature available on biosecurity practices in small-scale and backyard farms raising livestock and/or poultry species in developed countries. It will provide the necessary information to determine the feasibility of a future systematic review

assessing the frequency of implementation of various biosecurity practices in small-scale and backyard farms, and the factors (e.g., geographical location, species raised) associated with their implementation. This study will also provide information of critical value to (1) national and regional agencies to adapt their emergency plans in case of newly-introduced diseases; (2) local agencies and veterinarians to adjust their endemic disease surveillance and control programs; and (3) extension specialists and educators to develop adapted training and educational materials [1]. Finally, it will identify knowledge gaps and inform future studies.

Regarding the strengths of this proposed scoping review, the publication of an *a priori* protocol ensures the transparency and repeatability of our work, as well as reduces the risk of duplication [12,23]. Additionally, to increase its accuracy, the search strategy was developed and refined in collaboration with a librarian, and included several databases. As for limitations, these will include the exclusion of possibly relevant studies written in a language other than English, as well as those on developing countries, which was necessary to ensure the feasibility of the scoping review.

Availability of Data and Materials: All information and datasets will be made available on eScholarship.

Type and Method of Review: Scoping review

Start Date: 15 August 2022

Anticipated Completion Date: 31 August 2023

Language: English

Country: United States of America

Stage of Review: Ongoing

Stage of Review at Time of This Submission:

Stage	Started	Completed
Searches	Yes	Yes
Search Results Screened Against Eligibility Criteria	Yes	No
Data Extraction	No	No

References

1. Correia-Gomes C, Henry MK, Auty HK, Gunn GJ. Exploring the Role of Small-scale Livestock Keepers for National Biosecurity—The Pig Case. *Prev Vet Med.* 2017;145: 7–15. doi:10.1016/j.prevetmed.2017.06.005

2. Gillespie AV, Grove-White DH, Williams HJ. Husbandry, Health and Biosecurity of the Smallholder and Pet Pig Population in England. *Vet Rec.* 2015;177: 47–47. doi:10.1136/vr.102759
3. Schembri N, Hernandez-Jover M, Toribio J-ALML, Holyoake PK. On-farm Characteristics and Biosecurity Protocols for Small-scale Swine Producers in Eastern Australia. *Prev Vet Med.* 2015;118: 104–116. doi:10.1016/j.prevetmed.2014.11.008
4. Ramos S, MacLachlan M, Melton A. Impacts of the 2014-2015 Highly Pathogenic Avian Influenza Outbreak on the U.S. Poultry Sector. United States Department of Agriculture; 2017 p. 22. Report No.: LDPM-282-02.
5. USDA-APHIS. Final Report for the 2014–2015 Outbreak of Highly Pathogenic Avian Influenza (HPAI) in the United States. United States Department of Agriculture; 2016.
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