# TICK SURVEILLANCE SYSTEMS IN NORTH AMERICA: A SCOPING REVIEW

## AUTHORS

Elise Romney[1], Susan Cork[1], Akaysha Envik[1], Heather Ganshorn[2], Isabelle Couloigner[1], Sylvia Checkley[1*]

[1]University of Calgary, Faculty of Veterinary Medicine
[2]University of Calgary, Libraries and Cultural Resources

*Corresponding Author
Contact info: email: slcheckl@ucalgary.ca
Address: University of Calgary, Faculty of Veterinary Medicine 3280 Hospital Dr. NW Calgary, Alberta T2N 4Z6.

*ER, AE, SC, HG, SCh conceptualized the research question and search. HG created the search terms and will perform the database searches. The review will be double-blinded with a third reviewer in case of conflict. ER will be the primary author of the presentation. ER, AE, SC HG, IC, SCh will co-author the peer-reviewed article.*

## ABSTRACT

**Introduction:** Tick surveillance is important to detect new ticks or changes in tick occurrence and distribution within a region. This facilitates communication of and response to changes in tick distribution. Tick surveillance systems also provide a framework from which to assess tick-borne disease carriage. This information can be used to launch further investigation and inform risk assessments and mitigation strategies for tick-borne disease in people and animals.  For example, many tick surveillance systems focus on blacklegged ticks, like *Ixodes scapularis*, that can carry *Borrelia burgdorferi*, the causative agent of Lyme disease. Lyme disease can cause clinical signs such as erythema migrans, meningitis, cranial neuropathy, arthritis, carditis[1] in people and some animal species like dogs and horses. White-footed mice and other small mammals are important natural reservoirs of the bacteria while deer and other mammals can carry the ticks.[2,3] Hard ticks (Family: Ixodidae) are found in an increasingly broad range of environments as climate change apparently makes it possible for them to survive in regions where they had not previously been found[4]. Lyme disease, and other tick-borne diseases such as Rocky Mountain spotted fever and Anaplasmosis, are a One Health problem, at the interface between human health, animal health, and the environment.

**Objectives:** The primary objective of this scoping review is to describe the characteristics of tick surveillance systems from 1960 onward. This research will focus on reviewing published and grey

literature and then describing the characteristics of tick surveillance systems, including location, year, type of surveillance, and method of data collection.

**Methods:** This scoping review will be carried out following PRISMA guidelines for scoping reviews. Databases used include MEDLINE, CAB Abstracts, BIOSIS Previews and the Web of Science Core Collection. ProQuest Dissertations will be searched for relevant dissertations. The articles will be screened at the title and abstract, and full text levels by two reviewers blinded to each other's assessment. Articles published prior to 1960 will be excluded, and only articles that describe surveillance systems will be included. Government websites will also be searched for information about tick surveillance programs, globally.

# REVIEW QUESTION
What are the characteristics of existing tick surveillance systems globally?

Population:
- Domestic animals (livestock and pets), wildlife, humans

Concept:
- Surveillance for ticks
- Might be described as sentinel surveillance or citizen science
- Might be described as a Lyme disease surveillance system, but we won't include surveillance for tick-borne diseases only (has to have tick surveillance too)
    - e.g. Surveillance of Lyme disease - Canada.ca

Context:
- Environmental settings also possible (e.g. collection of the tick in the environment, not on a human or animal)
- Logical temporal cutoff is 1960 based on developments in the field of entomology at the time
- Include all regions of the world

# METHODS
## Search Strategy
The selected databases will be searched using controlled vocabulary terms and keywords for the following concepts:
- Ticks (Ixodidae)
- Surveillance

The MEDLINE search strategy (Appendix 1) will be translated to the other databases.

# Study Selection

Duplicate articles will be removed then there will be two stages of screening of the title and abstract screening and full-text. The inclusion and exclusion criteria will be applied at each level of screening. A keyword will be applied in COVIDENCE to excluded articles at the full text level so reasons for exclusion at the full text level can be summarized. Articles will continue to be included at each screening level if sufficient information is not available to make a decision.

**Inclusion Criteria**
- Article must refer to a surveillance system or reports from a surveillance system
  - Definition of surveillance: "The routing and systematic collection, analysis, interpretation, and reporting of population-based data for the purposes of detecting, characterizing, and countering threats to the health, fitness, well-being, and performance of members of defined populations."[5]
- Full text must be written in English, as we do not have resources for translation

**Exclusion Criteria**
- Primary research article
- Primary review article
- Written before 1960
- Not written in English

# Data Extraction

Two reviewers using COVIDENCE will conduct data extraction. Data extracted will be compared for consistency once completed.

Data fields to be extracted are described in Appendix 2.

# DATA ANALYSIS AND PRESENTATION

A series of descriptive statistics will be compiled upon completion of article selection. Information regarding the type of surveillance, the number of surveillance systems will be included. Other information that will be pulled from the articles will include location and timing of data collection, method of sample collection, key findings, methods of reporting collected data, and the primary purpose of the surveillance system (i.e. if tick collection was an indirect result of research being conducted for a different purpose). The above information and other key findings will be summarized by geographical location for clarity. The data will be presented at the University of Calgary's SURE Summer Program research day in August 2021.

## FUNDING

## REFERENCES

1. Shapiro ED (2014). Lyme Disease. *New England Journal of Medicine* 370(18), 1724-1731.

2. Harless W, Stone D (nd). "Your Pet and Lyme Disease". Available at https://www.vetmed.wsu.edu/outreach/Pet-Health-Topics/categories/diseases/your-pet-and-lyme-disease (Accessed: 07 July 2021).

3. LoGiudice K *et al (2003)*. The ecology of infectious disease: Effects of host diversity and community composition on Lyme disease risk. *Proceedings of the National Academy of Sciences of the United States of America* 100(2), 567-571.

4. Ogden NH, Radojevic M, Wu X, Duvvuri VR, Leighton PA, Wu J (2014) . Estimated effects of projected climate change on the basic reproductive number of the Lyme disease vector Ixodes scapularis. Environ Health Perspect. Jun;122(6):631-8. doi: 10.1289/ehp.1307799. Epub 2014 Mar 14. PMID: 24627295; PMCID: PMC4050516.

5. Rubertone MV, Brundage JF (2002). The Defence Medical Surveillance System and the Department of Defence Serum Repository: Glimpses of the Future of Public Health Surveillance. *American Journal of Public Health* 92(12), 1900-1904.

# Appendix 1: MEDLINE search strategy

Database(s): **Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily** 1946 to June 28, 2021
Search Strategy:

| # | Searches | Results |
|---|----------|---------|
| 1 | exp Ticks/ or Tick Infestations/ | 22826 |
| 2 | (tick or ticks or ixodid* or ixodes or Amblyomma or Dermacentor or Hyalomma or Haemaphysalis or Rhipicephalus).kf,tw. | 35251 |
| 3 | 1 or 2 | 37578 |
| 4 | exp Population Surveillance/ | 71976 |
| 5 | (surveil* or "citizen scien*").kf,tw. | 200169 |
| 6 | 4 or 5 | 242741 |
| 7 | 3 and 6 | 1420 |

# Appendix 2: Data Extraction Plan

| Variable | Input Description (examples) |
|---|---|
| Year of publication | Numerical |
| Country and State/Province, City of origin (where the study was published or conducted) | Text |
| Objective/purpose | Text |
| Study population | Domestic livestock |
| | Pets |
| | Wildlife |
| | People |
| | Environment |
| | Combination of above – describe_____ |
| | Other |
| Tick population under surveillance | Blacklegged ticks |
| | All ticks |
| | Ghost moose |
| | Other |
| Sample size justification | Yes/No |
| Surveillance methodology | Clinical specimens |
| | Active flagging |
| | Citizen science |
| | Sentinel surveillance |
| | Laboratory submissions e.g. TBD |
| | Other |
| Sample/data collection methods | Picture submission |
| | Picture submission and tick submission |

| | Tick submission |
| --- | --- |
| | Indirect tick assessment e.g. ghost moose |
| | Tick-borne disease assessment in humans |
| | Tick-borne disease assessment or risk in animals |
| | Other |
| Tick-borne disease studied (if applicable) | *Theileria* |
| | *Babesia* |
| | *Anaplasma phagocytophilum* |
| | *Anaplasma marginale* |
| | Rocky Mountain Spotted Fever |
| | *Ehrlichia* |
| | Other rickettsial infections |
| | Other |
| Method of tick-borne disease identification | Text |
| Timing of sample/data collection | Month(s) |
| Method of reporting | Not described |
| | Annual reports |
| | Open access data |
| | Other |
| Method of tick identification | Taxonomic |
| | PCR |
| | Other |
| Key findings - statement from abstract or conclusion | Text |
| Actions taken in response to surveillance | Text |
| Notes | Text |