THE EMERGENCE OF TULAREMIA FROM A ONE HEALTH PERSPECTIVE

Dolores Gavier-Widén and Gete Hestvik

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Tularemia: a One Health disease

humans

environment

wild animals, arthropods
Tularemia in a One Health context

- *Francisella tularensis*
- Vector borne
- Zoonotic
- Broad host range (>190 mammalian sp)
- Emerging/re-emerging
- “lemming-fever”- in humans (Horne, 1911)
Worldwide distribution of tularemia: Type A and B

*F. tularensis* subsp. *tularensis* (Type A): severe disease (highly virulent)

*F. tularensis* subsp. *holarctica* (Type B): milder disease (moderately virulent)

F. tularensis ssp. holarctica (Type B)

- Complex ecology
- Endemic areas
- Cyclic outbreaks of mortality
- Factors that trigger epidemics and/or emergence not well known
- Little known/understood epidemiology
- Overlap in distribution human-animal tularemia
REVIEW ARTICLE
The status of tularemia in Europe in a one-health context: a review

G. HESTVIK1,2*, E. WARNS-PETIT3, L. A. SMITH4, N. J. FOX4, H. UHLHORN1, M. ARTOIS5, D. HANNANT6, M. R. HUTCHINGS4, R. MATTSSON1, L. YON6 and D. GAVIER-WIDEN1,2

1 Department of Pathology and Wildlife Diseases, National Veterinary Institute, Uppsala, Sweden
2 Department of Biomedical Sciences and Veterinary Public Health, Swedish University of Agricultural Sciences, Uppsala, Sweden
3 European Center for Disease Prevention and Control, Stockholm, Sweden
4 Disease Systems, SRUC, Edinburgh, UK
5 Université de Lyon, VetAgro Sup, Marcy l’Etoile, France
6 Faculty of Medicine and Health Sciences, School of Veterinary Medicine and Science, University of Nottingham, UK

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Tularemia: an emerging/re-emerging infection in Europe

In the last 20 years expanded (or newly recognized):

- Host range (red fox, wild boar, raccoon dog, others)
- Geographical distribution, new/expanded areas, new countries
- Better reporting (in 1992 12 European countries reported to WHO, in 2010 31 countries reported to WHO/ECDC)
- Better diagnostics

Tularemia is constantly showing signs of local emergence and re-emergence in humans and wildlife
Emergence of tularemia in Sweden...

- Tularemia first detected in mountain hares in Sweden in 1931.
- Only found in mountain hares.

Mountain hare (	extit{Lepus timidus})

Slide acknowl. Gete Hestvik
Emergence of tularemia in Sweden

Since 2000:

- Found also in European brown hares.
- In new areas

Slide acknowl. Gete Hestvik
Tularemia in lagomorphs (1992-2012)

- Mountain hare (*Lepus timidus*)
- European brown hare (*Lepus europaeus*), Seroprevalence: up to 23%
- European rabbit (*Oryctolagus cuniculus*), *F. tularensis* detection: up to 2.9%
Hare hunting

- Public health (tularemia) problem in Europe
- One of the most significant European game species
Field mice (*Apodemus agrarius*)
Wood mice (*Apodemus sylvaticus*)
Yellow-necked field mice (*Apodemus flavicollis*)
Black rats (*Rattus rattus*)
House mice (*Mus musculus*)
Rodents: subfam. Arvicolinae (voles and lemmings)

- Norway lemming (*Lemmus lemmus*)
- Common vole (*Microtus arvalis*)
- Water vole (*Arvicola amphibius*)
- Bank voles (*Myodes glareolus*)
- Field vole (*Microtus agrestis*)
Order rodentia, others

- Red squirrel (*Sciurus vulgaris*)
- Hamsters (*Cricetus cricetus*)
- Gerbils (*Meriones erythrus* Gray) (Georgia)
- Others
Other wildlife hosts

- Shrews (Sorex sp)
- Raccoon dogs (*N. procyonoides*)
- Wild boar (*Sus scrofa*)
- Red fox (*Vulpes vulpes*)

**Birds:**
- Common buzzard (*Buteo buteo*)
- Rough legged buzzard (*Buteo lagopus*)
- Ural owl (*Strix uralensis*)
- Common raven (*Corvux corax*)
Species related susceptibility

- **High**: Acute infection, sepsis, short clinical course (1-3 days), high mortality
- **Moderate**: Subacute-chronic, disseminated or organ-localized (3-8 days), granulomatous, longer course, lower mortality
- **Low**: Subclinical, minimal or no visible lesions
Septicaemic-acute tularemia (rodents, mountain hares, E. brown hares)

Hare, tularemia, liver, H&E

Hare, tularemia, liver, IHC

Photo: Gete Hestvik
Tularemia in domestic animals in Europe

- Cattle and sheep (occasionally)
- Dogs


Hamilton Hound
Tularemia in animals (all species) in Europe (OIE reports and publications)- 1992-2012
Tularemia in humans: disease forms and sources of infection

- Ulceroglandular/Glandular: scratch, cut, insect bite

Risk factors: hunting, farming, manipulating contaminated game or fish, outdoor activities

Source: internethaber.com/bu-hastalık

Source: M. Gyurancz, 2011, PhD dissertation
Tularemia in humans: disease forms and sources of infection

- **Oropharyngeal**: ingestion

**Risk factors**: Drinking untreated water, presence of rodent faeces in food storages
Tularemia in humans: disease forms and sources of infection

- **Pneumonic**: inhalation, contaminated dust (hay) or aerosols (crops, carcass skinning, eviscerating).

  **Risk factors**: hunting and farming

Source: jaktojagare.se
Tularemia in humans: Case numbers, incidence and outbreaks

- 18,343 human cases reported
- Average incidence rate (2006-2012), i.e. number of cases per 100,000 inhabitants: 0.04
- The highest average incidence rates: Finland (4.84), Sweden (3.78), Norway (1.16) and Slovakia (0.93)
- Hotspots in Scandinavia and Central Europe
Tularemia in humans in Europe 1992-2012

Reported

Not reported

Map of Europe showing regions where Tularemia was reported and not reported.
Number of cases of tularemia in humans by month recorded in the ECDC database, 2007-2012 (n= 5715)
Tularemia outbreak in Norrbotten, 2015: human cases

- 370 cases in Norrbotten up to 25/9
- Luleå, Boden

Source: Smittskydd i Norrbotten
Tularemia outbreak in Norrbotten, 2015: human cases

Source: Smittskydd i Norrbotten
Tularemia outbreak in Norrbotten, 2015: human cases

Source: Smittskydd i Norrbotten
Mortality outbreak in mountain hares in Sweden, July-September 2015

- 150 reports dead hares in Norrbotten and Västerbotten (vilt@sva.se)
- 25 hares examined
- 12 positive

Source: [www.sva.se](http://www.sva.se) and data from Gete Hestvik
Haematophagous arthropods

ticks
- *Dermacentor reticulatus*
- *Haemaphysalis concinna*
- others

mosquitoes
- *Aedes*
- *Culex*
- *Anopheles*

tabanid flies, fleas, midges, mites, others
Ticks: biological vectors of tularemia and maintenance of *F. tularensis*

- *F. tularensis* in midgut and salivary glands
- Replicates within the tick
- Ticks capable transmitting infection during blood meal
- Transtadial transmission
Eco-epidemiology of tularemia

- Complex
- Varies with ecosystem and geographical region
- Nidality/focality: areas of high endemicity, cases often occur every year, and in high numbers. Highly localized subpopulations of identical genotypes, over multiple years
- Many unknowns
- Terrestrial and aquatic ecological cycles
Tularemia aquatic ecological cycle: rivers, lakes, flooded wetlands, ponds (possible scenarium)

Water vole

Aedes sticticus
Tularemia terrestrial ecological cycle: grassland and medowland habitats (possible scenarium)

Dermacentor reticulatus

Field vole

Common vole
Summary

- Tularemia is widely distributed in humans, wildlife and arthropods vectors in Europe
- Wild animals and arthropods are important sources of infection for humans and other animals
- Surveillance needed to assess risk of exposure

- Complex epidemiology, varies with ecosystem and geographical region
- Different species show different susceptibility to disease
- Gaps in knowledge of epidemiological role of vectors, wildlife and the environment in development, transmission and maintenance
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