National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Foodborne parasites in Europe
Some perspectives

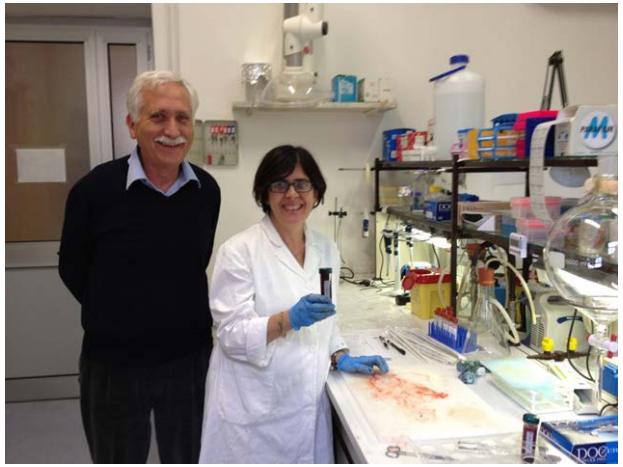
Joke van der Giessen, DVM PhD

RIVM-Center for Infectious Diseases Control

Center for Zoonoses and Environmental Microbiology

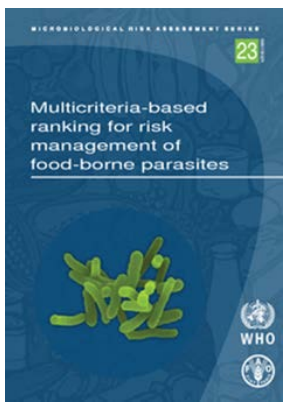
Thanks to ISS and EURL-Parasites and colleagues for 27 years collaborations and good memories

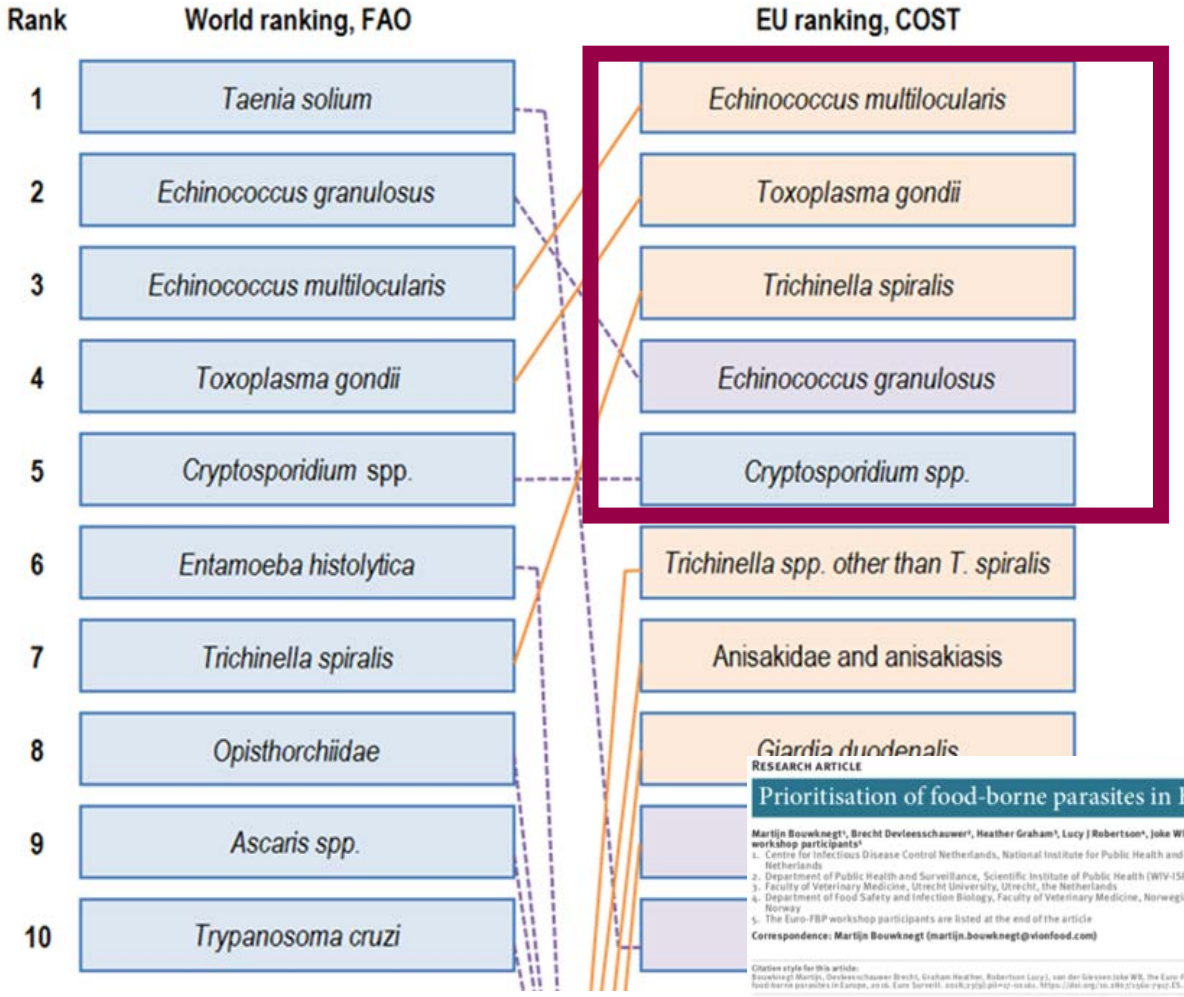
EURL-Parasites
Edoardo Pozio
Simone Caccio
Adriano Casulli
Patrizia Rossie
Maria Angeles Gomes
Furio Spano
Fabio Tossini
Gianluca Marucci
and all others



Ranking Global versus Europe

- Multicriteria decision analyse
  - Number of global foodborne illnesses
  - Global distribution (number of regions)
  - Acute morbidity severity (disability weight)
  - Chronic morbidity severity (disability weight)
  - Fraction of illness that is chronic (%)
  - Case-fatality ratio (%)
  - Likelihood of increased human burden (%)
  - How relevant is this parasite/food pathway for international trade?
  - What is the scope of impact to economically vulnerable communities?





Surveillance in human and animals in Europa

1. *Echinococcus multilocularis*
2. *Toxoplasma gondii*
3. *Trichinella spiralis*
4. *Echinococcus granulosus*
5. *Cryptosporidum* spp.

Parasite Epidemiology and Control 13 (2021) e00205

Contents lists available at ScienceDirect

Parasite Epidemiology and Control

journal homepage: www.elsevier.com/locate/parepi

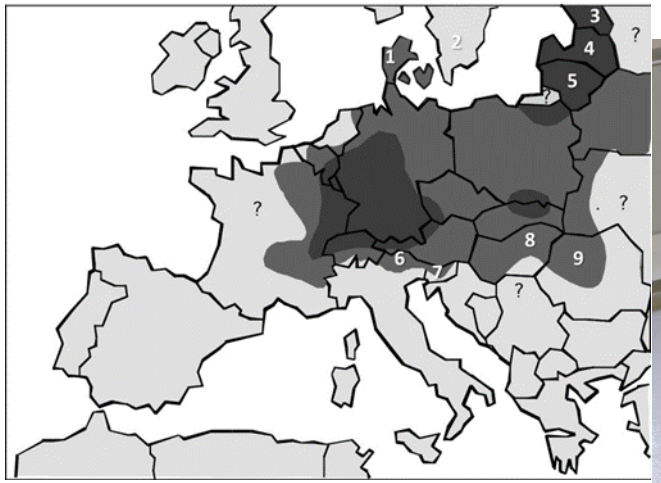
Surveillance of foodborne parasitic diseases in Europe in a One Health approach

Joke van der Giessen [a,*], Gunita Deksne [b,c], Maria Angeles Gómez-Morales [d], Karin Troell [e], Jacinto Gomes [f], Smaragda Sotiraki [g], Miroslaw Rozycki [h], István Kucsera [i], Olgica Djurković-Djaković [j], Lucy J. Robertson [k]

Surveillance systems in humans and animals in Western Europe. Countries included in the region – Austria (AU); Belgium (BE); France (FR); Germany (DE); Liechtenstein (LI); Republic of Ireland (IE); The Netherlands (NL); Switzerland (CH); United Kingdom (UK).

Disease/parasitic agent	Human			Animals			
	Notifiable	Active surveillance	Passive surveillance	Notifiable	Active surveillance	Population under active surveillance	Passive surveillance
Alveolar echinococcosis/*Echinococcus multilocularis*	AU, DE, FR, IE	None	All	BE, CH, DE, IE, NL, UK	AU, BE, CH, DE, IE, NL, UK[c]	Red foxes and slaughtered animals[d]	BE, CH, FR, LI, NL[f]
Toxoplasmosis/*Toxoplasma gondii*	DE; FR; IE[a], UK	AU, BE, DE, FR, NL[b]	All, except BE, NL	BE, CH, DE, IE, LI, NL	BE, DE, FR, NL	Livestock	BE, CH, DE, IE, LI, NL, UK[f]
Trichinellosis/*T. spiralis* and other *Trichinella* spp.	All except BE, FR, UK	None	All	All	All	Slaughtered pigs, solipeds, red fox, wild boar[e]	None
Cystic echinococcosis/*Echinococcus granulosus*	AU, DE, FR, IE	None	All	All	All	Slaughtered animals[d]	CH, DE, NL[f]
Cryptosporidiosis/*Cryptosporidium* spp.	DE, IE, UK	NL[g]	All	CH	None	None	CH, IE, NL, UK[f]

1996: is *E.multilocularis* present in foxes in the Netherlands?



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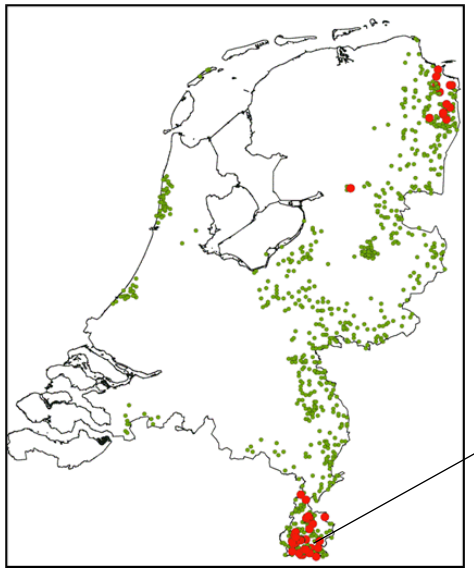
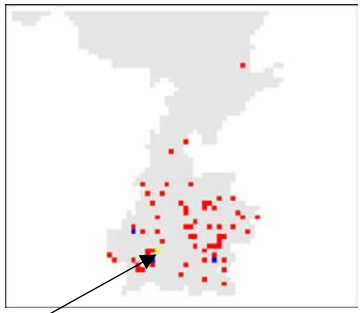
Veterinary Parasitology
Volume 82, Issue 1, 22 March 1999, Pages 49-57

Detection of *Echinococcus multilocularis* in foxes in The Netherlands

J.W.B van der Giessen, Y.B Rombout, J.H Franchimont, L.P Limper, W.L Homan

Em in foxes and AE in humans the Netherlands





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CASE REPORT

The First Locally Acquired Human Infection of *Echinococcus multilocularis* in The Netherlands

Laura van Dommelen,[a] Jan H. M. B. Stoot,[a] Vincent C. Cappendijk,[a] Myrurgia A. Abdul Hamid,[a] Foekje F. Stelma,[a] Laetitia M. Kortbeek,[b] Joke van der Giessen,[b] and Astrid M. L. Oude Lashof[a]
Maastricht University Medical Center, Maastricht, The Netherlands,[a] and National Institute for Public Health and the Environment, Bilthoven, The Netherlands[b]

In the northern part of Western Europe, *Echinococcus multilocularis* is primarily detected in and spreading among foxes. The present case marks *E. multilocularis* as an emerging pathogen for humans, as it describes the first human case of probably locally acquired *E. multilocularis* in The Netherlands, with various interesting clinical aspects.

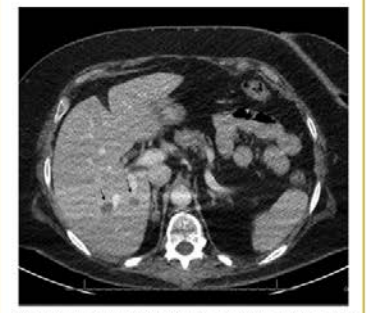


FIG 1 Computed tomogram of the liver after intravenous administration of iodine-containing contrast medium, scanned in the portovenous phase. In this transverse plane of the liver, two hypodense lesions are visible (arrows).

Epidemiol Infect. 2012 May;140(5):867-71. doi: 10.1017/S0950268811001221. Epub 2011 Jul 7.

Mapping the increasing risk of human alveolar echinococcosis in Limburg, The Netherlands

K Takumi [1], D Hegglin, P Deplazes, B Gottstein, P Teunis, J van der Giessen

Veterinary Parasitology 206 (2014) 167–172

Contents lists available at ScienceDirect

Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar

Significant increase of *Echinococcus multilocularis* prevalence in foxes, but no increased predicted risk for humans

M. Maas[a,*], W.D.C. Dam-Deisz[a], A.M. van Roon[b], K. Takumi[a], J.W.B. van der Giessen[a]

Zuid Limburg surveillance foxes

2002–2003: 12.8% (95% CI: 9.4–17.2%)
2005-2006: 11% (95% CI: 7-18%) R0 1.6
2012-2013: 59.0% 95% CI: 43-74%) 37 worms per fox

No surveillance data after 2013 in Limburg

neHEALTHEJP MeME 2020-2023

E. multilocularis in the Netherlands (PhD Laura Derks)

- Contamination rate of **commercially grown berries**
  - 220 berry samples from fruit producers in the endemic area of Limburg
  - Soil and fecal samples from same berry plots
  - Camera traps → foxes observed on 43% of fruit farms
- Current prevalence and spread of Em in **foxes**
  - Foxes provided by hunters
  - Magnetic capture qPCR & intestinal scraping technique
- Comparison of **human seroprevalence** in and outside of endemic area
- Geographic origin of Em in the Netherlands
  - EmsB typing

Echinococcus findings in 2023-2024

Horse. *E. equinus* in a horse after autopsy. Lesions in liver. Confirmed by RIVM. Horse imported from UK (February 2023).

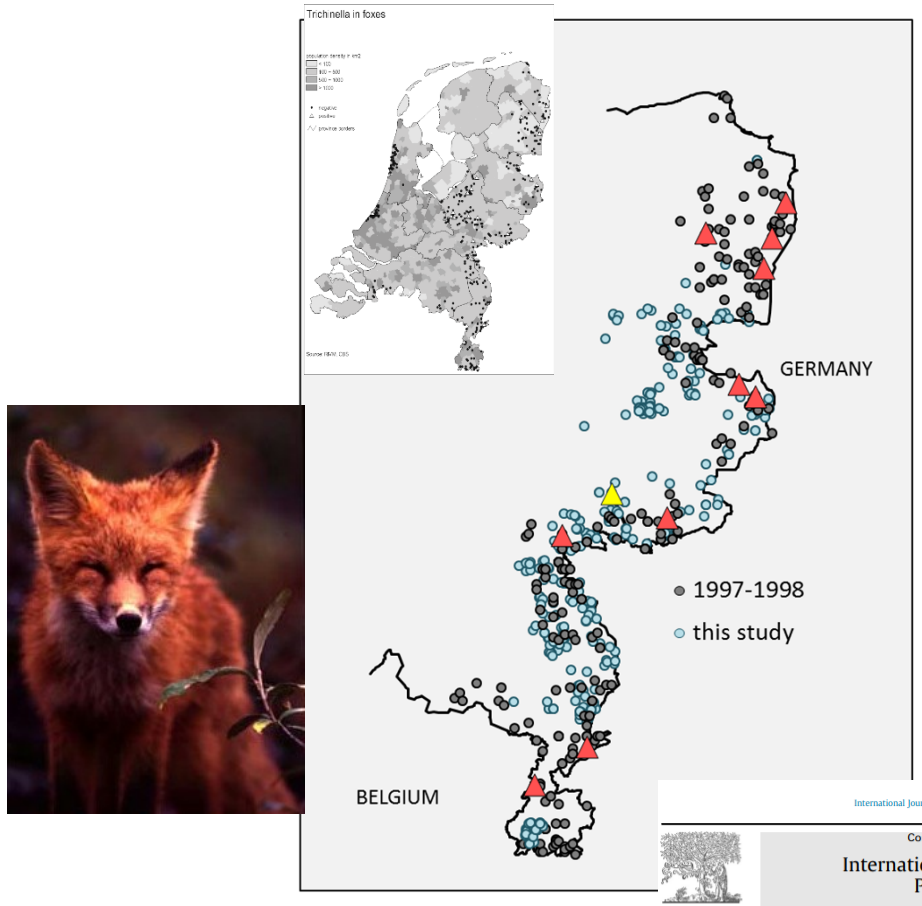
Dog. *E. multilocularis* in fecal material after routine testing by a vet. Confirmed by RIVM Dog stayed of 1 dog 2-3 months in Switzerland. Treatment and retest negative. (September 2023)

Dog. Alveolar echinococcosis in a dog . Liver punctate positive with qPCR *E. multilocularis*. Dog originates from southern Limburg. Treatment, still alive (November 2023)

Gorilla. Vet in Zoo reports gorilla with illness, ddx AE. Serology positive, after autopsy lesions in liver. RIVM confirmed qPCR positive; serology confirmed wit Em 18 ELISA/blot. (September 2024). ZOO located in southern Limburg. Visit and plan for screening/source

Trichinella in wildlife in the Netherlands

Risk assessment for public health



Foxes:

Sluiters *et al.* 1972

1969–1971: prevalence 2.8%, n=106

Van der Giessen *et al*., 1998

1997–1998: prevalence 3.9%, n=276

Franssen et al., 20

2010-2013: prevalence 0.27%, n=369

T. *spiralis: wild boar, raccoon dog*
T. britovi: fox
T. pseudospiralis: wild boar


International Journal for Parasitology: Parasites and Wildlife 5 (2016) 277–279

Contents lists available at ScienceDirect

International Journal for Parasitology: Parasites and Wildlife

journal homepage: www.elsevier.com/locate/ijppaw

Current opinion

First findings of *Trichinella spiralis* and DNA of *Echinococcus multilocularis* in wild raccoon dogs in the Netherlands

Miriam Maas [a, *], Sanne van den End [a, 1], Annika van Roon [a], Jaap Mulder [b], Frits Franssen [a], Cecile Dam-Deisz [a], Margriet Montizaan [c], Joke van der Giessen [a]

Overview wildlife samples tested 2023-2024

Species	2013	2014	2016	2019	2020	2021	2022	2023	2024	Total
Wolf	1				2	2	3	5	5	**18**
Fox								1	3	**4**
Raccoon dog	1	6	2	1	8	10	4	18	10	**60**
Raccoon								24	39	**63**
Bever					1	15		3	7	**26**
Total	2	6	2	1	11	27	7	51	64	**171**

Findings

2013: 1 positive wolf –***T. britovi*** (1.2 LPG) confirmed by multiplex PCR and 5S PCR

2024: 1 positive racoon dog – ***T. britovi*** (0.17 LPG) confirmed by multiplex PCR

International Cie for Trichinellosis


Veterinary Parasitology 159 (2009) 197–205

Contents lists available at ScienceDirect

Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar

Trichinella diagnostics and control: Mandatory and best practices for ensuring food safety

Alvin A. Gajadhar[a,*], Edoardo Pozio[b], H. Ray Gamble[c], Karsten Nöckler[d], Charlotte Maddox-Hyttel[e], Lorry B. Forbes[a], Isabelle Vallée[f], Patrizia Rossi[b], Albert Marinculić[g], Pascal Boireau[f]


Food and Waterborne Parasitology 12 (2019) e00039

Contents lists available at ScienceDirect

Food and Waterborne Parasitology

journal homepage: www.elsevier.com/locate/fawpar

International Commission on Trichinellosis: Recommendations on pre-harvest control of *Trichinella* in food animals

H. Ray Gamble[a,*], Lis Alban[b], Dolores Hill[c], Dave Pyburn[d], Brad Scandrett[e]

[a] National Academy of Sciences, 500 Fifth Street NW, Washington, DC 20001, United States of America
[b] Danish Agriculture & Food Council, Axeltorv 3, DK-1609 Copenhagen, Denmark
[c] United States Department of Agriculture, Agricultural Research Service, Animal Parasitic Diseases Laboratory, Beltsville, MD 20705, United States of America
[d] National Pork Board, 1776 NW 114th St., Clive, IA 50325, United States of America
[e] Centre for Food-borne and Animal Parasitology, Canadian Food Inspection Agency, 116 Veterinary Road, Saskatoon, SK S7N 2R3, Canada


Food and Waterborne Parasitology 12 (2019) e00041

Contents lists available at ScienceDirect

Food and Waterborne Parasitology

journal homepage: www.elsevier.com/locate/fawpar

International Commission on Trichinellosis: Recommendations on post-harvest control of *Trichinella* in food animals

Karsten Noeckler[a], Edoardo Pozio[b], Joke van der Giessen[c], Dolores E. Hill[d], H. Ray Gamble[e,*]

[a] Federal Institute for Risk Assessment, Diedersdorfer Weg 1, 12277 Berlin, Germany
[b] Department of Infectious, Parasitic and Immunomediated Diseases, Istituto Superiore di Sanità, viale Regina Elena 299, 00161 Rome, Italy
[c] National Institute for Public Health and the Environment (RIVM), Center for Zoonoses and Environmental Microbiology, Antonie van Leeuwenhoeklaan 9, 3721, MA, Bilthoven, Netherlands
[d] United States Department of Agriculture, Agricultural Research Service, Animal Parasitic Diseases Laboratory, Beltsville, MD 20705, United States of America
[e] National Academy of Sciences, 500 Fifth Street NW, Washington, DC 20001, United States of America

Trichinella control in meat animals

EU legislation 1375/2015 and ISO-NEN 18743 reference method. Digestion and confirmation: microcopy and multiplex-PCR/sequencing

Pigs controlled housing: no individual carcass control; surveillance and auditing. Risk assessment to support

Pigs non controlled housing: individual carcass control in and in horses and susceptible animals for human consumption (harmonised guidelines WOAH, FAO/WHO and EU)

Harmonised with guidelines from WOAH/FAO/Codex Alimentarius

Risk based surveillance and control

Food and Waterborne Parasitology 10 (2018) 14–22

Contents lists available at ScienceDirect

Food and Waterborne Parasitology

journal homepage: www.elsevier.com/locate/fawpar

Assessing the risk of human trichinellosis from pigs kept under controlled and non-controlled housing in Europe

Frits Franssen *, Katsuhisa Takumi, Joke van der Giessen, Arno Swart

National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands

Controlled housing:

Effective to prevent 100% human trichinellosis cases compared to non-controlled housing.

Testing pigs from controlled housing does not contribute to public health.

Non-controlled housing:

Trichinella testing of these pigs (and wildlife) prevents 98.6% of human trichinellosis cases.

But is meat inspection/digestion sensitive enough?

ICT /ISO : Detection 1-3 larvae per gram based on infectious dose of at least 100 larvae in consumption of 100gram meat to prevent human trichinellosis

Some thoughts
Dose response of Trichinella in humans

Epidemiol. Infect. (2012), **140**, 210–218. © Cambridge University Press 2011
doi:10.1017/S0950268811000380

Human beings are highly susceptible to low doses of *Trichinella* spp.

P. F. M. TEUNIS[1,2*], M. KONINGSTEIN[3], K. TAKUMI[1] AND J. W. B. VAN DER GIESSEN[1]

[1] *Centre for Infectious Disease Control, RIVM (National Institute of Public Health and the Environment), Bilthoven, The Netherlands*
[2] *Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA*
[3] *Department of Epidemiology, Statens Serum Institut, Copenhagen, Denmark*

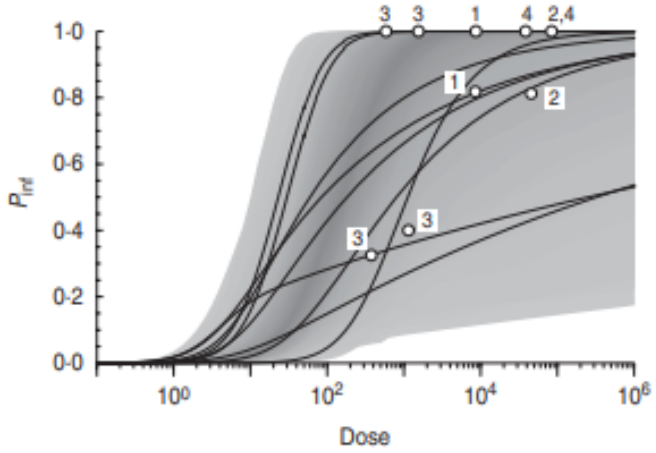
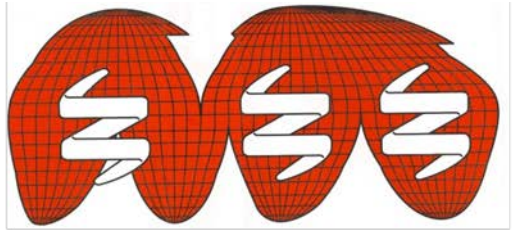


Fig. 1. Outbreak-based *Trichinella* dose–response for infection: individual best (posterior mode) relationships for each of the 10 data-points from nine outbreaks (nine curves, as Ranque *et al.* [5] contributes two different doses). Numbers indicate species: 1, *spiralis*; 2, *nativa*; 3, *britovi*; 4, *pseudospiralis*. The density graph of the predicted (generalized) probability of infection (99% interval) is also shown.

Even doses between 10-100 larvae in pigs can result in human trichinellosis

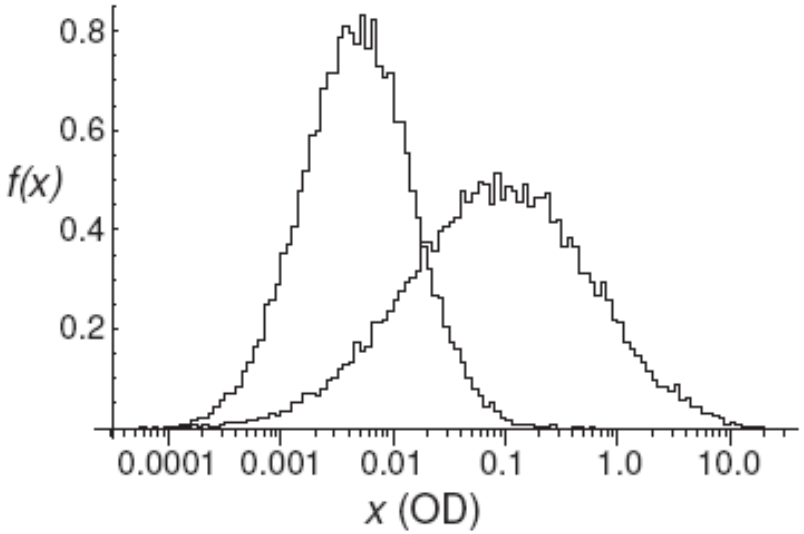
Surveillance in food-producing animals by serology



International Commission on Trichinellosis: Recommendations on the use of serological tests for the detection of *Trichinella* infection in animals and humans

- The ICT does not recommend use of indirect (serological) methods for testing individual carcasses of food animals at slaughter for the purpose of assuring food safety (Gamble et al., 2004). This recommendation is consistent with practical legislation of many governmental bodies, under which meat inspection programs for Trichinella in pork, horse and game meats are performed using a direct method such as artificial digestion (see Commission Implementing Regulation, 2015; International Organization for Standardization, 2015; OIE 2016).

Serology in pigs for surveillance



Validation of serological assays:

These are very low correlations, indicating that the predictive value of serology for actual infection in meat is low


Veterinary Parasitology
Contents lists available at ScienceDirect
journal homepage: www.elsevier.com/locate/vetpar
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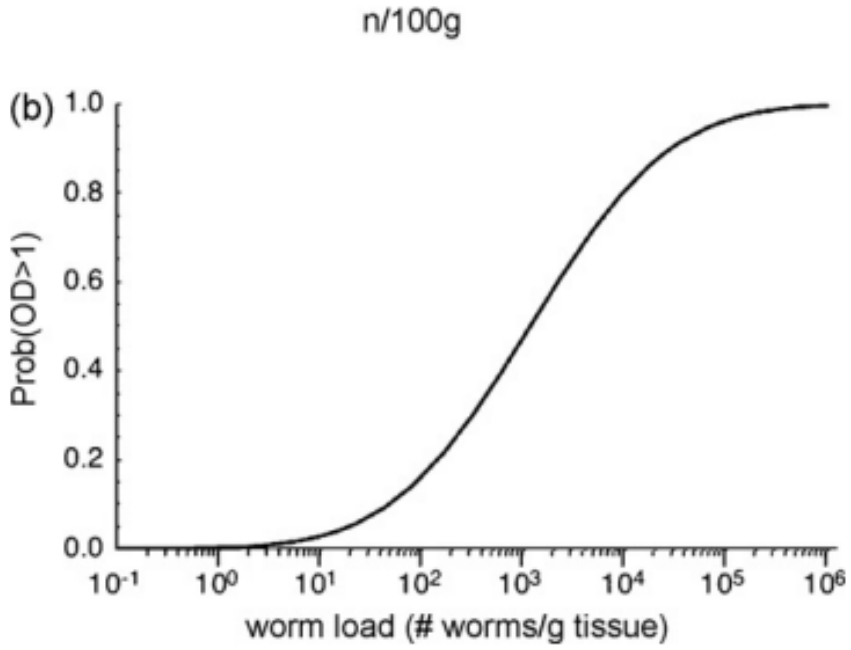
Usefulness of sero-surveillance for *Trichinella* infections in animal populations

P.F.M. Teunis [a,b,*], M.T.M. Fonville [c], D.D.V. Döpfer [d], I.A.J.M. Eijck [d], V. Molina [e], E. Guarnera [e], J.W.B. van der Giessen [c]



*Teunis PF, Fonville MT, Döpfer DD, Eijck IA, Molina V, Guarnera E, van der Giessen JW. Usefulness of sero-surveillance for Trichinella infections in animal populations. Vet Parasitol. 2009 Feb 23;159(3-4):345-9.

Thanks to …. and all the best

Adriano Casulli
Simone Caccio
Patrizia Rossie
Maria Angeles Gomes
and all EURL-P workshop friends

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Maria Angeles Gómez-Morales
Karin Troell
Jacinto Gomes
Smaragda Sotiraki
Miroslaw Rozycki
István Kucsera
Olgica Djurković-Djaković
Lucy J. Robertson

Martijn Bouwknegt, Heather Graham,
Brecht Devleeschhauwer

RIVM
Rijksinstituut voor Volksgezondheid en Milieu
Ministerie van Volksgezondheid, Welzijn en Sport

Yvonne Rombouts
Frits Franssen
Cecile Dam
Manoj Fonville
Ankje de Vries
Huifang Deng
Peter Teunis
Arno Swart
Axel Bonacic Marinovic
Katsuhisa Takumi
Joke van der Giessen

Denise Hoek
Marieke Opsteegh