THE LANCET
Planetary Health

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Tang K L, Caffrey N P, Nóbrega D B, et al. Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis. *Lancet Planet Health* 2017; published online Nov 6, 2017. http://dx.doi.org/10.1016/S2542-5196(17)30141-9

Appendix: Table of Contents

Section 1: MEDLINE search strategy

#	Searches	Results
1	exp Poultry/	135,574
2	exp Ruminants/	447,143
3	exp Swine/	193,661
4	exp Bees/	9,624
5	exp Fishes/	154,782
6	exp Seafood/	11,624
7	exp Mollusca/	52,115
8	exp Crustacea/	35,148
9	(food animal* or farm* or production animal* or livestock or feedlot* or animal feeding operation* or AFO or CAFO).kw,tw.	78,843
10	(ruminant* or cattle or bovine or cow* or beef or heifer* or steer* or calf or calves or sheep or ovine or caprine or goat* or equine or horse* or lepine or rabbit* or deer or elk or game or buffalo or bison or swine or pork or pig* or hog* or boar*).kw,tw.	1,164,249
11	(chicken* or broiler* or turkey* or duck* or geese or goose or poultry or fowl or avian).kw,tw.	175,957
12	(bee or bees or honeybee* or apiary or apicultur*).kw,tw.	14,422
13	((farm* or aquaculture) adj2 (fish or shellfish or seafood or amberjack or arapaima or asp or atipa or barb or barramundi or bass or beluga or bluefin or bluefish or bocachico or bonythongue or bream or bullhead or carp or catfish or char or cichlid or cobia or cod or dorada or eel* or gourami or guapote or grouper or halibut or lai or loach or mackerel or mandarin fish or meagre fish or milkfish or mojarra or mullet or mudfish or nori nei or perch or pejerrey or pike or porgy or pompano or red drum or roach or roho labeo or salmon or sampa or seabass or seabream or snakehead or snapper or snook or sole or spinefood or sturgeon or sweetfish or tench or tilapia or trout or tuna or turbot or vendace or whitefish)).kw,tw.	3,753
14	((farm* or aquaculture) adj2 (shrimp or prawn* or crayfish or lobster* or crab*)).kw,tw.	615
15	((farm* or aquaculture) adj2 (abalone or bivalve* or clam* or carpet shell or cockle* or corbicula or geoduck or mussel* or oyster* or periwinkle* or quahog	439

	or sand gaper* or scallop* or shellfish or tagelus or venus)).kw,tw.	
16	aquaculture.kw,tw.	6,172
17	Aquaculture/	4,788
18	1 or 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	1,832,370
19	drug resistance, microbial/ or exp drug resistance, bacterial/	122,825
20	((antibacterial or anti-bacterial or antibiotic or anti-biotic or antimicrobial or anti-microbial) adj2 (resistan* or susceptib* or minimum inhibitory concentration)).kw,tw.	52,123
21	((aldesulfone or amdinopenicillin* or amikacin or aminocyclitol* or aminoglycoside* or aminopenicillin* or amoxicillin* or ampicillin or amphenicol* or ansamycin* or antipseudomonal or antistaphylococcal or apramycin or arbekacin or aspoxicillin or avilamycin or avoparcin or azalide or azidocillin or azithromycin or azlocillin or aztreonam or bacampicillin or bacitracin or baquiloprim or bekanamycin or benzylpenicillin or biapenem or bicozamycin or bicyclomycin* or brodimoprim or calcium aminosalicylate or capreomycin or carbadox or carbapenem* or carbenicillin or carboxypenicillin* or carindacillin or carumonam or cef* or cepha* or chloramphenicol or chlortetracycline or cinoxacin or ciprofloxacin or clarithromycin or clindamycin or clofazimine or clometocillin or clomocycline or cloxacillin or colistin or cyclic ester* or cyclic polypeptide* or cycloserine or dalbavancin or dalfopristin or danofloxacin or dapsone or daptomycin or demeclocycline or diaminopyrimidine* or dibekacin or dicloxacillin or difloxacin or dirithromycin or dihydrostreptomycin or doripenem or doxycycline or dihydrofolate reductase inhibitor* or enoxacin or enramycin or enrofloxacin or epicillin or ertapenem or erythromycin or ethambutol or ethionamide or faropenem or fleroxacin or flomoxef or florphenicol or flucloxacillin or flumeqin* or fluoroquinolone* or flurithromycin or fosfomycin or framycetin or furaltadone or furazolidone or fusidic acid or gamithromycin or garenoxacin or gatifloxacin or gemifloxacin or gentamicin or glycopeptide* or glycylcycline* or gramicidin or grepafloxacin or hetacillin or ibafloxacin or iclaprim or imipenem or ionophore* or isepamicin or isoniazid or josamycin or kanamycin or ketolilde* or kitasamycin or lasalocid or latamoxef or levofloxacin or lincomycin or lincosamide* or linezolid or lipopeptide* or lomefloxacin or loracarbef or lymecycline or macrolide* or maduramycin or marbofloxacin or mecillinam or meropenem or metacycline or	93,911

	metampicillin or methicillin or meticillin or metronidazole or mezlocillin or midecamycin or miloxacin or miocamycin or minocycline or mirosamycin or monensin or monobactam* or morinamide or moxifloxacin or mupirocin or nafcillin or nalidixic acid or narasin or neomycin or netilmicin or nifurtoinol or nitrofur* or nitroimidazole* or norfloxacin or novobiocin or ofloxacin or oleandomycin or orbifloxacin or oritavancin or ormosulfathiazole or ornidazole or orthosomycin* or oxacillin or oxazolidinone* or oxolinic acid or oxytetracycline or panipenem or para-aminosalicylic acid or paromomycin or pazufloxacin or pefloxacin or penamecillin or penethatamate or penicillin* or penimepicycline or phenethicillin or pheneticillin or phenicol* or phenoxypenicillin* or phenoxymethylpenicillin or phthalylsulfathiazole or pipemidic acid or piperacillin or pirlimycin or piromidic acid or pivampicillin or pivmecillinam or pleuromutilin* or polymixin* or polymyxin* or polypeptide* or pristinamycin or propicillin or protionamide or prulifloxacin or pseudomonic acid* or pyrazinamide or pyrimethamine or quinolone* or quinoxaline* or quinupristin or retapamulin or ribostamycin or rifa* or riminofenazine* or rokitamycin or rolitetracycline or rosoxacin or roxithromycin or rufloxacin or salfadoxine or salinomycin or semduramicin or sisomicin or sitafloxacin or sodium aminosalicylate or sparfloxacin or spectinomycin or spiramycin or streptoduocin or streptogramin* or streptomycin or sulbenicillin or sulfachlorpyridazine or sulfadi* or sulfafurazole or sulfaisodimidine or sulfisoxazole or sulfon* or sulfaguanidine or sulfam* or sulfon* or sulfanilamide or sulfafurazole or sulfalene or sulfam* or sulfanilamide or sulfap* or sulfaquinoxaline or sulfath* or sultamicillin or talampicillin or teicoplanin or telavancin or telithromycin or temafloxacin or temocillin or terdecamysin or terizidone or tetracycline* or tetroxoprim or thiamphenicol or tiamulin or ticarcillin or tigecycline or tildipirosin or tilmicosin or tinidazole or tiocarlide or tobicillin or tobramycin or trimethoprim or troleandomycin or trovafloxacin or tulathromycin or tylosin or tylvalosin or valnemulin or vancomycin or virginiamycin) adj2 (resistan* or susceptib* or minimum inhibitory concentration)).kw,tw.	
22	exp Drug Resistance/	273,591
23	exp Anti-Bacterial Agents/ or exp Animal Feed/	654,369
24	(antibacterial or anti-bacterial or antibiotic or anti-biotic or antimicrobial or anti-microbial).kw,tw.	291,134

25	23 or 24	791,722
26	22 and 25	102,558
27	AMR.kw,tw.	1,504
28	19 or 20 or 21 or 26 or 27	188,126
29	((reduc* or decreas* or restrict* or limit* or ban or bans or banning or eliminat* or control* or regulat* or less* or cut* or scale* or scaling or down* or taper*) adj5 ("use" or usage or utilization or dose* or dosage or administ* or prescri*)).kw,tw.	427,628
30	(organic or (antibiotic adj2 free) or without antibiotic* or without antimicrobial*).kw,tw.	216,036
31	29 or 30	640,063
32	18 and 28 and 31	849
33	remove duplicates from 32	835

Notes on search terms:

- Antibiotic-related keywords were derived from the WHO List of Critically Important Antimicrobials for Human Medicine (http://apps.who.int/iris/bitstream/10665/77376/1/9789241504485_eng.pdf) and the OIE List of Antimicrobial Agents of Veterinary Importance (http://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/Eng_OIE_List_antimicrobials_May2015.pdf).
- Keywords for species used in aquaculture were derived from the FAO Fisheries list of animal species used in aquaculture at http://www.fao.org/docrep/W2333E/W2333E00.htm.

Section 2: Grey literature search strategy

The following websites/agencies/documents were included in our grey literature search:

1. CANADA

1.1 Canadian Antimicrobial Resistance Alliance (http://www.can-r.com)
Manuscripts

1.2 Public Health Agency
Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) (http://www.phac-aspc.gc.ca/cipars-picra/index-eng.php)
Canadian Antimicrobial Resistance Surveillance System Reports 2013 – 2015
Canadian Nosocomial Infection Surveillance Program (CNISP) (http://www.phac-aspc.gc.ca/nois-sinp/survprog-eng.php)

- Surveillance projects
- Publications

1.3 Health Canada
Antimicrobial resistance section (http://www.hc-sc.gc.ca/dhp-mps/vet/antimicrob/index-eng.php)

1.4 Canadian Institutes of Health Research (http://www.cihr-irsc.gc.ca)
Health Services and Policy Research

- Publications

Population and Public Health

- Publications

2. DENMARK

DANMAP (http://www.danmap.org/)

- Reports

3. THE NETHERLANDS

3.1 MARAN (http://www.wageningenur.nl/en/Research-Results/Projects-and-programmes/MARAN-Antibiotic-usage.htm)

- References

3.2 Sda

- Associations between antimicrobial use and the prevalence of resistant micro-organisms (http://www.autoriteitdiergeneesmiddelen.nl/Userfiles/rapport%20ab%20en%20resistentie/def-engels-rapport-abgebruik-en-resistentie-0516.pdf)

3.3 Government of the Netherlands
- Reduced and Responsible: use of antibiotics in food-producing animals in the Netherlands (https://www.government.nl/documents/leaflets/2014/02/28/reduced-and-responsible-use-of-antibiotics-in-food-producing-animals-in-the-netherlands)

4. SWEDEN

SVARM
- Reports (http://www.sva.se/en/antibiotika/svarm-reports)

5. AUSTRALIA

JETACAR (http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubs-jetacar-cnt.htm)

6. UNITED KINGDOM

Antimicrobial Resistance (https://www.gov.uk/government/collections/antimicrobial-resistance-amr-information-and-resources#strategic-publications)
- Strategic publications

7. EUROPEAN UNION

7.1 Health and Food Safety
AMR (http://ec.europa.eu/dgs/health_food-safety/amr/action_eu/index_en.htm)
Projects, Studies and Related Information (http://ec.europa.eu/dgs/health_food-safety/amr/projects/index_en.htm)

7.2 European Centre for Disease Prevention and Control (ECDC)
European Antimicrobial Resistance Surveillance Network (EARS-Net)
(http://ecdc.europa.eu/en/activities/surveillance/EARS-Net/Pages/index.aspx)
European Surveillance of Antimicrobial Consumption (ESAC-Net)
(http://ecdc.europa.eu/en/activities/surveillance/ESAC-Net/Pages/index.aspx)

7.3 European Food Safety Authority (EFSA)
Antimicrobial resistance (http://www.efsa.europa.eu/en/topics/topic/amr)
- Completed work

7.4 European Medicines Agency (EMA)
European Surveillance of Veterinary Antimicrobial Consumption (ESVAC)
(http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000302.jsp)

Antimicrobial Resistance
(http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general_content_001686.jsp&mid=WC0b01ac05807a4e0d)

- ECDC/EFSA/EMA first joint report on the integrated analysis of the consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals

8. CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

Antibiotic/Antimicrobial Resistance (https://www.cdc.gov/drugresistance/)

- Digital Materials (https://www.cdc.gov/drugresistance/resources/digital_materials.html)
- Publications (https://www.cdc.gov/drugresistance/resources/publications.html)
- National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) (http://www.cdc.gov/narms/index.html)
    - Publications section
- Translatlantic Task Force on Antimicrobial Resistance (TATFAR) (https://www.cdc.gov/drugresistance/tatfar/index.html)
    - Links and Resources
- Interagency Taskforce on Antimicrobial Resistance (ITFAR) (http://www.cdc.gov/drugresistance/itfar/index.html
    - ITFAR Link and Resources

9. US FOOD AND DRUG ADMINISTRATION (FDA)

Antimicrobial Resistance
(http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/)

- Guidance for Industry #209

10. JOINT PROGRAMMING INITIATIVE ON ANTIMICROBIAL RESISTANCE
(http://www.jpiamr.eu/)

Library
Workshop reports
Papers

11. WORLD ANTIMICROBIAL RESISTANCE CONFERENCE US
(http://www.terrapinn.com/conference/antimicrobial-resistance-congress-usa/index.stm)

12. WORLD HEALTH ORGANIZATION (WHO)

12.1 IRIS Repository (http://apps.who.int/iris/)
Search "antimicrobial resistance"

Antimicrobial use in aquaculture and antimicrobial resistance

- Antimicrobial resistance and rational use of antimicrobial agents (EM/RC49/8)

- Use of antimicrobials in food animals (weekly epidemiological record, no. 33, 18 August 2000)
- Impacts of antimicrobial growth promoter termination in Denmark
- Joint FAO/OIE/WHO Expert Workshop on Non-Human Antimicrobial Usage and Antimicrobial Resistance: Scientific assessment
- Second Joint FAO/OIE/WHO Expert Workshop on Non-Human Antimicrobial Usage and Antimicrobial Resistance: Management options
- The Medical Impact of Antimicrobial Use in Food Animals. Report of a WHO Meeting. Berlin, Germany, 13-17 October 1997
- Containing Antimicrobial Resistance (WHO/CDS/CSR/DRS/99/2)
- WHO Scientific working group on monitoring and management on bacterial resistance to antimicrobial agents (WHO/CDS/BVI/95.7)
- Regional strategy on prevention and containment of antimicrobial resistance 2010-2015
- Use of quinolones in food animals and potential impact on human health (WHO/EMC/ZDI/98.12)

12.2 Strategic and Technical Advisory Group (STAG) on antimicrobial resistance
(http://www.who.int/antimicrobial-resistance/events/stag/en/)
6th meeting 11 May 2016
5th meeting 23-24 November 2015
4th meeting 24-25 February 2015
3rd meeting 17 October 2014
2nd meeting 14-16 April 2014
1st meeting 19-20 September 2013

12.3 International Clinical Trials Registry Platform
(http://apps.who.int/trialsearch/Default.aspx)
List by "Health Topics"
- Antimicrobial Resistance
- Epidemiology

13. INTERNATIONAL VETERINARY INFORMATION SERVICE
(http://www.ivis.org/home.asp)

Search "antimicrobial resistance"

14. EUROPEAN SOCIETY OF CLINICAL MICROBIOLOGY AND INFECITOUS DISEASES (ESCMID)

14.1 eLibrary (https://www.escmid.org/escmid_publications/escmid_elibrary/)
Search "antimicrobial use animals"
- Checked all items until achieve 50% of relevance scale

14.2 Conference on Reviving Old Antibiotics
(https://www.escmid.org/research_projects/escmid_conferences/past_escmid_conferences/reviving_old_antibiotics/)
Final Programme

14.3 The Lancet/ESCMID Conference on healthcare-associated infections and antimicrobial resistance
(https://www.escmid.org/research_projects/escmid_conferences/past_escmid_conferences/hai_and_ab_resistance/)

15. ReACT (http://www.reactgroup.org/)

Policy and Reports

16. CONSUMERS INTERNATIONAL

WCRD 2016: Antibiotic Resistance (http://www.consumersinternational.org/our-work/wcrd/wcrd-2016/)
- WCRD 2016 Resource Pack

17. WORLD ORGANIZATION FOR ANIMAL HEALTH (OIE)

Antimicrobial Resistance (http://www.oie.int/en/for-the-media/amr/)
OIE Global Conference on the Prudent Use of Antimicrobial Agents for Animals
- Presentations / Abstracts (http://www.oie.int/eng/A_AMR2013/presentations.htm)

18. ANTIMICROBIAL RESISTANCE ONE HEALTH COLLOQUIUM

Available on
https://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/AMR%20%20One%20Health%20Colloquium%20Meeting%20Summary%20jm-er%20ao%20-%2028%20April%2015.pdf

19. FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS (FAO)

Antimicrobial Resistance (http://www.fao.org/antimicrobial-resistance/en/)
- Publications section
- Uso de antimicrobianos en animales de consumo (http://www.fao.org/3/a-y5468s.pdf)
- Joint FAO/WHO/OIE Expert Meeting on Critically Important Antimicrobials (ftp://ftp.fao.org/docrep/fao/010/i0204e/i0204e00.pdf)
- CODEX Alimentarius
    - Guidelines for risk analysis of foodborne antimicrobial resistance CAC/GL 77- 2011 (http://www.fao.org/fao-who-codexalimentarius/sh-

proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCAC%2BGL%2B77-2011%252FCXG_077e.pdf)

- Code of practice to minimize and contain antimicrobial resistance CAC/RCP 61-2005 (http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCAC%2BRCP%2B61-2005%252FCXP_061e.pdf)

20. ANIMAL HEALTH INSTITUTE

Animal Antibiotics (http://www.ahi.org/issues-advocacy/animal-antibiotics/)

- The Danish experience (http://www.ahi.org/wp-content/uploads/2011/06/Pork-Check-off-DanishExperience1.pdf)
- Political bans on antibiotics are counterproductive (http://www.ahi.org/Files/Antibiotics%20in%20Livestock/H.%20Danish%20experience.pdf)

21. AMERICAN VETERINARY MEDICAL ASSOCIATION (AVMA)

Antimicrobial Resistance FAQs
(https://www.avma.org/KB/Resources/FAQs/Pages/Antimicrobial-Use-and-Antimicrobial-Resistance-FAQs.aspx)

22. NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES (NIAID)

NIAID's Antibacterial Resistance Program: Current Status and Future Directions
(http://www.niaid.nih.gov/topics/antimicrobialResistance/Documents/ARstrategicplan2014.pdf)

23. CLINICALTRIALS.GOV

Search "Antimicrobial Animal"

24. INNOVATIVE MEDICINES INITIATIVE (IMI)

Combating antimicrobial resistance in Europe (COMBACTE)
(http://www.imi.europa.eu/content/combacte)

- Projects

25. LIST OF CONFERENCE PROCEEDINGS FROM SCIENTIFIC MEETINGS:

Proceedings/presentations from the following conferences/meetings were manually reviewed and abstracts were selected based on the eligibility criteria described in the methods section of the report:

ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens
Denmark, 2008

2nd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans and the Environment
Canada, 2010

3rd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans and the Environment
France, 2012

4th ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens
United States, 2015

2009 - ASM-ESCMID Conference on Methicillin-resistant Staphylococci in Animals
England, 2009

2011 - Methicillin-resistant Staphylococci in Animals: Veterinary and Public Health Implications
United States, 2011

3rd ASM-ESCMID Methicillin-resistant Staphylococci in Animals: Veterinary and Public Health Implications
Denmark, 2013

4th ASM-ESCMID Conference on Methicillin-resistant Staphylococci in Animals: Veterinary and Public Health Implications
United States 2015

American Society for Microbiology 110th – 115th General Meetings

ASM-ESCMID International Workshop on Dermatological Infections and Food-borne Diseases
United States, 2015

2010 International Conference on Antimicrobial Research
Spain, 2010

2012 International Conference on Antimicrobial Research
Portugal, 2012

2014 International Conference on Antimicrobial Research
Spain, 2014

2016 International Conference on Antimicrobial Research
Spain, 2016

National Foundation for Infectious Diseases 2002 Conference on Antimicrobial Resistance
United States, 2002

National Foundation for Infectious Diseases 2003 Conference on Antimicrobial Resistance
United States, 2003

National Foundation for Infectious Diseases 2004 Conference on Antimicrobial Resistance
United States, 2004

National Foundation for Infectious Diseases 2005 Conference on Antimicrobial Resistance
United States, 2005

National Foundation for Infectious Diseases 2006 Conference on Antimicrobial Resistance
United States, 2006

National Foundation for Infectious Diseases 2007 Conference on Antimicrobial Resistance
United States, 2007

National Foundation for Infectious Diseases 2008 Conference on Antimicrobial Resistance
United States, 2008

National Foundation for Infectious Diseases 2010 Conference on Antimicrobial Resistance
United States, 2010

2015 Meeting of the Transatlantic Taskforce on Antimicrobial Resistance
Luxembourg, 2015

CDC 64th Epidemic Intelligence Service
United States, 2015

14th International Congress on Infectious Diseases
United States, 2010

15th International Congress on Infectious Diseases
Thailand, 2012

16th International Congress on Infectious Diseases
South Africa, 2014

17th International Congress on Infectious Diseases
India, 2016

2007 International Meeting on Emerging Diseases and Surveillance
Austria, 2007

2009 International Meeting on Emerging Diseases and Surveillance
Austria, 2009

2011 International Meeting on Emerging Diseases and Surveillance
Austria, 2011

2013 International Meeting on Emerging Diseases and Surveillance
Austria, 2013

2014 International Meeting on Emerging Diseases and Surveillance
Austria, 2014

22nd World Buiatrics Congress
Germany, 2002

23rd World Buiatrics Congress
Canada, 2004

24th World Buiatrics Congress
France, 2006

25th World Buiatrics Congress
Hungary, 2008

26th World Buiatrics Congress
Chile, 2010

27th World Buiatrics Congress
Portugal, 2012

28th World Buiatrics Congress
Australia, 2014

2010 National Mastitis Council Annual Meeting
United States, 2010

2011 National Mastitis Council Annual Meeting
United States, 2011

2012 National Mastitis Council Annual Meeting
United States, 2012

2013 National Mastitis Council Annual Meeting
United States, 2013

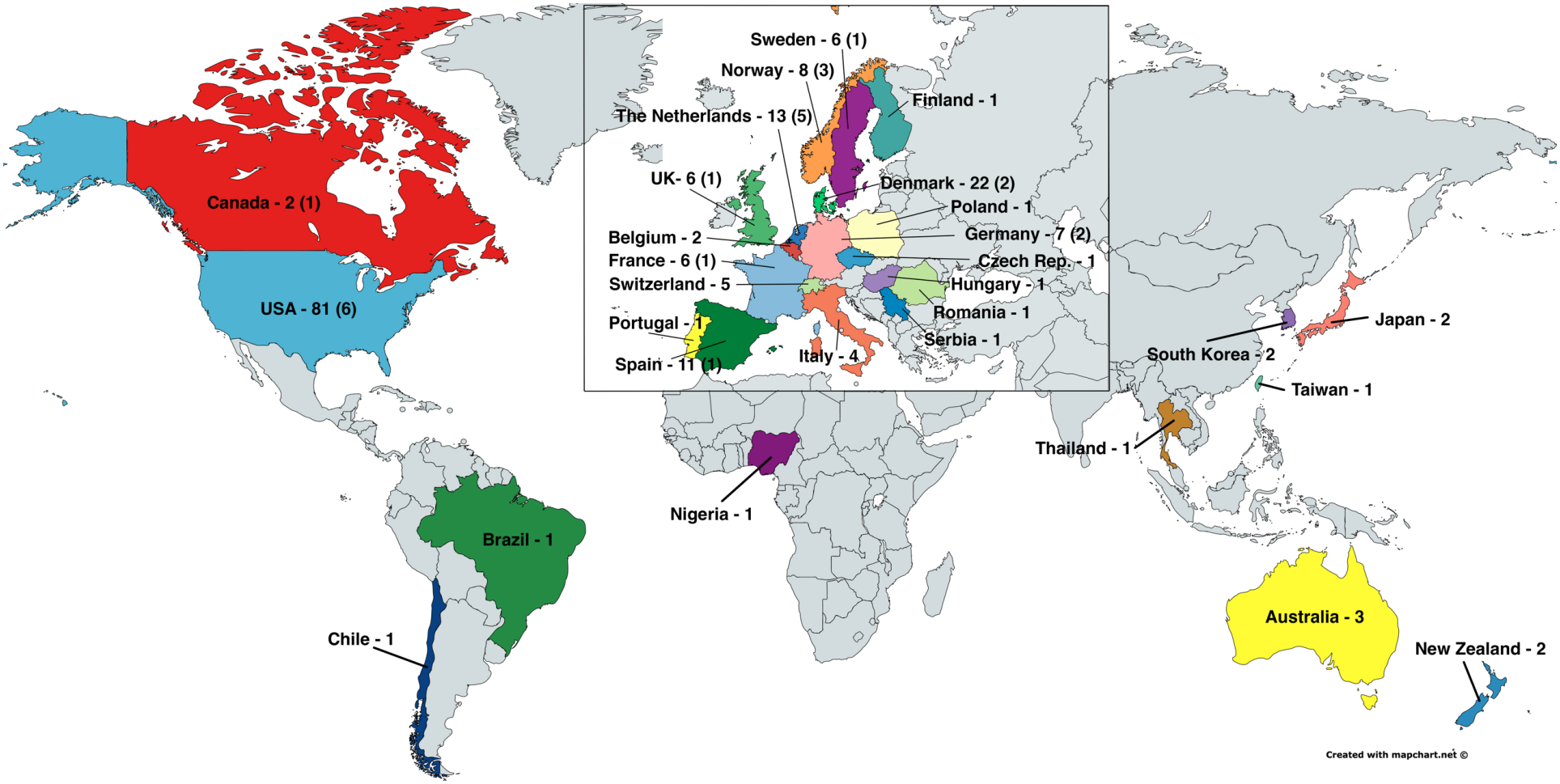
2014 National Mastitis Council Annual Meeting

United States, 2014

2015 National Mastitis Council Annual Meeting
United States, 2015

2011 International Meeting on Neglected Tropical Diseases
United States, 2011

Figure 1: Geographic representation of countries* from which animal studies (human studies in parentheses) originate, with enlarged European insert



*Studies may include data from more than one country. Five studies did not report the country of origin.

Table 1: Study characteristics of individual animal studies

			Intervention						Bacteria studied					
First author (Year)	Country	Study design	External ban	Organic	Antibiotic free	Voluntary reduction	Population sampled (Sample type)	Sample point	Unit of analysis (n)	Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	Genotypic or phenotypic resistance
Aarestrup (1995)[1]	Denmark	Cross-sectional			•		Broilers, egg layers (Faeces)	Farm	Isolate (29)		•				Both
Aarestrup (2000a)[2]	Denmark	Cross-sectional				•	Broilers (Faeces)	Farm	Isolate (192)		•				Phenotypic
Aarestrup (2000b)[3]	Denmark, Finland, Norway	Cross-sectional	•				Broilers, pigs (Faeces)	Farm	Isolate (322)		•				Both
Aarestrup (2001)[4]	Denmark	Longitudinal	•			•	Broilers, pigs (Caecal, cloacal)	Farm	Isolate (2,617)		•				Phenotypic
Aarestrup (2002)[5]	Denmark, Spain, Sweden	Cross-sectional	•				Pigs (Faeces)	Slaughter	Isolate (380)		•				Both
Abdalrahman (2015)[6]	USA	Cross-sectional		•			Broilers, turkeys (Meat)	Retail	Isolate (168)				•		Both
Agersø (2013)[7]	Denmark	Cross-sectional	•				Pigs (Caecal, faeces)	Farm, retail, slaughter	Sample (1,970)	•					Genotypic
Agga (2015)[8]	USA	Cross-sectional			•		Beef cows (Faeces)	NR	Animal (369)	•	•				Phenotypic
Alali (2010)[9]	USA	Cross-sectional		•			Broilers (Environment, faeces)	Farm	Isolate (70)	•					Phenotypic
Álvarez-Fernández (2012)[10]	Spain	Cross-sectional		•			Broilers, quail (Eggs)	Retail	Isolate (120)	•					Phenotypic
Álvarez-Fernández (2013)[11]	Spain	Cross-sectional		•			Broilers, turkey, quail (Meat)	Retail	Isolate (60)	•					Phenotypic
Avrain (2003)[12]	France	Longitudinal			•		Broilers (Caecal)	Slaughter	Isolate (346)			•			Phenotypic
Bager (1999)[13]	Denmark	Longitudinal	•				Broilers, pigs (Caecal, cloacal)	Slaughter	Isolate (437)		•				Phenotypic
Barlow (2008)[14]	Australia	Cross-sectional		•			Beef cows (Faeces, hide, meat)	Farm, slaughter	Isolate (556)					•	Genotypic
Barlow (2009)[15]	Australia	Cross-sectional		•			Beef cows (Faeces)	Farm, slaughter	Isolate (129)	•				•	Genotypic
Bauer-Garland (2006)[16]	USA	Non-randomized trial				•	Broilers (Caecal)	Farm	Isolate (40)	•					Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Bengtsson (2006)[17]	Denmark, Norway, Sweden, The Netherlands	Cross-sectional	•				Broilers, pigs (Faeces, meat)	NR	Isolate (3,473)	•	•				Phenotypic
Bennedsgaard (2006)[18]	Denmark	Cross-sectional		•			Dairy cows (Milk)	Farm	Animal (2,311), herd (57)				•		Phenotypic
Boerlin (2001)[19]	Switzerland	Longitudinal	•				Pigs (Faeces)	Farm	Isolate (155)		•				Both
Bombyk (2007)[20]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (NR)				•		Genotypic
Bombyk (2008)[21]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (405)				•		Phenotypic
Borgen (2000)[22]	Norway	Cross-sectional	•				Broilers (Bird, faeces)	Farm	Farm (147)		•				Both
Borgen (2001)[23]	Norway	Cross-sectional	•				Poultry (Carcass)	Slaughter	Isolate (150)		•				Both
Boutet (2005)[24]	Belgium	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (1,002)				•		Phenotypic
Boyer (2012)[25]	USA	Cross-sectional				•	Dairy cows (Faeces)	Farm	Sample (455)	•					Both
Bunner (2007)[26]	USA	Cross-sectional			•		Pigs (Faeces)	Farm	Isolate (1,381)	•					Phenotypic
Buntenkoetter (2014)[27]	Germany	Cross-sectional, longitudinal		•			Pigs (Environment)	Farm	Isolate (273)				•		Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Butaye (1999)[28]	Belgium	Cross-sectional	•				Broilers, egg layers, pigs (Faeces)	Farm	Animal (420)		•				Both
Cho (2006)[29]	USA	Cross-sectional		•			Dairy cows (Faeces, milk filters)	Farm, county fairs	Isolate (40)	•					Phenotypic
Cho (2007)[30]	USA	Cross-sectional		•			Dairy cows (Faeces)	Farm, county fairs	Isolate (83)	•					Phenotypic
Cicconi-Hogan (2014)[31]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (12)				•		Both
CIPARS (2016)[32]	Canada	Longitudinal				•	Chicken (Faeces, meat)	Farm, retail, slaughter	NR	•					Phenotypic
Coalition for Animal Health (NR)[33]	Denmark	Longitudinal	•				Pigs, poultry (Meat)	NR	NR	•	•	•			Phenotypic
Cohen Stuart (2012)[34]	The Netherlands	Cross-sectional		•			Broilers (Meat)	Retail	Sample (98)	•					Both
Cui (2004)[35]	USA	Cross-sectional		•			Broilers (meat)	Retail	Sample (259)	•					Phenotypic
Cui (2005)[36]	USA	Cross-sectional		•			Broilers (meat)	Retail	Isolate (185)	•		•			Phenotypic
Cuny (2012)[37]	Germany	Cross-sectional			•		Pigs (Nasal swab)	Farm	Farm (82)				•		Phenotypic
Del Grosso (2000)[38]	Italy	Longitudinal	•				Pigs, poultry (Faeces, meat)	Retail	Isolate (1,324)		•				Both
Desmonts (2004)[39]	France	Longitudinal	•				Broilers (Caecal, skin)	Farm, slaughter, retail	Isolate (661)			•			Phenotypic
Docic (2003)[40]	Hungary, Romania, Serbia	Cross-sectional				•	Pigs (Rectal swab)	Farm	Herd (39)	•					Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Dolejska (2011)[41]	Czech Republic	Cross-sectional				•	Dairy cows (Milk filter, rectal swab)	Farm	Sample (463)	•					Genotypic
Dorado-García (2013)[42]	The Netherlands	Longitudinal				•	Pigs (Nasal swab)	Farm	Farm (40)				•		Phenotypic
Dorado-García (2015a)[43]	The Netherlands	Longitudinal				•	Pigs (Nasal swab)	Farm	Farm (36)				•		Phenotypic
Dorado-García (2015b)[44]	The Netherlands	Longitudinal				•	Veal (Environment, nasal swab)	Farm	Farm (51)				•		Phenotypic
Dorado-García (2016)[45]	The Netherlands	Longitudinal	•				Broilers, Pigs, Veal Calves, Dairy cows (MARAN)	Farm, slaughter	Isolate (MARAN)	•					Phenotypic
Dutil (2010)[46]	Canada	Longitudinal				•	Broilers (Meat)	Retail	Isolate (950)	•					Phenotypic
El-Shibiny (2005)[47]	UK	Longitudinal		•			Broilers (Faeces)	Farm	Isolate (55)			•			Phenotypic
Emborg (2002)[48]	Denmark	Longitudinal	•				Broilers (Cloacal swab, meat)	Retail, slaughter	Isolate (DANMAP)		•				Phenotypic
Fraqueza (2014)[49]	Portugal	Cross-sectional		•			Broilers (Caecal, meat)	Slaughter	Isolate (167)			•			Phenotypic
Gallay (2007)[50]	France	Longitudinal	•				Broilers, pigs (Caecal)	Slaughter	Isolate (1,789)			•			Phenotypic
Garcia-Migura (2005)[51]	UK	Longitudinal		•			Broilers, pigs (Environment, faeces)	Farm	Farm (47)		•				Both
Garmo (2010)[52]	Norway	Longitudinal		•			Dairy cows (Milk)	Farm	Isolate (4,209)				•		Phenotypic
Ge (2004)[53]	USA	Cross-sectional		•			Chickens (Meat)	Retail	Isolate (NR)			•			Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Gebreyes (2006)[54]	USA	Cross-sectional			•		Pigs (Carcass swab, faeces)	Farm, slaughter	Isolate (703)	•					Phenotypic
Gellin (1989)[55]	USA	Cross-sectional			•	•	Pigs (Rectal swab)	Farm	Isolate (1,324)	•					Phenotypic
Gerzova (2015)[56]	Denmark, France, Italy, Sweden	Cross-sectional		•			Pigs (Faeces)	Slaughter	Sample (468)					•	Genotypic
Guarddon (2014)[57]	Spain	Cross-sectional		•			Beef cows, broilers, pigs (Meat)	Retail	Sample (200)	•					Genotypic
Halbert (2006a)[58]	USA	Longitudinal		•			Dairy cows (Faeces)	Farm	Isolate (1,216)			•			Both
Halbert (2006b)[59]	USA	Longitudinal		•			Dairy cows (Environment, faeces, milk)	Farm	Isolate (2,030)			•			Phenotypic
Hammerum (2007)[60]	Denmark	Longitudinal	•				Broilers, pigs (Faeces, meat)	Slaughter	NR		•				Phenotypic
Han (2009)[61]	USA	Longitudinal		•			Broilers (Meat)	Retail	Isolate (165)			•			Phenotypic
Harper (2009)[62]	USA	Cross-sectional		•			Pigs (Nasal swab)	Farm	Sample (312)				•		Phenotypic
Harvey (2009)[63]	USA	Cross-sectional		•			Beef cows (Faeces)	Farm	Sample (122)	NR					Genotypic
Hässig (2014)[64]	Switzerland	Longitudinal	•				Beef cows (Faeces, nasal swab)	Farm	Farm (1,847)	•	•		•	•	Phenotypic
Heuer (2001)[65]	Denmark	Longitudinal		•			Broilers (Cloacal)	Slaughter	Flock (160)			•			Phenotypic
Heuer (2002)[66]	Denmark	Longitudinal	•	•			Broilers (Cloacal)	Slaughter	Flock (162)		•				Both
Hiki (2015)[67]	Japan	Longitudinal				•	Broilers (Faeces)	Farm	Isolate (693)	•					Both

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Hiroi (2012)[68]	Japan	Cross-sectional			•		Broilers (Faeces)	Farm	Bird (32)	•					Genotypic
Hoogenboom (2008)[69]	The Netherlands	Cross-sectional		•			Broilers, cattle, laying hens, pigs (carcass, eggs, faeces)	Farm, slaughter	Not specified (MARAN)	•	•	•			Phenotypic
Huijbers (2015)[70]	The Netherlands	Longitudinal		•			Broilers (Cloacal, environmental, throat swab)	Farm	Isolate (49)	•			•		Both
Jensen (2014)[71]	Denmark	Longitudinal	•				Pigs (Faeces)	DANMAP	Isolate (DANMAP)	•					Phenotypic
Johnson (2007)[72]	USA	Cross-sectional			•		Chicken, turkeys (Meat)	Retail, slaughter	Isolate (401)	•					Phenotypic
Johnston (2002)[73]	USA	Cross-sectional		•			Dairy cows (Faeces)	Farm	Isolate (180)	NR					Phenotypic
Joseph (2007)[74]	USA	Cross-sectional		•	•		Poultry (Environment)	Farm	Isolate (702)		•				Phenotypic
Joseph (2008)[75]	USA	Cross-sectional		•	•		Broilers (Environment)	Farm	Isolate (802)	•					Phenotypic
Kassem (2017)[76]	USA	Cross-sectional		•			Laying hens (Faeces)	Farm	Isolate (248)			•			Both
Keelara (2013)[77]	USA	Longitudinal			•		Pigs (Environment, faeces, meat, mesenteric lymph nodes)	Farm, slaughter	Isolate (1,090)	•					Phenotypic
Kerouanton (2014)[78]	France	Cross-sectional		•			Pigs (Faeces)	Slaughter	Isolate (373)	•					Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Khachatryan (2006)[79]	USA	Non-randomized trial				•	Dairy cows (Faeces)	Farm	Isolate (75)	•					Phenotypic
Kieke (2006)[80]	USA	Cross-sectional			•		Poultry (Meat)	Retail	Isolate (100)		•				Both
Kilonzo-Nthenge (2015)[81]	USA	Cross-sectional		•			Broilers (Meat)	Retail	Isolate (343)		•				Phenotypic
Kola (2012)[82]	Germany	Cross-sectional		•			Broilers (Meat)	Retail	Isolate (185)	•					Both
Kruse (1999)[83]	Norway	Longitudinal	•				Broilers, turkey, pigs (Carcass, faeces)	Farm, slaughter	Isolate (247)		•				Both
Kühn (2005)[84]	Spain, Sweden, UK	Cross-sectional	•				Beef cows, broilers, pigs (Environment, faeces)	Farm	Sample (2,580)		•				Both
Lam (2012)[85]	The Netherlands	Longitudinal	•				Dairy cows (Faeces, milk)	MARAN	Isolate (MARAN)	•	•		•		Both
Langlois (1983)[86]	USA	Longitudinal				•	Pigs (Faeces)	Farm	Isolate (3,094)	•					Phenotypic
Langlois (1986)[87]	USA	Longitudinal				•	Pigs (Faeces, rectal swab)	Farm	Isolate (7,343)	•					Phenotypic
Larsen (1975)[88]	Denmark	Longitudinal	•				Pigs (Faeces)	Farm	Isolate (443)	•					Phenotypic
Lauderdale (2007)[89]	Taiwan	Longitudinal	•				Chicken (Faeces)	Farm	Isolate (1,988)		•				Both

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Lebek (1979)[90]	Switzerland	Cross-sectional	•				Dairy cows (Faeces)	Farm	Isolate (63)	•					Phenotypic
Lee (2013)[91]	South Korea	Cross-sectional		•			Chicken (Eggs)	Farm	Isolate (26)	•					Phenotypic
LeJeune (2004)[92]	USA	Cross-sectional			•		Beef cows (Meat)	Retail	Isolate (150)	•	•				Phenotypic
Lenart-Boron (2016)[93]	Poland	Cross-sectional		•			Broilers (Faeces)	Farm	Isolate (98)	•					Both
Lestari (2009)[94]	USA	Cross-sectional		•			Broilers (Meat)	Retail	Isolate (126)	•					Phenotypic
Looft (2012)[95]	USA	Non-randomized trial				•	Pigs (Faeces)	Farm	Sequence (133,294)	•				•	Genotypic
Lou (1995)[96]	USA	Cross-sectional				•	Pigs (Faeces)	Farm	Isolate (2,931)	•					Genotypic
Luangtongkum (2006)[97]	USA	Cross-sectional		•			Broilers, turkey (Faeces)	Slaughter	Isolate (694)			•			Phenotypic
Mathew (2001)[98]	USA	Cross-sectional			•		Pigs (Faeces)	Farm	Isolate (NR)	•					Phenotypic
Mazengia (2014)[99]	USA	Cross-sectional		•	•		Poultry (Meat)	Retail	Isolate (106)	•					Phenotypic
Meemken (2009)[100]	Germany	Cross-sectional		•			Pigs (Nasal swab)	Farm	Animal (678)				•		Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Mehboob (2003)[101]	NR	Cross-sectional		•			Pigs (Environment, faeces)	Farm	Sample (30)	NR					Genotypic
Millar (2007)[102]	New Zealand	Cross-sectional		•			Chicken (Meat)	Retail	Animal (6)			•			Phenotypic
Millman (2013)[103]	USA	Cross-sectional		•	•		Chicken (Meat)	Retail	Isolate (213)	•					Phenotypic
Miranda (2007)[104]	Spain	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (180)		•				Phenotypic
Miranda (2008a)[105]	Spain	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (180)	•					Phenotypic
Miranda (2008b)[106]	Spain	Cross-sectional		•			Pigs (Meat)	Retail	Isolate (180)	•					Phenotypic
Miranda (2008c)[107]	Spain	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (483)	•			•	•	Phenotypic
Miranda (2009a)[108]	Spain	Cross-sectional		•			Beef cows (Meat)	Slaughter	Isolate (180)	•			•	•	Phenotypic
Miranda (2009b)[109]	Spain	Cross-sectional		•			Dairy cows (Cheese)	Retail	Isolate (568)	•			•	•	Phenotypic
Miranda CD (2007)[110]	Chile	Cross-sectional				•	Salmon (Environment, fingerling)	Farm	Isolate (70)	•					Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Mitchell (2004)[111]	USA	Cross-sectional		•			Dairy cows (Environmental, faeces)	Farm	Isolate (1,518)	•					Phenotypic
Mollenkopf (2014)[112]	USA	Cross-sectional		•	•		Chicken (Meat)	Retail	Sample (231)	•		•			Both
Morley (2011)[113]	USA	Cross-sectional			•		Beef cows (Faeces)	Farm	Isolate (8,882)	•					Phenotypic
Nannapaneni (2009)[114]	USA	Longitudinal	•				Chicken (Meat)	Retail	Animal (744)			•			Phenotypic
Noormohamed (2014)[115]	USA	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (149)			•			Phenotypic
Norby (2003)[116]	USA	Cross-sectional			•		Pigs (Faeces)	Farm	Farm (72)			•			Phenotypic
Nugent (2001)[117]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (180)				•		Phenotypic
Nulsen (2008)[118]	New Zealand	Cross-sectional		•			Pigs (Faeces)	Farm	Isolate (728)	•	•				Phenotypic
Nwankwo (2014)[119]	Nigeria	Cross-sectional				•	Chicken (Cloacal)	Farm	Isolate (45)	•					Phenotypic
Obeng (2012)[120]	Australia	Cross-sectional			•		Broiler (Faeces)	Farm, slaughter	Isolate (251)	•					Both
O'Brien (2012)[121]	USA	Cross-sectional			•		Pigs (Meat)	Retail	Isolate (256)				•		Both
O'Neill (2010)[122]	UK	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (161)				•		Both

Table 1 (continued)

			Intervention						Bacteria studied					
First author (Year)	Country	Study design	External ban	Organic	Antibiotic free	Voluntary reduction	Population sampled (Sample type)	Sample point	Unit of analysis (n)	Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	Genotypic or phenotypic resistance
Osadebe (2012)[123]	USA	Cross-sectional				•	Pigs (Nasal swab)	Farm	Sample (263)				•		Phenotypic
Österberg (2016)[124]	Denmark, France, Italy, Sweden	Cross-sectional		•			Pigs (Faeces)	Farm, slaughter	Isolate (590)	•					Phenotypic
Pantosti (1999)[125]	Italy	Longitudinal	•				Poultry (Meat)	Slaughter	Sample (605)		•				Both
Park (2012)[126]	USA	Longitudinal		•			Dairy cows (Milk)	Farm	Isolate (257)	•			•	•	Phenotypic
Patchanee (2008)[127]	USA	Cross-sectional				•	Pigs (Faeces)	Farm	Isolate (711)	•					Phenotypic
Peng (2016)[128]	USA	Cross-sectional		•	•		Broilers, cows, goats, laying hens, pigs (Eggs, environment, faeces)	Farm, retail	Isolate (300)	•					Phenotypic
Pettey (2008)[129]	USA	Cross-sectional			•		Pigs (Environment, faeces)	Farm	Isolate (242)					•	Both
Pol (2007)[130]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (2,503)				•	•	Phenotypic
Price (2005)[131]	USA	Cross-sectional			•		Chicken (Meat)	Retail	Isolate (76)			•			Both
Price (2007)[132]	USA	Cross-sectional			•		Chicken (Meat)	Retail	Isolate (329)			•			Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Ray (2006)[133]	USA	Cross-sectional		•			Dairy cows (Environment, faeces, flank swab, milk tank and filter)	Farm	Farm (129)	•					Phenotypic
Reinstein (2009)[134]	USA	Cross-sectional			•		Beef cows (Faeces, rectal swab)	Slaughter	Isolate (60)	•					Phenotypic
Roesch (2006)[135]	Switzerland	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (158)				•	•	Phenotypic
Rollo (2010)[136]	USA	Cross-sectional			•		Pigs (Faeces)	Farm	Isolate (512)			•			Phenotypic
Rossa (2013)[137]	Brazil	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (133)	•					Phenotypic
Salaheen (2016)[138]	USA	Cross-sectional		•	•		Broilers, chicken, cows, goats, laying hens, pigs (Eggs, environment, faeces, meat)	Farm, retail	Isolate (222)			•			Phenotypic
Sanchez (2015)[139]	USA	Cross-sectional		•	•		Chicken (Meat)	Retail	Isolate (381)	•					Phenotypic
Sapkota (2010)[140]	USA	Cross-sectional		•			Poultry (Environment)	Farm	Isolate (100)	•					Phenotypic
Sapkota (2011)[141]	USA	Cross-sectional		•			Broilers (Environment, faeces)	Farm	Isolate (259)		•				Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Sapkota (2014)[142]	USA	Cross-sectional		•			Broilers (Environment, faeces)	Farm	Isolate (103)	•					Phenotypic
Sato (2004a)[143]	USA	Cross-sectional		•			Dairy cows (Faeces)	Farm	Isolate (332)			•			Phenotypic
Sato (2004b)[144]	Denmark, USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (483)				•		Phenotypic
Sato (2005)[145]	USA	Cross-sectional		•			Dairy cows (Faeces)	Farm	Isolate (1,121)	•					Phenotypic
Schmidt (2015)[146]	NR	Longitudinal			•		Beef cows (Faeces)	Slaughter	Sample (719)	•	•				Phenotypic
Schwaiger (2008)[147]	Germany	Cross-sectional		•			Laying hens (Cloacal, eggs)	Farm	Isolate (910)	•		•			Phenotypic
Schwaiger (2010)[148]	Germany	Cross-sectional		•			Laying hens (Cloacal, eggs)	Farm	Isolate (1,003)		•			•	Phenotypic
Siemon (2007)[149]	USA	Cross-sectional			•		Broilers (Faeces)	Farm	Isolate (350)	•					Phenotypic
Sischo (2010)[150]	NR	Cross-sectional				•	Dairy cows (Faeces)	Farm	Isolate (670)	•					Phenotypic
Skjøt-Rasmussen (2009)[151]	Denmark	Longitudinal	•				Broilers, chicken (Faeces, meat)	Farm, Retail	Isolate (2,711)			•			Phenotypic
Smith (1981)[152]	UK	Longitudinal	•				Broilers, pigs (Faeces)	Farm	Sample (200)	•					Phenotypic
Smith (2013)[153]	USA	Cross-sectional			•		Pigs (Nasal swab)	Farm	Animal (1.085)				•		Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Soonthornchaikul (2006)[154]	UK	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (NR)			•			Phenotypic
Sørum (2004)[155]	Norway	Cross-sectional	•				Chicken, turkeys (Faeces)	Farm	Isolate (94)		•				Phenotypic
Sørum (2006)[156]	Norway	Longitudinal	•				Broilers, turkeys (Faeces)	Farm	Sample (109)		•				Both
Stegeman (2006)[157]	The Netherlands	Longitudinal	•				Broilers (Caecal)	Slaughter	Sample (833)		•				Phenotypic
Struve (2010)[158]	Denmark	Cross-sectional		•	•		Pigs (Caecal)	Slaughter	Isolate (868)	•					Phenotypic
Suriyasathaporn (2010)[159]	Thailand	Longitudinal		•			Dairy cows (Milk)	Farm	Isolate (140)	•			•	•	Phenotypic
Tadesse (2009)[160]	USA	Cross-sectional			•		Pigs (Faeces, meat)	Farm, slaughter	Isolate (1,429)	•		•			Phenotypic
Tamang (2015)[161]	South Korea	Cross-sectional		•			Pigs (Faeces)	Farm	Isolate (100)	•					Both
Teramoto (2016)[162]	USA	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (24)				•		Both
Thakur (2005)[163]	USA	Cross-sectional			•		Pigs (Carcass swab, faeces)	Farm, slaughter	Isolate (1,459)			•			Phenotypic
Tikofsky (2003)[164]	USA	Cross-sectional		•			Dairy cows (Milk)	Farm	Isolate (261)				•		Phenotypic
Tragesser (2006)[165]	USA	Cross-sectional				•	Dairy cows (Faeces)	Farm	Herd (18)	•					Both

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Trost (2013)[166]	NR	Cross-sectional		•			Chickens (Faeces, tracheal)	Farm	Isolate (148)	•					Phenotypic
Truszczyński (2006)[167]	Denmark	Longitudinal				•	Beef cows, broilers, pigs (DANMAP)	Farm	Isolate (DANMAP)		•				Phenotypic
van den Bogaard (2000)[168]	The Netherlands	Longitudinal	•				Broilers, pigs (Faeces)	Farm	Sample (548)		•				Phenotypic
van den Bogaard (2001)[169]	The Netherlands	Cross-sectional				•	Broilers, laying hens, turkeys (Faeces)	Farn	Isolate (122)	•					Phenotypic
Veldman (2014)[170]	The Netherlands	Longitudinal	•				Broilers, dairy cows, pigs, veal (Faeces)	Farm	Isolate (NR)	•	•	•			Phenotypic
Walk (2007)[171]	USA	Cross-sectional		•			Dairy cows (Faeces)	Farm	Isolate (678)	•					Genotypic
Wanninger (2016)[172]	Switzerland	Cross-sectional				•	Pigs (Faeces, conjunctival swab)	Farm	Isolate (18)					•	Both
Warnick (2015)[173]	USA	Cross-sectional		•			Dairy cows (Environmental, faeces)	Farm	Isolate (1,518)	•					Phenotypic
Wyckoff (2012)[174]	USA	Longitudinal		•			Dairy cows (Milk)	Farm	Isolate (904)				•		Phenotypic
Zawack (2016)[175]	USA	Longitudinal	•				Chicken (Caecal, meat)	Slaughter, retail	Isolate (NR)	•		•			Phenotypic

Table 1 (continued)

First author (Year)	Country	Study design	Intervention				Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied					Genotypic or phenotypic resistance
			External ban	Organic	Antibiotic free	Voluntary reduction				Enterobacteriaceae	*Enterococcus* spp.	*Campylobacter* spp.	*Staphylococcus* spp.	Other	
Zhang (2005)[176]	USA	Cross-sectional		•			Chicken (Meat)	Retail	Isolate (71)					•	Both
Zhang (2010)[177]	USA	Cross-sectional			•		Beef cows (Meat)	Retail	Isolate (NR)	•	•				Phenotypic
Zhang (2011)[178]	USA	Cross-sectional			•		Chicken (Meat)	Retail	Isolate (329)	•	•				Phenotypic
Zwonitzer (2016)[179]	USA	Cross-sectional		•			Pigs (Faeces)	Farm	Isolate (491)	•					Phenotypic

Abbreviations: DANMAP - Danish Integrated Antimicrobial Resistance Monitoring and Research Programme; MARAN - Monitoring of Antimicrobial Resistance and Antibiotic Usage in Animals in the Netherlands; NR - not reported; UK - United Kingdom; USA - United States of America

Table 2: Study characteristics of individual human studies

			Intervention							Bacteria studied				
First author (year)	**Country**	**Study design**	**External ban**	**Organic**	**Antibiotic free**	**Voluntary reduction**	**Population sampled (Sample type)**	**Sample point**	**Unit of analysis (n)**	**Enterobacteriaceae**	***Enterococcus* spp.**	***Campylobacter* spp.**	***Staphylococcus* spp.**	**Genotypic or phenotypic resistance**
Borgen (2000)[22]	Norway	Cross-sectional	•				Poultry producers (Faeces)	Farm	Sample (147)		•			Both
Coalition for animal health (NR)[33]	Denmark	Longitudinal	•				(Not specified) DANMAP	(Not specified) DANMAP	(Not specified) DANMAP	•	•	•		Phenotypic
Cuny (2012)[37]	Germany	Cross-sectional			•		Humans working or living on pig farms (Nasal swabs)	Farm	Human (202)				•	Phenotypic
Dorado-García (2015a)[43]	The Netherlands	Longitudinal				•	Farmers, employees and family members (Nasal swabs)	Farm	Sample (158)				•	Phenotypic
Dorado-García (2015b)[44]	The Netherlands	Longitudinal				•	Farmers, employees and family members (Nasal swabs)	Farm	Sample (206)				•	Phenotypic
Dutil (2010)[46]	Canada	Longitudinal				•	Hospital/private clinical laboratories (Not specified)	Hospitals, clinics	Isolate (1,424)	•				Phenotypic
Gallay (2007)[50]	France	Longitudinal	•				Hospital/private clinical laboratories (Blood, faeces, other)	Hospitals, clinics	Isolate (5,685)			•		Phenotypic
Harper (2009)[62]	USA	Cross-sectional		•			Humans working on pig farms (Nasal and pharyngeal swabs)	Farm	Sample (71)				•	Phenotypic
Huijbers (2015)[70]	The Netherlands	Longitudinal		•			Farmers, employees, family members, farm residence (Environment, faeces & nasal swabs)	Farm	Sample humans (27) homes (75)				•	Both

Table 2 (continued)

First author (year)	Country	Study design	Intervention: External ban	Intervention: Organic	Intervention: Antibiotic free	Intervention: Voluntary reduction	Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied: Enterobacteriaceae	Bacteria studied: *Enterococcus* spp.	Bacteria studied: *Campylobacter* spp.	Bacteria studied: *Staphylococcus* spp.	Genotypic or phenotypic resistance
Johnson (2007)[72]	USA	Longitudinal			•		Adult hospital patients, healthy self-identified vegetarians (Faeces)	Hospital patients, healthy adult vegetarians	Isolate (530)	•				Phenotypic
Kieke (2006)[80]	USA	Cross-sectional			•		Hospital patients, vegetarians (Faeces, rectal swabs)	Hospital	Isolate (170)		•			Both
Klare (1999)[180]	Germany	Longitudinal	•				Healthy, non-hospitalized humans (Faeces)	Healthy adults	Sample (600)		•			Both
Kruse (1999)[83]	Norway	Longitudinal	•				Poultry farmers (Faeces)	Farm	Isolate (26)		•			Both
Kühn (2005)[84]	Sweden, Spain, Denmark, UK	Cross-sectional	•				Healthy and hospitalized individuals, patients with enterococcal infections (Clinical samples, faeces, raw, treated, and hospital sewage)	Hospital, clinics, healthy adults, sewage facilities	Sample (522)		•			Both
Osadebe (2012)[123]	USA	Cross-sectional				•	Humans present on the farm on the day of animal sampling (Nasal and oropharyngeal swabs)	Farm	Sample (9)				•	Phenotypic
Rinsky (2013)[181]	USA	Cross-sectional			•		Humans working at pig or poultry operations, household members (Nasal swabs)	Farm	Sample (204)				•	Both
Skjøt-Rasmussen (2009)[151]	Denmark	Longitudinal	•				Domestically acquired human cases, travel associated human cases (DANMAP)	Hospitals, clinics	Isolate (1,023)			•		Phenotypic
Smith (2013)[153]	USA	Longitudinal			•		Farm workers (Nasal swabs)	Farm	Sample (145)				•	Phenotypic
Sørum (2006)[156]	Norway	Longitudinal	•				Poultry producers (Faeces)	Farm	Sample (115)		•			Both

Table 2 (continued)

First author (year)	Country	Study design	Intervention: External ban	Intervention: Organic	Intervention: Antibiotic free	Intervention: Voluntary reduction	Population sampled (Sample type)	Sample point	Unit of analysis (n)	Bacteria studied: Enterobacteriaceae	Bacteria studied: *Enterococcus* spp.	Bacteria studied: *Campylobacter* spp.	Bacteria studied: *Staphylococcus* spp.	Genotypic or phenotypic resistance
van den Bogaard (2000)[168]	The Netherlands	Longitudinal	•				(Sub)urban residents (Faeces)	Healthy adults in (sub)urban areas	Sample (288)		•			Phenotypic
van den Bogaard (2001)[169]	The Netherlands	Cross-sectional				•	Poultry farmers (Faeces)	Farm	Isolate (123)	•				Phenotypic

Abbreviations: NR - not reported; UK - United Kingdom; USA - United States

Table 3: Assessment of study quality for individual animal studies

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Aarestrup (1995)	Yes	No	Yes	Yes	No	Unknown	No	No	No
Aarestrup (2000a)	Yes	No	Yes	Yes	Yes	Yes	Yes	N/A	No
Aarestrup (2000b)	Yes	No	Yes	Yes	No	Unknown	No	Yes	No
Aarestrup (2001)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Aarestrup (2002)	Yes	No	No	Yes	No	No	Unknown	No	No
Abdalrahman (2015)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Agersø (2013)	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No
Agga (2015)	Yes	No	No	Yes	No	No	Unknown	Unknown	No
Alali (2010)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Álvarez-Fernández (2012)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Álvarez-Fernández (2013)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Avrain (2003)	Yes	No	Yes	Yes	No	Yes	Unknown	Yes	Unknown
Bager (1999)	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No
Barlow (2008)	Yes	No	No	Yes	No	No	No	Yes	No
Barlow (2009)	Yes	No	No	Yes	No	Yes	No	Yes	No
Bauer Garland (2006)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Bengtsson (2006)	Yes	No	Yes	Yes	No	Yes	No	Yes	No
Bennedsgaard (2006)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Boerlin (2001)	Yes	No	Yes	Yes	Yes	Unknown	Yes	Yes	No
Bombyk (2007)	Yes	No	No	Yes	No	No	No	Unknown	No

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Bombyk (2008)	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes
Borgen (2000)	Yes	No	Yes	Yes	Yes	No	No	N/A	No
Borgen (2001)	Yes	No	Yes	Yes	No	Yes	No	Yes	No
Boutet (2005)	Yes	No	Yes	Yes	No	No	Yes	Yes	Unknown
Boyer (2012)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Bunner (2007)	Yes	Unknown	No	Yes	Yes	Unknown	Yes	Yes	Yes
Buntenkoetter (2014)	Yes	No	Yes	Yes	Yes	No	No	Yes	No
Butaye (1999)	No	No	No	Yes	No	No	No	No	No
Cho (2006)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Cho (2007)	Yes	No	Yes	Yes	No	No	No	Yes	No
Cicconi-Hogan (2014)	Yes	No	No	Yes	Yes	No	Yes	Yes	No
CIPARS (2016)	Yes	No	Yes	Yes	No	Yes	Unknown	N/A	No
Coalition for Animal Health (NR)	Yes	No	Yes	Yes	No	Unknown	Unknown	N/A	No
Cohen Stuart (2012)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Cui (2004)	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Cui (2005)	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Cuny (2012)	No	Unknown	Unknown	Unknown	No	No	Yes	Unknown	No
Del Grosso (2000)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	No
Desmonts (2004)	Yes	No	Yes	Yes	No	No	Yes	Yes	No
Docic (2003)	Yes	No	Yes	Yes	No	Yes	No	No	No
Dolejska (2011)	Yes	Yes	No	Yes	No	No	Yes	Yes	No

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Dorado-García (2013)	Yes	No	Yes	Yes	No	Yes	Yes	N/A	No
Dorado-García (2015a)	Yes	Yes	Yes	Yes	Yes	Unknown	Yes	N/A	Yes
Dorado-García (2015b)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Dorado-García (2016)	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Dutil (2010)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
El-Shibiny (2005)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Unknown
Emborg (2002)	Yes	No	Yes	Yes	Yes	Yes	Yes	N/A	Unknown
Fraqueza (2014)	Yes	No	Yes	Yes	Yes	Unknown	No	Yes	No
Gallay (2007)	Yes	No	No	Yes	No	Yes	Yes	Yes	No
Garcia Migura (2005)	Yes	No	No	Yes	No	Unknown	Yes	Yes	No
Garmo (2010)	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Ge (2004)	Yes	No	No	Yes	No	No	No	Yes	Unknown
Gebreyes (2006)	Yes	No	Yes	Yes	Yes	No	Unknown	Yes	No
Gellin (1989)	Yes	No	Yes	Yes	No	No	Unknown	Unknown	No
Gerzova (2015)	Yes	No	No	Yes	Yes	Yes	Unknown	Yes	No
Guarddon (2014)	Yes	Yes	Yes	Yes	No	Unknown	Yes	Yes	No
Halbert (2006a)	Yes	No	No	Yes	No	Unknown	No	Unknown	No
Halbert (2006b)	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No
Hammerum (2007)	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Unknown
Han (2009)	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Harper (2009)	Yes	No	No	No	No	No	Unknown	Unknown	Unknown

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Harvey (2009)	Yes	Yes	Yes	Yes	No	No	Yes	Unknown	No
Hässig (2014)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
Heuer (2001)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Heuer (2002)	Yes	Yes	Yes	Yes	No	Unknown	No	Yes	No
Hiki (2015)	Yes	No	Yes	Yes	No	Yes	Yes	N/A	No
Hiroi (2012)	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Hoogenboom (2008)	Yes	No	No	Yes	No	Unknown	Unknown	No	Unknown
Huijbers (2015)	Yes	Yes	No	Yes	No	Yes	No	No	No
Jensen (2014)	No	No	Yes	No	No	No	No	Yes	Unknown
Johnson (2007)	Yes	Yes	No	Yes	No	Unknown	Unknown	Unknown	Yes
Johnston (2002)	Yes	No	Yes	Yes	No	No	No	Yes	No
Joseph (2007)	Yes	No	Yes	Yes	No	No	No	Unknown	No
Joseph (2008)	Yes	No	No	Yes	No	Unknown	Unknown	Unknown	Unknown
Kassem (2017)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Keelara (2013)	Yes	No	Yes	Yes	No	Unknown	No	Yes	Yes
Kerouanton (2014)	Yes	No	No	No	No	No	Unknown	Yes	No
Khachatryan (2006)	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No
Kieke (2006)	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Kilonzo-Nthenge (2015)	Yes	Yes	No	Yes	Yes	No	No	No	No
Kola (2012)	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Kruse (1999)	No	No	Yes	Yes	No	Unknown	Unknown	No	No

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Kühn (2005)	Yes	No	Yes	Yes	No	Unknown	No	Yes	Unknown
Lam (2012)	Yes	No	Yes	No	No	Yes	Unknown	N/A	Unknown
Langlois (1983)	Yes	No	Yes	No	No	No	Yes	N/A	Unknown
Langlois (1986)	Yes	No	Yes	Yes	No	No	No	Yes	No
Larsen (1975)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Lauderdale (2007)	Yes	No	Yes	Yes	No	Yes	Yes	N/A	No
Lebek (1979)	Unknown	No	Yes	Yes	No	No	Yes	N/A	No
Lee (2013)	Yes	No	No	Yes	No	No	Unknown	Yes	No
LeJeune (2004)	Yes	No	No	Yes	No	Unknown	Unknown	Yes	No
Lenart-Boron (2016)	Yes	No	Yes	Yes	No	No	No	Yes	No
Lestari (2009)	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Looft (2012)	Yes	Yes	Yes	No	No	No	Yes	Yes	No
Lou (1995)	Yes	Yes	Yes	Yes	No	No	Yes	N/A	No
Luangtongkum (2006)	Yes	No	Yes	Yes	No	Unknown	No	Yes	No
Mathew (2001)	Yes	No	Yes	Yes	No	Yes	Unknown	Unknown	No
Mazengia (2014)	Yes	No	No	Yes	No	No	Yes	Yes	No
Meemken (2009)	Yes	No	No	No	No	Unknown	Unknown	Unknown	No
Mehboob (2003)	Yes	No	Yes	Yes	No	Unknown	Unknown	Unknown	Unknown
Millar (2007)	No	No	No	No	No	No	No	Yes	No
Millman (2013)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Miranda (2007)	Yes	Yes	No	Yes	No	No	Yes	Yes	No

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Miranda (2008a)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Miranda (2008b)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Miranda (2008c)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Miranda (2009a)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	No
Miranda (2009b)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Miranda CD (2007)	Yes	No	Yes	Yes	Yes	No	Unknown	Yes	No
Mitchell (2004)	Yes	No	No	Yes	Yes	Unknown	Yes	Yes	Yes
Mollenkopf (2014)	Yes	Yes	No	Yes	No	No	Unknown	Yes	Yes
Morley (2011)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Nannapaneni (2009)	Yes	No	Yes	Yes	No	Unknown	Yes	N/A	No
Noormohamed (2014)	Yes	No	No	No	No	Unknown	Unknown	Yes	No
Norby (2003)	Yes	No	Yes	Yes	No	Yes	Yes	Unknown	Unknown
Nugent (2001)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	Unknown
Nulsen (2008)	Yes	No	Yes	No	No	Unknown	Unknown	Yes	No
Nwankwo (2014)	Yes	No	Yes	Yes	No	Unknown	Unknown	Unknown	No
Obeng (2012)	Yes	No	Yes	Yes	No	No	Unknown	Yes	Unknown
O'Brien (2012)	Yes	Yes	No	Yes	Yes	Yes	Unknown	Yes	No
O'Neill (2010)	Yes	No	Yes	Yes	No	Unknown	Unknown	Unknown	No
Osadebe (2012)	Yes	Yes	Yes	Yes	No	Unknown	Yes	Yes	Yes
Österberg (2016)	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
Pantosti (1999)	Yes	No	Yes	No	No	No	Yes	N/A	No

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Park (2012)	Yes	No	Yes	Yes	No	Unknown	Yes	N/A	No
Patchanee (2008)	Yes	No	No	Yes	No	No	Unknown	Unknown	No
Peng (2016)	Yes	No	No	Yes	No	Unknown	No	Unknown	No
Pettey (2008)	No	No	Yes	No	No	No	Unknown	Unknown	No
Pol (2007)	Yes	No	Yes	Yes	No	No	Unknown	Unknown	No
Price (2005)	Yes	No	No	Yes	Yes	No	Unknown	Yes	No
Price (2007)	Yes	No	No	Yes	Yes	No	Unknown	Yes	No
Ray (2006)	Yes	No	Yes	Yes	Yes	Yes	Unknown	Yes	Yes
Reinstein (2009)	Yes	No	Yes	No	Yes	Unknown	Unknown	Unknown	No
Roesch (2006)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Rollo (2010)	Yes	Yes	Yes	Yes	Yes	Unknown	Yes	Yes	Yes
Rossa (2013)	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Salaheen (2016)	Yes	No	No	Yes	No	Unknown	No	Unknown	No
Sanchez (2015)	Yes	No	No	Yes	No	No	No	Unknown	No
Sapkota (2010)	Yes	No	No	Yes	No	Unknown	Unknown	Unknown	Unknown
Sapkota (2011)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Unknown
Sapkota (2014)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Unknown
Sato (2004a)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	Yes
Sato (2004b)	Yes	No	Yes	Yes	Yes	No	Unknown	Yes	No
Sato (2005)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	Yes
Schmidt (2015)	Yes	No	No	No	No	Unknown	Unknown	Yes	Unknown

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Schwaiger (2008)	Yes	No	No	Yes	No	Unknown	Unknown	Yes	No
Schwaiger (2010)	Yes	No	No	Yes	No	Unknown	Unknown	Yes	No
Siemon (2007)	Yes	Yes	Yes	Yes	No	Unknown	Unknown	Yes	No
Sischo (2010)	Yes	No	Yes	Yes	No	No	Yes	Yes	Unknown
Skjøt-Rasmussen (2009)	Yes	Yes	Yes	Yes	No	Unknown	No	N/A	No
Smith (1981)	No	No	Yes	No	No	Yes	Unknown	N/A	No
Smith (2013)	No	Yes	No	No	Yes	No	Unknown	Yes	Unknown
Soonthornchaikul (2006)	Yes	No	No	Yes	No	No	Unknown	Unknown	No
Sørum (2004)	Yes	No	No	Yes	Yes	Unknown	Unknown	Unknown	No
Sørum (2006)	Yes	No	Yes	Yes	No	No	Yes	N/A	No
Stegeman (2006)	Yes	No	Yes	Yes	Yes	Yes	Yes	N/A	Yes
Struve (2010)	Yes	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Suriyasathaporn (2010)	Yes	Yes	Yes	Yes	No	Yes	Yes	N/A	No
Tadesse (2009)	Yes	Yes	No	Yes	No	No	No	Unknown	No
Tamang (2015)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Teramoto (2016)	Yes	No	No	Yes	No	No	No	Yes	No
Thakur (2005)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	No
Tikofsky (2007)	Yes	Yes	Yes	Yes	Yes	Unknown	Yes	Yes	No
Tragesser (2006)	Yes	No	Yes	Yes	Yes	No	Yes	Unknown	No
Trost (2013)	Yes	No	Yes	Yes	No	Unknown	Unknown	Unknown	Unknown
Truszczyński (2006)	Yes	No	Yes	Yes	No	Yes	Yes	N/A	Unknown

Table 3 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (i.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (i.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
van den Bogaard (2000)	Yes	No	Yes	Unknown	No	Unknown	Unknown	N/A	No
van den Bogaard (2001)	Yes	No	No	Yes	No	Unknown	No	Unknown	No
Veldman (2014)	No	No	No	No	No	Yes	Yes	N/A	No
Walk (2007)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Wanninger (2016)	Yes	No	No	Yes	Yes	Unknown	Unknown	Yes	No
Warnick (2015)	Yes	No	No	Yes	Yes	Unknown	Unknown	Yes	Yes
Wyckoff (2012)	Yes	No	Yes	Yes	No	Unknown	Yes	Yes	Unknown
Zawack (2016)	Yes	No	No	No	No	Unknown	Unknown	N/A	No
Zhang (2005)	Yes	No	No	Yes	No	Unknown	Unknown	Yes	No
Zhang (2010)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No
Zhang (2011)	Yes	Yes	No	Yes	No	No	Yes	Yes	No
Zwonitzer (2016)	Yes	No	No	Yes	No	Unknown	No	Yes	No

Yes - study quality criteria met; No - study quality criteria not met; Unknown - insufficient information to assess study quality
Abbreviations: N/A - not applicable, NR - not reported

Table 4: Assessment of study quality for individual human studies

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (I.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (I.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Borgen (2000)	Yes	Unknown	Yes	Yes	Yes	Unknown	Yes	Yes	No
Coalition for Animal Health (NR)	Yes	No	Yes	Yes	No	Unknown	Unknown	N/A	No
Cuny (2012)	No	Unknown	Unknown	Unknown	No	No	Yes	Unknown	No
Dorado-García (2015a)	Yes	No	No	No	Yes	Unknown	Unknown	Yes	Unknown
Dorado-García (2015b)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Dutil (2010)	Yes	No	Yes	Yes	No	Yes	Yes	No	Unknown
Gallay (2007)	Yes	No	No	Yes	No	Yes	Yes	Yes	Unknown
Harper (2009)	Yes	Yes	No	No	Unknown	Unknown	Unknown	Unknown	Unknown
Huijbers (2015)	Yes	Yes	Yes	Yes	Yes	Yes	No	Unknown	Unknown
Johnson (2007)	Yes	Yes	No	Yes	No	Unknown	Unknown	Unknown	Yes
Kieke (2006)	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Klare (1999)	Yes	No	Yes	Yes	No	No	Yes	N/A	No
Kruse (1999)	No	No	Yes	Yes	No	Unknown	Unknown	No	No
Kühn (2005)	Yes	Yes	Yes	Yes	No	Unknown	No	No	Unknown
Osadebe (2012)	Yes	Yes	Yes	Yes	No	Unknown	Yes	Yes	Yes
Rinsky (2013)	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Skjøt-Rasmussen (2009)	Yes	No	Yes	Yes	No	Unknown	No	N/A	No
Smith (2013)	No	Yes	No	No	Yes	No	Unknown	Yes	No

Table 4 (continued)

First author (Year)	Is hypothesis/aim/objective of the study clearly defined?	Are the characteristics of the animals/humans included in the study clearly described?	Are the interventions of interest clearly described?	Are the main outcomes clearly described in the Introduction or Methods section?	Does the study provide estimates of the random variability in the data for main outcomes? (I.e. SD, 95% CI, etc.)	Were the subjects included in the study representative of the entire population from which they were recruited?	Were animals/humans included in the intervention and control groups recruited from the same source population? (I.e. Were they sampled from the same population?)	Were animals/humans included in the intervention and control groups recruited over the same period of time?	Was there adequate adjustment for important confounders in the analysis?
Sørum (2006)	Yes	No	Yes	Yes	No	No	Yes	N/A	No
van den Bogaard (2000)	Yes	No	Yes	Unknown	No	Unknown	Unknown	N/A	No
van den Bogaard (2001)	Yes	No	No	Yes	No	Unknown	No	Unknown	No

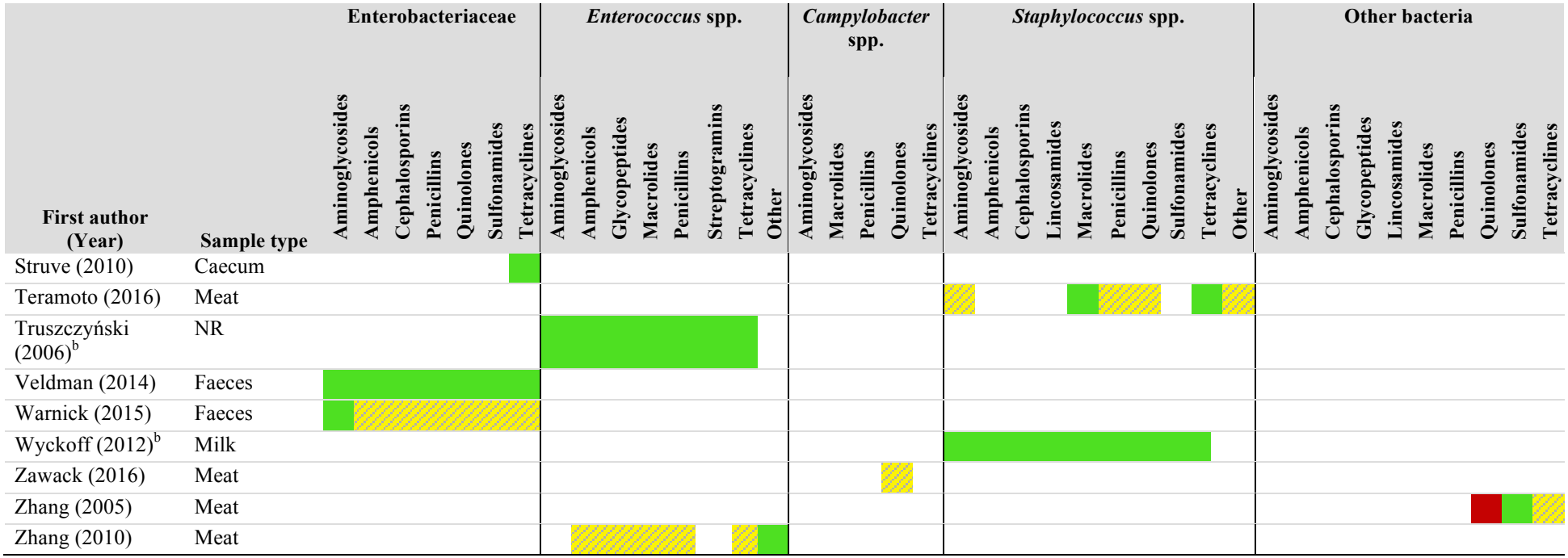
Yes- study quality criteria met; No- study quality criteria not met; Unknown- insufficient information to assess study quality
Abbreviations: NR- year not reported; N/A- not applicable

Table 5: Trends in the prevalence of antibiotic resistance by bacterial class for studies not included in meta-analyses

Table 5 (continued)

Table 5 (continued)

Table 5 (continued)



Red: higher prevalence of antibiotic resistance in intervention group compared to comparator group (i.e. increased resistance with interventions that reduce antibiotic use);
Green: higher prevalence of antibiotic resistance in comparator group compared to intervention group (i.e. decreased resistance with interventions that reduce antibiotic use);
Yellow: no difference in prevalence of antibiotic resistance in the intervention group compared to the comparator group

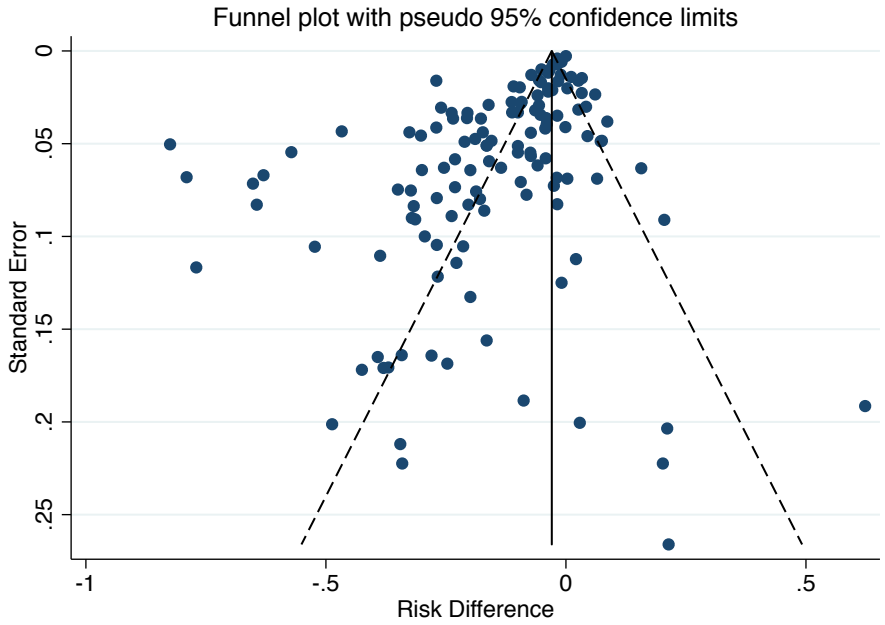
[a] No comparison made between intervention and control groups due to low numbers of resistant isolates

[b] Resistance not reported by individual antibiotic class

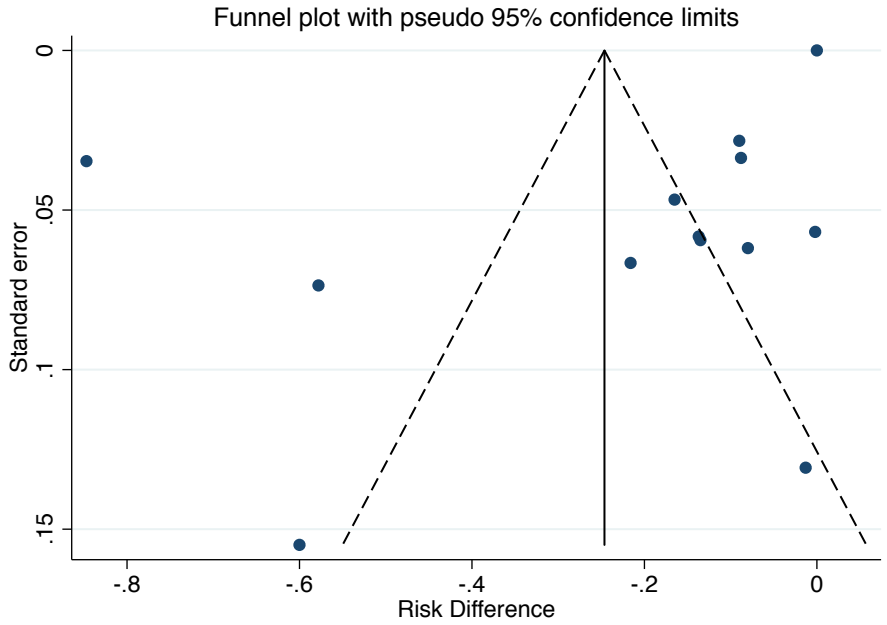
Abbreviations: NR- not reported

Figure 2: Funnel plot for animal (Panel A) and human (Panel B) studies included in meta-analysis

A: Animal Studies



B: Human Studies



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