UK Health Security Agency

Zoonotic tuberculosis transmission from humans to animals

A rapid systematic review

Contents

Main messages

1. This rapid review (search up to 11 November 2024) aimed to identify and summarise evidence on the risk of human to animal transmission of *Mycobacterium (M.) bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. tuberculosis* (TB).

2. In total, 5,055 records from 3 databases were screened. However, no relevant studies were found to answer the review question.

Purpose

The purpose of this rapid systematic review was to identify and summarise the available evidence that described the risk of transmission of *Mycobacterium (M.) bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. tuberculosis* (TB) from humans to animals.

1. The review question was: what is the risk of transmission of *M. bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. TB* from humans to animals?

Methods

A rapid systematic review was conducted, following streamlined systematic methods to accelerate the review process. A literature search was undertaken to look for relevant observational studies published or available as preprint, up to 11 November 2025.

The population of interest was non-human animals, whether domestic or agricultural or other animals.

Studies investigating *M. bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. TB* transmission to animals from any human contact, regardless of context, were included. The following transmission routes were considered:

- oral (such as animal food contaminated by humans)
- respiratory (inhalation of airborne bacterial particle droplets)
- direct contact (such as through handling of animals by infected humans or animal contact with contaminated surfaces)

There was no comparator required.

The specific tuberculosis species (*M. bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. TB*) included in this review were agreed by subject matter experts within the UKHSA Tuberculosis, Acute Respiratory Infections, Zoonoses, Emerging Infections and Travel Health (TARZET)

Division, as those with greatest potential for transmission from humans to animals. Other members of the *M. TB* complex (such as the species *M. africanum*, *M. canettii*, *M. pinnipedii*, *M. mungi* and *M. suricattae*) were not included as they were considered to be particularly rare or have not been reported in the UK to date.

A protocol was produced before the literature search was conducted, including the review question, the eligibility criteria, and all other methods. Full details of the methodology are provided in the protocol in Annexe A. There were no deviations from the protocol.

Screening on title and abstract was undertaken in duplicate by 2 reviewers for 20% of the eligible studies, with the remainder completed by one reviewer. Screening on full text was undertaken by one reviewer and checked by a second.

Evidence

In total, 5,055 studies were screened at title and abstract and 114 studies were screened at full text. Of these, no studies met the inclusion criteria for the review question. A PRISMA diagram showing the flow of studies through the review is shown in Annexe B, and studies excluded on full text screening are available with the reasons why in Annexe C.

Health inequalities

This review question looked at the risk of TB transmission from humans to animals. It is possible that specific human population groups at risk of health inequalities and in particular settings may be more likely to transmit TB (such as people with impaired immune function who may have higher bacterial loads), but as no studies were identified for inclusion in this review, this could not be assessed.

Limitations

This rapid systematic review used streamlined systematic methods to accelerate the review process. Sources of evidence searched included databases of peer-reviewed and preprint research, but an extensive search of other sources was not conducted and most article screening was completed without duplication, so it is possible relevant evidence may have been missed.

The concept of human to animal, also known as reverse zoonotic or zoo-anthroponotic transmission is challenging to define for the purpose of literature searching. However, it was necessary to include terms for this concept in the searches for this review in order to return a manageable number of results to screen with the time and resource available. It is acknowledged that use of this concept may have limited the searches, leading to a risk of

relevant literature. However, the methods for this review also included backwards and forwards citation searching, with the intent of mitigating against this risk. Citation searching retrieved an additional 8 references which were screened at full text. None of these 8 references met inclusion criteria, indicating that the main database search performed adequately in identifying relevant literature.

Evidence gaps

No studies were identified for inclusion in this review relating to the risk of transmission of *M. bovis*, *M. TB*, *M. orygis*, *M. microti* and *M. caprae* from humans to animals, highlighting an evidence gap in this area.

Conclusion

The aim of this review was to identify and assess available evidence evaluating the risk of transmission of *M. bovis*, *M. caprae*, *M. microti*, *M. orygis* and *M. TB*. However, no relevant studies were identified that met the inclusion criteria, and therefore this review is unable to answer the research question.

Acknowledgments

We would like to thank colleagues within the All Hazards Public Health Response division who either reviewed or input into aspects of the review.

Disclaimer

UKHSA's rapid systematic reviews and evidence summaries aim to provide the best available evidence to decision makers in a timely and accessible way, based on published peer-reviewed scientific papers, and papers on preprint servers. Please note that the reviews:

- use accelerated methods and may not be representative of the whole body of evidence publicly available
- have undergone an internal independent peer review but not an external peer review
- are only valid as of the date stated on the review

In the event that this review is shared externally, please note additionally, to the greatest extent possible under any applicable law, that UKHSA accepts no liability for any claim, loss or damage arising out of, or connected with the use of, this review by the recipient or any third party including that arising or resulting from any reliance placed on, or any conclusions drawn from, the review.

References

1. JBI. 'JBI Critical appraisal tools' 2020
2. TGW G. 'GRADE handbook for grading quality of evidence and strength of recommendations' 2013

Annexe A. Protocol

Review question

The review question is:

1. What is the risk of transmission of *Mycobacterium (M.) bovis*, *M. tuberculosis*, *M. orygis*, *M. microti* and *M. caprae* from humans to animals?

A search for primary evidence to answer this review question will be conducted up to 11th November.

Eligibility criteria

Table A.1. Inclusion and exclusion criteria

	Included	Excluded
Population	Non-human animal species	Humans
Context	Any context in which animals are in contact with humans infected with the below specified zoonotic TB strains, whether domestic or agricultural or other.	
Settings	Any	
Intervention or exposure	Exposure to humans with active *M. bovis*, *M. tuberculosis*, *M. orygis*, *M. microti* or *M. caprae*. The following routes of transmission will be included: • oral (such as animal food contaminated by humans) • respiratory (inhalation of airborne bacterial particle droplets) • direct contact (such as through handling of animals by infected humans or contact with contaminated surfaces [fomites])	
Comparator	No comparator required	

	Included	Excluded
Outcomes	Risk of transmission from humans to animals of *M. bovis*, *M. tuberculosis*, *M. orygis*, *M. microti* or *M. caprae*, such as: • incidence • risk ratios (relative risk) • hazard ratios • odds ratios	Human-to-human transmission risk Animal-to-human transmission risk
Language	English	Any other language
Date of search	Up to 11 November 2025	
Study design	Observational studies including cross-sectional, case-control and cohort studies	Experimental studies including but not limited to randomised-controlled trials, quasi-experimental studies, cross-over designs, before-and-after studies Reviews (all types) Case reports, case series Qualitative research Mixed methods Modelling studies
Publication type	Peer-reviewed published research Preprints	Conference abstracts Editorials Letters News articles Other grey literature

Background

The bacterial strains included in this review are members of the mycobacterium tuberculosis complex. These are mycobacteria related to mycobacterium tuberculosis that cause a tuberculosis-like illness in humans and animals.

The specific tuberculosis strains included in this review were selected by experts within the UKHSA ‘Tuberculosis, Acute Respiratory Infections, Zoonoses, Emerging Infections and Travel Health’ (TARZET) Division, as those with greater potential for transmission from animals to humans. This review aims to explore the potential for further onward transmission from humans to animals. Other members of the mycobacterium tuberculosis complex were not included as they are particularly rare or have not been reported in the UK to date.

Identification of studies

The following databases will be searched for studies published up to 29 October 2024: Ovid Medline, Ovid Embase, Web of Science Preprint Citation Index. The search strategy is presented below. Ovid database searches for this review (Medline and Embase) were executed with run-time stop word processing disabled, so that phrases such as ‘from human’ could be searched for exactly.

Backwards and forwards citation searching of primary studies included during full text screening will be carried out by searching Lens.org via CitationChaser. References that are included following full text screening will be used as seed references.

Screening

Title and abstract screening will be undertaken in duplicate by 2 reviewers for at least 20% of the eligible studies, with the remainder completed by one reviewer. Disagreement will be resolved by discussion or with involvement of a third reviewer where necessary.

Screening on full text will be undertaken by one reviewer and checked by a second.

References retrieved through citation searching will be cross checked against the results of the database search, and duplicates will be removed. The remaining references will be screened by one reviewer.

Data extraction

Summary information for each study will be extracted and reported in tabular form. Information to be extracted will include country, study period, study design, exposure, participant demographics, results, and any relevant contextual data. This will be undertaken by one reviewer and checked by a second.

Risk of bias assessment

Two reviewers will independently complete a risk of bias assessment for included studies, with disagreements resolved by discussion or with a third reviewer. Primary studies will be assessed using the JBI critical appraisal checklists (1).

Certainty of evidence

If appropriate, the certainty of evidence identified within this review will be assessed using a modified version of the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework (2).

Certainty of evidence will be assessed at the outcome level, and be rated as one of 4 levels:

- very low (the true effect is probably different from the estimated effect)
- low (the true effect might be different from the estimated effect)
- moderate (the true effect is probably close to the estimated effect)
- high (the authors are confident that the true effect is similar to the estimated effect)

The certainty of evidence will be assessed by one reviewer (and checked by a second) for each outcome across 4 domains:

1. Risk of bias: where results may not represent the true effect because of limitations in the design or conduct of the study.
2. Inconsistency: where studies show different effects for the same outcome of interest (only assessed where there are 2 or more studies measuring the same outcome). Inconsistency will be rated down if the point estimates are not similar, or the confidence intervals do not overlap.
3. Indirectness: where elements of the study differ from the intended elements in the review question (for example, the outcome of interest has not been directly measured). This will be rated down if the population, intervention, comparator, or outcome of interest have not been directly measured.
4. Imprecision: a measure of how uncertain the estimate is. Imprecision will be rated down if the confidence intervals cross the line of no effect, or if the reviewer judges that the confidence intervals are overly wide and so the true effect is likely to be different at the upper versus the lower end of the confidence interval.

Publication bias will not be used to assess the quality of the evidence in this review.

Evidence may be downgraded one or two levels following the assessment of quality or upgraded if there is a large magnitude of effect or clear dose-response gradient.

Synthesis

Where studies are similar enough to combine and present data in a consistent format, a narrative synthesis will be produced to interpret the findings. The number of studies, the number of participants in each study, effect size and variance and a summary of the risk of bias across studies reporting each outcome will be summarised and presented. The evidence will be presented for each route of transmission separately (oral, respiratory, and direct contact).

Alternatively, if studies present methodological differences that would make synthesis inappropriate, a narrative summary of each study will be provided.

Health inequalities

Variations across populations and subgroups who may be more likely to be infected with and transmit TB to animals will be considered, where evidence is available such as immune-compromised individuals, people experiencing homelessness, and people who live in rural areas.

Search strategy

Ovid MEDLINE(R) ALL (1946 to 12 November 2024)

1. Mycobacterium bovis/ (14,169)
2. Tuberculosis, Bovine/ (3,879)
3. (Tuberculosis/ or Latent Tuberculosis/) and exp Ruminants/ (1,784)
4. calmette-guerin bacillus.tw,kf. (121)
5. mycobacterium bovis.tw,kf. (8,203)
6. M Bovis.tw,kf. (5,386)
7. "M.Bovis".tw,kf. (80)
8. ((Bovine or cow or cattle) adj3 (TB or tuberculo*)).tw,kf. (4,130)
9. Mycobacterium orygis.tw,kf. (34)
10. M orygis.tw,kf. (28)
11. "M.orygis".tw,kf. (0)
12. Mycobacterium microti.tw,kf. (168)
13. M microti.tw,kf. (172)
14. "M.microti".tw,kf. (2)
15. Mycobacterium tuberculosis variation muris.tw,kf. (0)
16. vole bacillus.tw,kf. (61)
17. Mycobacterium caprae.tw,kf. (132)
18. M caprae.tw,kf. (145)
19. "M.caprae".tw,kf. (4)
20. Mycobacterium bovis subsp* caprae.tw,kf. (8)
21. Mycobacterium tuberculosis subsp* caprae.tw,kf. (3)
22. or/1-21 (22,178)
23. Mycobacterium tuberculosis/ (59,854)
24. exp *Tuberculosis/ (188,634)
25. tuberculosis.tw,kf. (246,837)
26. Mycobacteriam tuberculosis.tw,kf. (1)
27. "M.tuberculosis".tw,kf. (299)
28. M tuberculosis.tw,kf. (21,552)
29. or/23-28 (277,181)
30. (transmi* adj3 (non-human* or nonhuman* or animal* or livestock* or cattle* or cow* or bovine or wildlife or wild life)).tw,kf. (5,902)
31. (human* adj2 animal*).tw,kf. (86,027)
32. zooanthropono*.tw,kf. (157)

33. (human* adj2 (vector* or reservoir*)).tw,kf. (5,879)
34. Zoonoses/ or Bacterial Zoonoses/ (19,688)
35. (spillback or spill back).tw,kf. (214)
36. (spillover* or spill over*).tw,kf. (10,330)
37. "from human*".tw,kf. (112,772)
38. (interspecies or inter species).tw,kf. (16,249)
39. between species.tw,kf. (17,298)
40. cross species.tw,kf. (9,505)
41. (revers* adj2 (zoonotic* or zoonos#s)).tw,kf. (223)
42. (animal adj1 human adj1 interface*).tw,kf. (388)
43. (livestock adj1 human adj1 interface*).tw,kf. (67)
44. (wildlife adj1 human adj1 interface*).tw,kf. (96)
45. ((livestock or animal* or wildlife) adj1 spillover).tw,kf. (17)
46. (infect* adj (animal* or livestock* or cattle* or cow* or wildlife)).tw,kf. (18,071)
47. exp *Animals/ and Humans/ and (transmi*.tw,kf. or transmission.fs.) (25,522)
48. or/30-47 (304,890)
49. farmer*.tw,kf. (33,388)
50. (agricultural adj (worker* or labo?rer*)).tw,kf. (2,832)
51. (farm adj (worker* or labo?rer*)).tw,kf. (1,795)
52. Farmers/ (4,671)
53. Farms/ (6,777)
54. exp Animal Husbandry/ (23,337)
55. animal husbandry.tw,kf. (3,456)
56. animal handler*.tw,kf. (186)
57. ((domestic or companion) adj animal*).tw,kf. (16,221)
58. exp Animals, Domestic/ (42,499)
59. Animals, Wild/ (20,052)
60. ((livestock* or cattle* or cow or cows) adj2 human*).tw,kf. (6,869)
61. (pet or pets).tw,kf. (148,104)
62. (cat or cats).tw,kf. (172,544)
63. (dog or dogs).tw,kf. (244,834)
64. Cats/ or Dogs/ (466,311)
65. exp Camelidae/ (7,541)
66. llama*.tw,kf. (2,550)
67. alpaca*.tw,kf. (1,703)
68. Veterinarians/ (5,862)
69. (veterinarian or vet or veterinary nurse*).tw,kf. (7,083)
70. exp Animal Feed/ (62,908)
71. (contamina* adj3 animal food*).tw,kf. (40)
72. (contamina* adj3 animal feed*).tw,kf. (274)
73. or/49-72 (906,615)
74. (inhalation or inhale* or inhaling).tw,kf. (121,456)
75. aerosol*.tw,kf. (60,289)

76. ((air flow* or airflow* or aerodynamic* or air condition* or cough* or sneez* or breath* or sing or singing or shout* or (air adj2 circulat*) or (air adj2 recirculation) or (air adj2 re-circulation)) and (transmission* or transmit* or distanc* or dispers*)).tw,kf. (12,138)
77. ((ventilation or ventilated) and (transmission* or distanc* or dispers*)).tw,kf. (5,126)
78. ((route or routes or mode or modes) adj2 (transmission* or transmit*)).tw,kf. (16,579)
79. (far field and (exposure* or transmission* or transmit*)).tw,kf. (827)
80. (long* distance* adj2 (transmission* or transmit*)).tw,kf. (422)
81. bioaerosol*.tw,kf. (2,469)
82. droplet*.tw,kf. (69,721)
83. exp *Body Fluids/ (175,714)
84. body fluid*.tw,kf. (28,691)
85. (infect* adj (hide* or tissue*)).tw,kf. (5,754)
86. (exhalation or exhale* or exhaling).tw,kf. (17,984)
87. Inhalation Exposure/ (10,621)
88. Inhalation/ (5,973)
89. Exhalation/ (5,158)
90. Aerosols/ (35,724)
91. direct contact*.tw,kf. (18,669)
92. Skin Absorption/ (13,104)
93. ((cutaneous or skin or dermal*) adj1 contact*).tw,kf. (4,428)
94. ((cutaneous or skin or dermal*) adj3 absorb*).tw,kf. (1,040)
95. Fomites/ (669)
96. fomite*.tw,kf. (1,590)
97. indirect transmission.tw,kf. (460)
98. (contaminat* adj3 (surface* or environment* or touch*)).tw,kf. (21,547)
99. transmi*.ti,kf. (143,568)
100. transmission.fs. (162,891)
101. or/74-100 (803,949)
102. 48 or 73 (1,177,360)
103. 22 or 29 (285,466)
104. 102 and 103 (6,375)
105. 22 and 101 (1,776)
106. 104 or 105 (7,401)
107. limit 106 to (comment or editorial or letter or news) (442)
108. 106 not 107 (6,959)

Embase (1974 to 12 November 2024)

1. exp Mycobacterium bovis/ (14,004)
2. bovine tuberculosis/ (2,832)
3. (tuberculosis/ or latent tuberculosis/) and exp ruminant/ (800)
4. calmette-guerin bacillus.tw,kf. (122)
5. mycobacterium bovis.tw,kf. (8,674)
6. M Bovis.tw,kf. (5,804)

7. "M.Bovis".tw,kf. (121)
8. ((Bovine or cow or cattle) adj3 (TB or tuberculo*)).tw,kf. (3,645)
9. Mycobacterium orygis.tw,kf. (30)
10. M orygis.tw,kf. (27)
11. "M.orygis".tw,kf. (0)
12. mycobacterium microti/ (263)
13. Mycobacterium microti.tw,kf. (172)
14. M microti.tw,kf. (181)
15. "M.microti".tw,kf. (4)
16. Mycobacterium tuberculosis variation muris.tw,kf. (0)
17. vole bacillus.tw,kf. (10)
18. mycobacterium caprae/ (187)
19. Mycobacterium caprae.tw,kf. (134)
20. M caprae.tw,kf. (139)
21. "M.caprae".tw,kf. (5)
22. Mycobacterium bovis subsp* caprae.tw,kf. (9)
23. Mycobacterium tuberculosis subsp* caprae.tw,kf. (3)
24. or/1-23 (20,325)
25. Mycobacterium tuberculosis/ (80,138)
26. tuberculosis/ or latent tuberculosis/ (145,167)
27. tuberculosis.tw,kf. (227,492)
28. Mycobacteriam tuberculosis.tw,kf. (1)
29. "M.tuberculosis".tw,kf. (681)
30. M tuberculosis.tw,kf. (25,547)
31. or/25-30 (277,237)
32. (transmi* adj3 (non-human* or nonhuman* or animal* or livestock* or cattle* or cow* or bovine or wildlife or wild life)).tw,kf. (6,331)
33. (human* adj2 animal*).tw,kf. (100,274)
34. zooanthropono*.tw,kf. (174)
35. (human* adj2 (vector* or reservoir*)).tw,kf. (7,446)
36. zoonosis/ or bacterial zoonosis/ (22,032)
37. (spillback or spill back).tw,kf. (221)
38. (spillover* or spill over*).tw,kf. (10,891)
39. "from human*".tw,kf. (136,136)
40. (interspecies or inter species).tw,kf. (17,834)
41. between species.tw,kf. (17,730)
42. cross species.tw,kf. (10,892)
43. (revers* adj2 (zoonotic* or zoonos#s)).tw,kf. (240)
44. (animal adj1 human adj1 interface*).tw,kf. (435)
45. (livestock adj1 human adj1 interface*).tw,kf. (68)
46. (wildlife adj1 human adj1 interface*).tw,kf. (100)
47. ((livestock or animal* or wildlife) adj1 spillover).tw,kf. (23)
48. (infect* adj (animal* or livestock* or cattle* or cow* or wildlife)).tw,kf. (19,957)
49. exp *animal/ and *human/ and transmi*.tw,kf. (10,214)

50. or/32-49 (340,672)
51. farmer*.tw,kf. (37,032)
52. (agricultural adj (worker* or labo?rer*)).tw,kf. (2,754)
53. (farm adj (worker* or labo?rer*)).tw,kf. (2,101)
54. agricultural worker/ (30,290)
55. exp agricultural land/ (25,715)
56. animal husbandry/ (20,976)
57. animal husbandry.tw,kf. (3,933)
58. animal handler*.tw,kf. (227)
59. ((domestic or companion) adj animal*).tw,kf. (17,552)
60. domestic animal/ (16,105)
61. wild animal/ (13,909)
62. ((livestock* or cattle* or cow or cows) adj2 human*).tw,kf. (7,446)
63. (pet or pets).tw,kf. (256,709)
64. (cat or cats).tw,kf. (186,395)
65. (dog or dogs).tw,kf. (251,004)
66. exp cat/ or exp dog/ (397,962)
67. exp camelid/ (8,498)
68. llama*.tw,kf. (2,442)
69. alpaca*.tw,kf. (2,013)
70. exp veterinarian/ (9,243)
71. (veterinarian or vet or veterinary nurse*).tw,kf. (9,716)
72. exp animal food/ (69,272)
73. (contamina* adj3 animal food*).tw,kf. (44)
74. (contamina* adj3 animal feed*).tw,kf. (302)
75. or/51-74 (980,805)
76. (inhalation or inhale* or inhaling).tw,kf. (170,388)
77. aerosol*.tw,kf. (80,877)
78. ((air flow* or airflow* or aerodynamic* or air condition* or cough* or sneez* or breath* or sing or singing or shout* or (air adj2 circulat*) or (air adj2 recirculation) or (air adj2 re-circulation)) and (transmission* or transmit* or distanc* or dispers*)).tw,kf. (17,601)
79. ((ventilation or ventilated) and (transmission* or distanc* or dispers*)).tw,kf. (7,188)
80. ((route or routes or mode or modes) adj2 (transmission* or transmit*)).tw,kf. (19,486)
81. (far field and (exposure* or transmission* or transmit*)).tw,kf. (694)
82. (long* distance* adj2 (transmission* or transmit*)).tw,kf. (396)
83. bioaerosol*.tw,kf. (3,427)
84. droplet*.tw,kf. (79,557)
85. exp *body fluid/ (919,386)
86. body fluid*.tw,kf. (31,816)
87. (infect* adj (hide* or tissue*)).tw,kf. (6,314)
88. (exhalation or exhale* or exhaling).tw,kf. (27,087)
89. inhalational exposure/ (314)
90. inhalation/ (30,955)
91. exhalation/ (6,339)

92. aerosol/ (67,842)
93. direct contact*.tw,kf. (22,678)
94. skin absorption/ (8,463)
95. ((cutaneous or skin or dermal*) adj1 contact*).tw,kf. (5,643)
96. ((cutaneous or skin or dermal*) adj3 absorb*).tw,kf. (1,442)
97. fomite/ (906)
98. fomite transmission/ (129)
99. fomite*.tw,kf. (1,820)
100. indirect transmission.tw,kf. (478)
101. (contaminat* adj3 (surface* or environment* or touch*)).tw,kf. (24,809)
102. transmi*.ti,kf. (161,147)
103. or/76-102 (1,540,051)
104. 50 or 75 (1,288,157)
105. 24 or 31 (285,526)
106. 104 and 105 (8,780)
107. 24 and 103 (2,205)
108. 106 or 107 (10,503)
109. limit 108 to (conference abstract or conference paper or editorial or letter) (2,235)
110. 108 not 109 (8,268)

Web of Science Preprint Citation Index (1990 to the present)

Date: 13 November 2024

TS=("calmette-guerin bacillus") OR TS=("mycobacterium bovis") OR TS=("M Bovis") OR TS=("M.Bovis") OR TS=(((Bovine or cow or cattle) NEAR/2 (TB or tuberculo*))) OR TS=("Mycobacterium orygis") OR TS=("M orygis") OR TS=("M.orygis") OR TS=("Mycobacterium microti") OR TS=("M microti") OR TS=("M.microti") OR TS=("Mycobacterium tuberculosis variation muris") OR TS=("vole bacillus") OR TS=("Mycobacterium caprae") OR TS=("M caprae") OR TS=("M.caprae") OR TS=("Mycobacterium bovis subsp* caprae") OR TS=("Mycobacterium tuberculosis subsp* caprae") OR TS=(tuberculosis) OR TS=("Mycobacteriam tuberculosis") OR TS=("M.tuberculosis") OR TS=("M tuberculosis")

AND

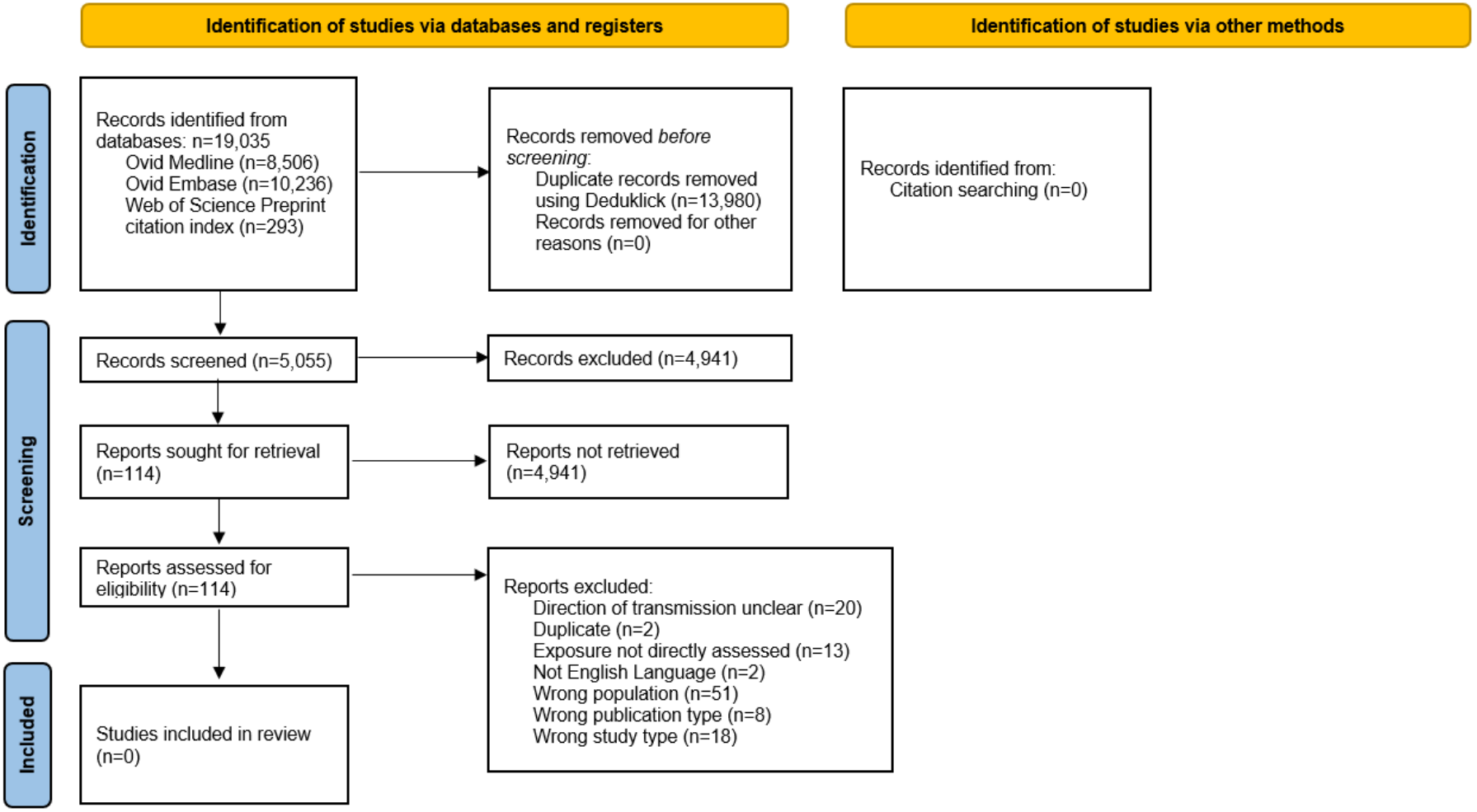
TS=((transmi* NEAR/2 (non-human* or nonhuman* or animal* or livestock* or cattle* or cow* or bovine or wildlife or "wild life"))) OR TS=((human* NEAR/1 animal*)) OR TS=(zooanthropono*) OR TS=(human* NEAR/1 (vector* or reservoir*)) OR TS=((spillback or "spill back")) OR TS=((spillover* or "spill over*")) OR TS=("from human*") OR TS=((interspecies or "inter species")) OR TS=("between species") OR TS=((revers* NEAR/1 (zoonotic* or zoonos?s))) OR TS=((animal NEAR/0 human NEAR/0 interface*)) OR TS=((livestock NEAR/0 human NEAR/0 interface*)) OR TS=((wildlife NEAR/0 human NEAR/0 interface*)) OR TS=(((livestock or animal* or wildlife) NEAR/0 spillover)) OR TS=((infect* NEAR/0 (animal* or livestock* or cattle* or cow* or wildlife))) OR TS=(human AND transmi*) OR TS=(farmer*) OR TS=((agricultural NEAR/0

(worker* or labo$rer*))) OR TS=((farm NEAR/0 (worker* or labo$rer*))) OR TS=("animal husbandry") OR TS=("animal handler*") OR TS=(((domestic or companion) NEAR/0 animal*)) OR TS=(((livestock* or cattle* or cow or cows) NEAR/1 human*)) OR TS=((pet or pets)) OR TS=((cat or cats)) OR TS=((dog or dogs)) OR TS=(llama*) OR TS=(alpaca*) OR TS=((veterinarian or vet or "veterinary nurse*")) OR TS=((contamina* NEAR/2 "animal food*")) OR TS=((contamina* NEAR/2 "animal feed*")) OR TS=((inhalation or inhale* or inhaling)) OR TS=(aerosol*) OR TS=(("air flow*" or airflow* or aerodynamic* or "air condition*" or cough* or sneez* or breath* or sing or singing or shout* or (air NEAR/1 circulat*) or (air NEAR/1 recirculation) or (air NEAR/1 re-circulation)) and (transmission* or transmit* or distanc* or dispers*))) OR TS=(((ventilation or ventilated) and (transmission* or distanc* or dispers*))) OR TS=(((route or routes or mode or modes) NEAR/1 (transmission* or transmit*))) OR TS=(("far field" and (exposure* or transmission* or transmit*))) OR TS=(("long* distance*" NEAR/1 (transmission* or transmit*))) OR TS=(bioaerosol*) OR TS=(droplet*) OR TS=("body fluid*") OR TS=((infect* NEAR/0 (hide* or tissue*))) OR TS=((exhalation or exhale* or exhaling)) OR TS=("direct contact*") OR TS=(((cutaneous or skin or dermal*) NEAR/0 contact*)) OR TS=(((cutaneous or skin or dermal*) NEAR/2 absorb*)) OR TS=(fomite*) OR TS=("indirect transmission") OR TS=((contaminat* NEAR/2 (surface* or environment* or touch*))) OR KP=(transmi*) OR TI=(transmi*)

198 results.

Annexe B. Study selection flowchart

Figure B.1. PRISMA diagram



Text version of Figure B.1. PRISMA diagram

A PRISMA diagram showing the flow of studies through this review, ultimately including no studies.

From identification of studies via databases and registers, n=19,035 records identified from databases:

- Ovid Medline (n=8,506)
- Ovid Embase (n=10,236)
- Web of Science Preprint citation index (n=293)

From these, records removed before screening:

- duplicate records removed using Deduklick (n=13,980)
- records removed for other reasons (n=0)

n=5,055 records screened, of which n=4,941 were excluded, leaving n=114 papers sought for retrieval, of which all were retrieved.

No studies were identified from identification of studies via other methods.

Of the n=114 papers assessed for eligibility, all were excluded:

- direction of transmission unclear (n=20)
- duplicate (n=2)
- exposure not directly assessed (n=13)
- not English Language (n=2)
- wrong population (n=51)
- wrong publication type (n=18)
- wrong study type (n=18)

No studies were included in the review.

Annexe C. Excluded full texts

Direction of transmission unclear (20 studies)

Abdel-Moein KA and others. 'Molecular detection of Mycobacterium tuberculosis in cattle and buffaloes: a cause for public health concern' Tropical Animal Health and Production 2016: volume 48, issue 8, pages 1,541 to 1,545

Adesokan HK and others. 'Reverse zoonotic tuberculosis transmission from an emerging Uganda I strain between pastoralists and cattle in South-Eastern Nigeria' BMC Veterinary Research [Electronic Resource] 2019: volume 15, issue 1, page 437

Alelign A and others. 'Tuberculosis at Farmer-Cattle Interface in the Rural Villages of South Gondar Zone of Northwest Ethiopia' Tuberculosis Research and Treatment Print 2019: volume 2019, 2106981

Amemor EA and others. 'The Prevalence of Tuberculosis in Cattle and Their Handlers in North Tongu, Volta Region, Ghana' African Journal of Infectious Diseases 2017: volume 11, issue 1, pages 12 to 17

Bashe W and others. 'Relationship between human and bovine tuberculosis in Ohio. An epidemiologic study' Ohio State Medical Journal 1962: volume 58, pages 46 to 48

Bates MN and others. 'Bovine ownership and reduced pulmonary tuberculosis risk in Nepal: A case-control study' Zoonoses and Public Health 2021: volume 68, issue 6, pages 650 to 657

Cook AJ and others. 'Human and bovine tuberculosis in the Monze District of Zambia--a cross-sectional study' British Veterinary Journal 1996: volume 152, issue 1, pages 37 to 46

Kassa A and others. 'Bovine Tuberculosis (Btb) as a Risk Factor for Developing Tuberculosis in Humans in the Rural Community of Ethiopia: A Case-Control Study' Ethiopian Medical Journal 2015: volume 53, issue 1, pages 1 to 8

Kouengoua APK and others. 'Prevalence and zoonotic risk factors of Mycobacterium bovis tuberculosis in cattle at the cattle-wildlife-human interface in South and East Cameroon' Veterinary World 2024: volume 17, issue 1, pages 8 to 16

Krajewska-Wedzina M and others. 'Human as a potential vector of bovine tuberculosis in cattle' Annals of Agricultural and Environmental Medicine 2019: volume 26, issue 3, pages 396 to 399

Krishnaswami KV and others. 'Mycobacterium tuberculosis humanis causing zoonotic tuberculosis among cattle' Indian Journal of Public Health 1983: volume 27, issue 2, pages 60 to 63

Kwaghe AV and others. 'Prevalence and molecular characterization of Mycobacterium tuberculosis complex in cattle and humans, Maiduguri, Borno state, Nigeria: a cross-sectional study' BMC Microbiology 2023: volume 23, issue 1, page 7

Malama S and others. 'Isolation and molecular characterization of Mycobacterium tuberculosis from humans and cattle in Namwala District, Zambia' Ecohealth 2014: volume 11, issue 4, pages 564 to 570

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Nuru A and others. 'Preliminary investigation of the transmission of tuberculosis between farmers and their cattle in smallholder farms in northwestern Ethiopia: a cross-sectional study' BMC Research Notes 2017: volume 10, issue 1, page 31

O'Halloran C and others. 'Feline tuberculosis caused by Mycobacterium bovis infection of domestic UK cats associated with feeding a commercial raw food diet' Transboundary and Emerging Diseases 2021: volume 68, issue 4, pages 2,308 to 2,320

Palacios JJ and others. 'Molecular and epidemiological population-based integrative analysis of human and animal Mycobacterium bovis infections in a low-prevalence setting' Veterinary Microbiology 2016: volume 195, pages 30 to 36

Parsons SDC and others. 'Detection of Mycobacterium tuberculosis infection in dogs in a high-risk setting' Research in Veterinary Science 2012: volume 92, issue 3, pages 414 to 419

Duplicate (2 studies)

Amemor EA and others. 'The prevalence of tuberculosis in cattle and their handlers in north Tongu, Volta region, Ghana' African Journal of Infectious Diseases 2017: volume 11, issue 1, pages 12 to 17

Sichewo PR and others. 'Risk practices for bovine tuberculosis transmission to cattle and livestock farming communities living at wildlife-livestock-human interface in northern KwaZulu Natal, South Africa' bioRxiv 2019

Exposure not directly assessed (13 studies)

Azami HY and others. 'Phylogenetic analysis of Mycobacterium bovis Reveals Evidence Of Animal And Zoonotic Tuberculosis Transmission Between Morocco And European Countries' bioRxiv. 2024: volume 10

Cotter TP and others. 'Tuberculosis due to Mycobacterium bovis in humans in the south-west region of Ireland: is there a relationship with infection prevalence in cattle?' Tubercle and Lung Disease 1996: volume 77, issue 6, pages 545 to 548

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Prasad HK and others. 'Bovine tuberculosis in India: potential basis for zoonosis' Tuberculosis 2005: volume 85, issue 5-6, pages 421 to 428

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Wangmo K and others. 'Seroprevalence and risk factors associated with bovine tuberculosis in cattle in Eastern Bhutan' PLoS Neglected Tropical Diseases [electronic resource] 2024: volume 18, issue 5, e0012223

Wanzala SI and others. 'Retrospective Analysis of Archived Pyrazinamide Resistant Mycobacterium tuberculosis Complex Isolates from Uganda-Evidence of Interspecies Transmission' Microorganisms 2019: volume 7, issue 8, page 29

Not English Language (2 studies)

Schliesser. '[The role of tuberculosis in carnivorous animals in infection histories of human tuberculosis]' Beitrage zur Klinik und Erforschung der Tuberkulose und der Lungenkrankheiten 1967: volume 136, issue 1, pages 262 to 264

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Wrong population (51 studies)

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Anonymous. 'Human tuberculosis caused by Mycobacterium bovis--New York City, 2001-2004' MMWR - Morbidity and Mortality Weekly Report 2005: volume 54, issue 24, pages 605 to 608

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Fanning A and others. 'Mycobacterium bovis infection in human beings in contact with elk (Cervus elaphus) in Alberta, Canada' Lancet 1991: volume 338, issue 8777, pages 1,253 to 1,255

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Gebre D and others. 'Prevalence of smear positive pulmonary tuberculosis among patients attending Seka Health Center, Jimma, Oromia Region, Ethiopia' East African Journal of Public Health 2010: volume 7, issue 3, pages 268 to 273

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Zlot A and others. 'Diagnosis of Tuberculosis in Three Zoo Elephants and a Human Contact - Oregon, 2013' MMWR - Morbidity and Mortality Weekly Report 2016: volume 64, issue 52, pages 1,398 to 1,402

Wrong publication type (8 studies)

Al-Thwani A and others. 'Tuberculosis in slaughtered cattle and workers in some abattoirs of Baghdad governorate' The International Journal of Mycobacteriology 2016: volume 5 supplement 1, pages S250 to S251

Gutierrez Garcia JM. 'Milk as a vector of transmission of bovine tuberculosis to humans in Spain: a historical perspective' Veterinary Heritage: Bulletin of the American Veterinary History Society 2006: volume 29, issue 2, pages 41 to 44

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Vitale M. 'Zoonotic tuberculosis: a complex issue of the Mycobacterium tuberculosis complex' The Lancet. Microbe 2020: volume 1, issue 2, pages e45 to e46

Yakubu Y and others. 'Evidence and potential risk factors of tuberculosis among captive Asian elephants and wildlife staff in Peninsular Malaysia' Preventive Veterinary Medicine 2016: volume 125, pages 147 to 153

Wrong study type (18 studies)

Akkerman OW and others. 'Infection of great apes and a zoo keeper with the same Mycobacterium tuberculosis spoligotype' Medical Microbiology and Immunology 2014: volume 203, issue 2, pages 141 to 144

Cosivi O and others. 'Epidemiology of Mycobacterium bovis infection in animals and humans, with particular reference to Africa' Revue Scientifique et Technique 1995: volume 14, issue 3, pages 733 to 746

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El-Sayed A and others. 'Molecular Epidemiology of Mycobacterium bovis in Humans and Cattle' Zoonoses and Public Health 2016: volume 63, issue 4, pages 251 to 264

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