Supplementary Material

# Supplementary table 1. Eligibility criteria for the review

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| --- | --- |
| **Population** | * Must include companion animals * Both inpatient and outpatient populations were considered. * Studies considering only large animals, such as horses or livestock, were excluded |
| **Intervention** | * Seeks to quantify antibiotic use * Seeks to explain antibiotic use * Seek to alter antibiotic use |
| **Study designs** | * Observational studies * (Randomised controlled) trials * Before and after comparisons (e.g. field intervention studies) * Qualitative studies * Mixed methods studies * Delphi consensus techniques * Ethnographic studies |

**Supplementary table 2.** Summary of the characteristics of the identified research studies. # = dogs; ~ =cats; #~= dogs & cats; \* = companion animals.Annual surveillance reports are not included.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Year of publication | Lead author | Country/region | | | | | | | | Settings | | | | | | Approach | | | Methods | | | | | | Sample size | | | | | | | | |
| UK | Scandinavia | Rest of Europe | North America | Australia/New Zealand | Asia | Africa | South America | Pharmacies/wholesalers | University/referral hospitals | First opinion clinics and hospitals | Academia/government experts | University | Non-veterinary-owners | Quantitative | Mixed Methods | Qualitative | Manual case review, observation | Survey | Database study | Intervention, pre/post comparison | Interviews, focus groups | Genotyping | <50 | <100 | <500 | <1,000 | <5,000 | <10,000 | <50,000 | <100,000 | 100,000+ |
| 2001 | Odensvik#~ (1) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Not reported | | | | | | | | |
| Watson# (2) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2004 | Rantala# (3) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2005 | Heuer#~ (4) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Not reported | | | | | | | | |
| Holso#~ (5) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2006 | Hill\* (6) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Weese#~ (7) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2009 | Black# (8) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Regula#~ (9) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Thomson~ (10) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2010 | German# (11) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2011 | Escher#~ (12) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mateus#~ (13) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Radford\* (14) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Wayne# (15) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2012 | Baker# (16) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hughes#~ (17) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Knights#~ (18) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Murphy#~ (19) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pleydell\* (20) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2013 | De Briyne\* (21) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Kvaale# (22) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Not reported | | | | | | | | |
| 2014 | De Briyne\* (23) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mateus#~ (24) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Summers# (25) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2015 | AVMA#~ (26) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Jacob#~ (27) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Supplementary table 2 (cont.).** Summary of the characteristics of the identified research studies. # = dogs; ~ =cats; #~= dogs & cats; \* = companion animals. Annual surveillance reports are not included.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Year of publication | Lead author | Country/region | | | | | | | | Settings | | | | | | Approach | | | Methods | | | | | | Sample size | | | | | | | | |
| UK | Scandinavia | Rest of Europe | North America | Australia/New Zealand | Asia | Africa | South America | Pharmacies/wholesalers | University/referral hospitals | First opinion clinic and hospitals | Academia/government experts | University | Non-veterinary-owners | Quantitative | Mixed Methods | Qualitative | Manual case review | Survey | Database study | Intervention, pre/post comparison | Interviews, focus groups, observation | Genotyping | <50 | <100 | <500 | <1,000 | <5,000 | <10,000 | <50,000 | <100,000 | 100,000+ |
| 2016 | Buckland\* (28) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fowler\* (29) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lloyd\* (30) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2017 | Barbarossa\* (31) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Barzelai# (32) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Burke~ (33) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chipangura# (34) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hardefeldt#~ (35) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hardefeldt#~ (36) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Jessen\* (37) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sarrazin#~ (38) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton#~ (39) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2018 | Cartelet\* (40) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Currie\* (41) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Dyar\* (42) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Gomez# (43) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hardefeldt\* (44) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hardefeldt\* (45) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hardefeldt#~ (46) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hopman\* (47) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| King\* (48) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Smith\* (49) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sorensen# (50) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Van Cleven#~ (51) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Zhuo\* (52) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Supplementary table 2 (cont.).** Summary of the characteristics of the identified research studies. # = dogs; ~ =cats; #~= dogs & cats; \* = companion animals. Annual surveillance reports are not included.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Year of publication | Lead author | Country/region | | | | | | | | Settings | | | | | | Approach | | | Methods | | | | | | Sample size | | | | | | | | |
| UK | Scandinavia | Rest of Europe | North America | Australia/New Zealand | Asia | Africa | South America | Pharmacies/wholesalers | University/referral hospitals | First opinion clinic and hospitals | Academia/government experts | University | Non-veterinary-owners | Quantitative | Mixed Methods | Qualitative | Manual case review, | Survey | Database study | Intervention, pre/post comparison | Interviews, focus groups, observations | Genotyping | <50 | <100 | <500 | <1,000 | <5,000 | <10,000 | <50,000 | <100,000 | 100,000+ |
| 2019 | Dickson\* (53) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ekakoro\* (54) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hopman\* (55) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hopman\* (56) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Not reported | | | | | | | | |
| Hopman\* (57) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hopman\* (58) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Not reported | | | | | | | | |
| Norris\* (59) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Redding\* (60) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Redding\* (61) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Schmitt~ (62) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton\* (63) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton\* (64) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton# (65) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton\* (66) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2020 | Hardefeldt~ (67) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hubbuch~ (68) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hur#~ (69) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Joosten#~ (70) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lehner# (71) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lutz# (72) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Robbins#~ (73) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton#~ (74) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stallwood~ (75) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Tompson# (76) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Valiakos\* (77) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2021 | Alcantara\* (78) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Chirollo#~ (79) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Galarce\* (80) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lavigne\* (81) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Samuels\* (82) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Singleton#~ (83) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Supplementary table 3a.** An overview of quantitative studies estimating the association of factors with features of antibiotic use (n=11)

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| --- | --- | --- | --- | --- | --- |
| **Author, year** | **Country** | **Population** | **Outcome Measure** | **Methods** | **Sample size** |
| Hughes,  2012 (17) | UK | Companion animal vets working in first opinion and hospitals identified by professional register | Use of unlicensed antimicrobials  Use of 2nd & 3rd gen cephalosporins  Use of fluoroquinolones  Only reports statistically significant results. | Survey, multivariable logistic regression models | 444 veterinarians |
| Hardefeldt, 2017 (35) | Australia | Companion animal vets working in first opinion and hospitals identified by professional register | Surgical guidelines compliance | survey, multivariable logistic regression models | 886 veterinarians |
| Hardefeldt, 2017 (36) | Australia | Companion animal vets working in first opinion and hospitals identified by professional register | High user of antimicrobials | Survey | 892 veterinarians |
| Hardefeldt, 2018 (44) | Australia | Veterinary students | Guideline compliance | Survey | 476 veterinary students |
| Hardefeldt, 2018 (46) | Australia | Insured cats and dogs | Total antimicrobial usage, CIA usage | Logistic regression model using insurance claim data | 813,172 dog-years and 129,232 cat-years |
| Van Cleven, 2018 (51) | Belgium | First opinion companion animal veterinarians | Guideline compliance, use of first-choice agents | Survey, univariable analysis | 223 veterinarians |
| Ekakoro, 2019 (54) | US | Veterinarians working at a single teaching hospital | Concern about AMR | survey, multivariable logistic regression models | 121 veterinarians |
| Hopman, 2019 (58) | Netherlands | First opinion companion animal veterinary clinics | Total antimicrobial use, 3rd choice antimicrobial use | Multivariable regression analysis using prescribing data | 44 clinics |
| Hur,  2020 (69) | Australia | Companion animal veterinary consultations | Antimicrobial prescribing, HPCIA prescribing | Prescribing data | 4,400,519 consultations |
| Lutz,  2020 (72) | Switzerland | First opinion companion animal veterinary clinics and veterinary hospitals | Guideline compliance for selected canine diseases | Prescribing data | 1,065 cases |
| Singleton, 2020 (74) | UK | First opinion companion animal veterinary consultations | Systemic antimicrobial use, HPCIA use | Multivariable mixed effects logistic regression of prescribing data | 392,682 consultations |

AMR: Antimicrobial resistance; CIA: Critically Important Antimicrobials; HPCIA: Highest Priority Critically Important Antimicrobials.

**Supplementary table 3b.** An overview of the association between investigated factors and features of higher antibiotic use – owner and veterinarian related factors (n=8)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, year** | **Owner** | **Veterinarian** | | | | | | |
| **Insurance status** | **Gender** | **Age** | **Experience** | **Role** | **Country of graduation** | **Information sources used** | **Post-graduate qualification** |
| Hughes,  2012 (17) |  |  |  | More recent graduates↓ | Locum 🡩 |  | Pharmaceutical company info 🡩 |  |
| Hardefeldt, 2017 (35) |  | Not SS |  | Recent graduates (post 2011) 🡩 | Not SS |  |  | Not SS |
| Hardefeldt 2017 (36) |  |  |  | Not SS |  |  |  |  |
| Hardefeldt, 2018 (44) |  |  |  | Not SS |  |  |  |  |
| Van Cleven, 2018 (51) |  |  |  |  |  |  | Scientific literature 🡫 |  |
| Ekakoro,  2019 (54) |  |  |  | More recent graduates 🡫 |  |  | CPD 🡫 |  |
| Hopman,  2019 (58) |  | Not SS |  |  |  | Not SS |  |  |
| Singleton,  2020 (74) | Insured 🡫 (for systemic antibiotics)  Insured 🡩  (for HPCIAs) |  |  |  |  |  |  |  |

Not SS: Not statistically significant; 🡩Associated with a statistically significant increase of use; 🡫Associated with a statistically significant reduction of use

CPD: Continuing Professional Development; HPCIA: Highest Priority Critically Important Antimicrobials.

**Supplementary table 3b.** An overview of the association between investigated factors and features of higher antibiotic use – clinic related factors (n=9) Information about the role of specific geographic regions was not included due to limited relevence to a general audience.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, year** | **Clinic factors** | | | | | | | | |
| **Clinic type** | **Case mix** | **RCVS accreditation status** | **Clinic size** | **Location** | **Antibiotic use policy** | **Offers alternative medicines** | **Serves kennels** | **Serves breeders** |
| Hughes,  2012 (17) | Referral hospital 🡫 |  | Accredited 🡩 |  |  |  |  |  |  |
| Hardefeldt, 2017 (35) | Not SS | Mixed 🡩 |  | <3 vets 🡩 | Rural/urban: Not SS | Not SS |  |  |  |
| Hardefeldt, 2017 (36) |  | Not SS |  |  | Deprivation: Not SS |  |  |  |  |
| Hardefeldt, 2018 (44) |  | Not SS |  |  |  |  |  |  |  |
| Hardefeldt, 2018 (46) |  |  |  |  | Metropolitan 🡩 |  |  |  |  |
| Hopman,  2019 (58) |  |  |  | Not SS | Not SS |  | Not SS | Not SS | Not SS |
| Hur,  2020 (69) | Emergency and referral centres 🡩 |  |  |  | Urban 🡩 |  |  |  |  |
| Lutz,  2020 (72) | Referral hospital 🡫 |  |  |  |  |  |  |  |  |
| Singleton, 2020 (74) |  | Mixed 🡩 | Accredited 🡫 |  |  |  |  |  |  |

Not SS: Not statistically significant; 🡩 associated with a statistically significant increase of use; 🡫 associated with a statistically significant reduction of use

RCVS: Royal College of Veterinary Surgeons.

**Supplementary table 4.** Studies ranking factors influencing antibiotic use (n=7)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study details** | Whether or not to use antibiotics | Antibiotic choice in perioperative situations | Choice of antibiotics in general | | | | |
|  | | | Teaching hospital sites only | |
| Author, year | Zhuo, 2018 (52) | Knights,  2012 (18) | De Briyne, 2013 (21) | Norris, 2019 (59) | Alcantara, 2021 (78) | Jacob, 2015 (27) | Ekakoro, 2019 (54) |
| Country | Australia | UK | EU countries | Australia | Portugal | UK | US |
| n | 403 | 1,121 | 1,766 | 320 | 417 | 70 | 62 |
| Percentage of companion animal veterinarians | 66% | 100% | 100% | 100% | 100% | 100% | 60% |
| Scale (very unimportant to very important) | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 5 |
| Summary measure | Median | Median | Mean | Median | Median | Median | Mode |
| **Animal factors** | | | | | | | |
| Clinical signs/ symptoms | 4 | - | - | 4 | - | 5 | 4 |
| Animal's clinical history | 4 | - | - | - | - | - | - |
| Animal's condition/ immune status | 4 | - | - | - | - | - | - |
| History of antimicrobial use | 3 | - | - | 3 | - | 5 | 4 |
| Concerns about animal welfare | 3 | - | - | - | - | - | 4 |
| Patient safety | - | - | - | - | - | - | - |
| Immediate animal relief | 3 | - | - | - | - | - | - |
| Wound location | - | 3 | - | - | - | - | - |
| **Antibiotic properties** | | | | | | | |
| Likely efficacy | - | 5 | - | - | 5 | - | - |
| Spectrum of activity | - | 5 | - | 4 | - | - | - |
| Duration of activity | - | 4 | - | 3 | - | - | - |
| Potential for side effects/ adverse events | 3 | 4 | - | 3 | - | 5 | 4 |
| Bactericidal vs bacteriostatic | - | 4 | - | - | - | - | - |

In order to facilitate comparison, the scores of Jacob (2015) were inverted so that 1 = very important became 1 = very unimportant; the range of scores used by De Briyne (2013) were adjusted from 0-4 to 1-5. For example, 0 = very unimportant became 1 = very important.

**Supplementary table 4.** Studies ranking factors influencing antibiotic use (cont.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study details** | Whether or not to use antibiotics | Antibiotic choice in perioperative situations | Choice of antibiotics in general | | | | |
|  | | | Teaching hospital sites only | |
| Author, year | Zhuo, 2018 (52) | Knights,  2012 (18) | De Briyne, 2013 (21) | Norris, 2019 (59) | Alcantara, 2021 (78) | Jacob, 2015 (27) | Ekakoro, 2019 (54) |
| Country | Australia | UK | EU countries | Australia | Portugal | UK | US |
| n | 403 | 1,121 | 1,766 | 320 | 417 | 70 | 62 |
| Percentage of companion animal veterinarians | 66% | 100% | 100% | 100% | 100% | 100% | 60% |
| Scale (very unimportant to very important) | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 5 |
| Summary measure | Median | Median | Mean | Median | Median | Median | Mode |
| **Other product features** | | | | | | | |
| Availability | - | - | 3.3 | 3 | 3 | 5 | 4 |
| Frequency of administration | - | - | - | 3 | - | 4 | 3 |
| Available routes of administration | - | 3 | - | 3 | - | 4 | 4 |
| Ease of administration | - | - | 3.8 | 3 | 4 | - | - |
| Medication size/ volume | - | - | - | 3 | - | 4 | 3 |
| Veterinary product license | - | 4 | - | - | 3 | - | - |
| Availability of information on drug's action | - | 3 | - | - | - | - | - |
| Shelf-life | - | 2 | - | - | - | - | - |
| Cost | - | 2 | 2.9 | 3 | 3 | 4 | 3 |
| Profit margin | - | - | 1.7 | - | - | - | - |
| Marketing offers | - | - | 1.8 | - | - | - | - |
| **Views about AMR** | | | | | | | |
| Concern about AMR | - | - | 4 | 3 | - | - | - |
| Risk of AMR in the patient | 4 | - | - | - | - | - | - |
| Concerns about AMR in animals | - | - | - | - | - | - | 4 |
| Concerns about AMR in humans | - | - | - | - | - | - | 3 |
| Community risk of AMR | 3 | - | - | - | - | - | - |
| Environmental risk of AMR | - | 3 | - | - | - | - | - |

AMR: Antimicrobial resistance. In order to facilitate comparison, the scores of Jacob (2015) were inverted so that 1 = very important became 1 = very unimportant; the range of scores used by De Briyne (2013) were adjusted from 0-4 to 1-5. For example, 0 = very unimportant became 1 = very important.

**Supplementary table 4.** Studies ranking factors influencing antibiotic use (cont.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study details** | **Whether or not to use antibiotics** | **Antibiotic choice in perioperative situations** | **Choice of antibiotics in general** | | | | |
|  | | | **Teaching hospital sites only** | |
| Author, year | Zhuo, 2018 (52) | Knights,  2012 (18) | De Briyne, 2013 (21) | Norris, 2019 (59) | Alcantara, 2021 (78) | Jacob, 2015 (27) | Ekakoro, 2019 (54) |
| Country | Australia | UK | EU countries | Australia | Portugal | UK | US |
| n | 403 | 1,121 | 1,766 | 320 | 417 | 70 | 62 |
| Percentage of companion animal veterinarians | 66% | 100% | 100% | 100% | 100% | 100% | 60% |
| Scale (very unimportant to very important) | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 4 | 1 to 5 | 1 to 5 | 1 to 5 |
| Summary measure | Median | Median | Mean | Median | Median | Median | Mode |
| **Diagnostic information** | | | | | | | |
| Results of culture and sensitivity testing | 4 | - | 4.2 | 4 | - | 5 | 5 |
| Results of cytologic evaluation | - | - | 3.5 | - | - | 4 | 4 |
| **Information sources** | | | | | | | |
| Veterinarian's personal experience | 4 | - | - | 4 | - | - | - |
| SPC | - | - | 3.8 | - | - | - | - |
| SPC responsible use warnings | - | - | 3.6 | - | - | - | - |
| Guidelines /recommendations | 3 | - | 3.5 | 3 | - | - | 4 |
| Clinic policy | - | 3 | 3.4 | - | - | - | 2.5 |
| Advertisements/ promotional materials | - | - | 1.9 | 2 | - | - | 3 |
| Peer recommendations | - | - | - | - | - | 3 | - |
| **Clinic factors** | | | | | | | |
| Peer/ colleague expectations | 2 | - | - | 2 | - | - | - |
| Culture | - | - | 1.8 | - | - | - | - |
| **Owner factors** | | | | | | | |
| Owner expectations | 2 | - | 2 | 2 | - | 3 | 1 |
| Owner compliance | - | - | - | 3 | - | - | 4 |
| Fear of litigation by owner | - | - | - | - | - | - | 2 |

SPC: Summary of product characteristics. In order to facilitate comparison, the scores of Jacob (2015) were inverted so that 1 = very important became 1 = very unimportant; the range of scores used by De Briyne (2013) were adjusted from 0-4 to 1-5. For example, 0 = very unimportant became 1 = very important.

**Supplementary table 5.** Studies ranking barriers to ‘appropriate’ antibiotic use (n=2)

|  |  |  |
| --- | --- | --- |
| **Factors explored** | **Zhuo,**  **2018 (52)** | **Hopman,**  **2019 (55)** |
| Country | Australia | Netherlands |
| n | 403 | 353 |
| Percentage of companion animal veterinarians | 66% | 100% |
| Scale (very unimportant to very important) | 1 = no influence;  4 = strong influence | 1 = Completely disagree  6 = Completely agree |
| Summary measure | Median | Mode |
| **Financial/ business pressures** | | |
| My antimicrobial choices have nothing to do with higher financial profits |  | 6 |
| My antimicrobial choices have nothing to do with acquiring more clients |  | 6 |
| I freely prescribe antimicrobials because neighbouring clinics do |  | 2 |
| Fear of losing owners to different clinics if antimicrobials not prescribed | 1 |  |
| Cost of some antibiotics | 4 |  |
| **Owner interactions** | | |
| My antimicrobial choices have nothing to do with my perception of what the owner wants |  | 5 |
| My antimicrobial choices have nothing to do with what the owner wants |  | 5 |
| Pressure from owners to prescribe antimicrobials | 2 |  |
| Fear of being blamed if antibiotics are later needed | 2 |  |
| Lack of owner understanding about antimicrobials | 2 |  |
| Language/ cultural barriers when communicating with owners | 1 |  |
| I regularly encounter owner pressure to try antimicrobials before performing diagnostic tests |  | 5 |
| **Clinic environment** | | |
| My colleagues and I support each other to show restraint when prescribing antimicrobials |  | 5 |
| Our clinic policy is committed to show restraint in prescribing antimicrobials |  | 5 |
| I quite often experience pressure from colleagues and superiors to prescribe specific types of antimicrobials |  | 1 |
| Pressure from colleagues/ peers/ supervisors | 1 |  |
| Time pressures | 2 |  |
| **Diagnosis and diagnostic testing** | | |
| Difficulty of making an accurate diagnosis | 2 |  |
| Fear of missing an infection | 2 |  |
| In my clinic, we have sufficient possibilities to send samples for antimicrobial culture and susceptibility testing |  | 5 |
| I regularly encounter owners urging to try antimicrobials before performing diagnostic tests |  | 5 |
| Cost of antimicrobial culture and susceptibility testing | 3 |  |
| Lack of rapid diagnostic testing | 3 |  |
| **Information** | | |
| Lack of clear guidelines for some conditions | 2 |  |
| Lack of time to search for information | 2 |  |
| Lack of my own understanding | 1 |  |

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