



Singleton, D. A., Arsevska, E., Smyth, S., Barker, E. N., Jewell, C., Brant, B., ... Radford, A. D. (2019). Small animal disease surveillance: gastrointestinal disease, antibacterial prescription and *Tritrichomonas foetus*. *Veterinary Record*, 184(7), 211-216. <https://doi.org/10.1136/vr.1722>

Peer reviewed version

License (if available):
CC BY-NC

Link to published version (if available):
[10.1136/vr.1722](https://doi.org/10.1136/vr.1722)

[Link to publication record in Explore Bristol Research](#)
PDF-document

This is the accepted author manuscript (AAM). The final published version (version of record) is available online via BMJ at <http://dx.doi.org/10.1136/vr.1722> . Please refer to any applicable terms of use of the publisher.

University of Bristol - Explore Bristol Research

General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:
<http://www.bristol.ac.uk/pure/about/ebr-terms>

Small animal disease surveillance 2018: gastrointestinal disease, antibacterial prescription and *Tritrichomonas foetus*

David A. Singleton ^{a,*}, Elena Arsevska ^{a,b}, Emily N. Barker ^d, Christopher Jewell ^e, Steven Smyth ^a, Bethaney Brant ^a, Fernando Sánchez-Vizcaíno ^f, Susan Dawson ^c, Gina L. Pinchbeck ^a, Peter J.M. Noble ^c, Philip H. Jones ^g, Alan D. Radford ^a

^a *Institute of Infection and Global Health, University of Liverpool, Leahurst Campus, Chester High Road, Neston, CH64 7TE, United Kingdom*

^b *CIRAD, Research Unit ASTRE, Campus international de Baillarguet, Montpellier, France*

^c *Institute of Veterinary Science, University of Liverpool, Leahurst Campus, Chester High Road, Neston, CH64 7TE, United Kingdom*

^d *Langford Vets, University of Bristol, Langford Campus, BS40 5DU, United Kingdom*

^e *Lancaster Medical School, Lancaster University, Furness Building, Lancaster, LA1 4YG, United Kingdom*

^f *Bristol Veterinary School, University of Bristol, Langford Campus, BS40 5DU, United Kingdom*

^g *Surveillance Intelligence Unit, Animal and Plant Health Agency, Kendal Road, Harlescott, Shrewsbury, SY1 4HD, United Kingdom*

* Corresponding author. Tel: +44 151 7956080

E-mail address: D.A.Singleton@liverpool.ac.uk (D.A. Singleton)

Report summary

- Presentation for investigation and/or treatment of gastrointestinal (GI) disease comprised 3.0 per cent, 2.0 per cent and 1.9 per cent of total dog, cat and rabbit consultations respectively between 1 April 2017 and 31 October 2018
- Diarrhoea and vomiting without blood were the most frequently reported GI disease clinical signs (43.0 and 36.6 per cent in dogs, and 35.9 and 37.7 per cent in cats respectively)
- The proportion of GI disease consultations which prescribed antibiotics authorised for systemic administration (including oral and injectable formulations) decreased between April 2014 and October 2018
- The proportion of GI disease consultations which dispensed nutraceutical products advertised as being effective at managing primary GI disease (including prebiotics, probiotics etc.) increased between April 2014 and October 2018
- Between January 2011 and August 2018, 13.5 per cent of 20,194 feline faecal samples submitted to UK-based diagnostic laboratories tested positive for presence of *Tritrichomonas foetus*
- The proportion of feline sample submissions testing positive for *T.foetus* decreased between 2011 and 2018

About this report

This report is the seventh in a series by the Small Animal Veterinary Surveillance Network (SAVSNET). The other reports in the series are available from <http://veterinaryrecord.bmj.com>. As data are collected for longer periods, the estimates of changes in disease burden will become more refined, allowing more targeted local and perhaps national interventions. Anonymised data can be accessed for research by contacting the authors. SAVSNET also welcomes feedback on this report. More information about SAVSNET is available at www.liverpool.ac.uk/savsnet

Syndromic surveillance of GI disease

This report represents the third occasion the Small Animal Veterinary Surveillance Network (SAVSNET) has summarised GI disease in companion animals (Arsevska and others 2017; Sánchez-Vizcaíno and others 2015). The present report considers electronic health records (EHRs) captured by the SAVSNET project from 236 voluntary veterinary practices (526 sites) over a 19-month period from 1 April 2017 to 31 October 2018. A detailed description of the methodology used by SAVSNET to capture EHRs has been previously provided (Sánchez-Vizcaíno and others 2015; Sanchez-Vizcaino and others 2017). A total of 2,231,928 consultations were analysed, of which 69.8 per cent were from dogs, 26.8 per cent were from cats, 1.7 per cent were from rabbits, and the remaining 1.6 per cent were from other species, or where species was not recorded. Animals mainly presenting for investigation and/or treatment of GI disease according to the attending veterinary surgeon or nurse comprised 3.0 per cent, 2.0 per cent and 1.9 per cent of total dog, cat and rabbit consultations respectively.

Short questionnaires (Sánchez-Vizcaíno and others 2015) were completed by the attending practitioner after 13,768 random GI disease consultations (10,682 canine, 2,767 feline and including 13,098 unique animals). Most animals presented with mild GI clinical signs (82.1 per cent of dogs, 78.7 per cent of cats) after a history of illness of up to two days (51.8 per cent of dogs, 38.7 per cent of cats), where the surveyed consultation represented the first occasion the animal had presented to the veterinary professional for this episode of GI disease (70.3 per cent of dogs, 61.7 per cent of cats). The most common presenting signs in both species were diarrhoea and/or vomiting, in both cases without blood (Table 1).

Haematological/biochemical analyses were the most common diagnostic tests performed (8.3 per cent of dogs, 12.7 per cent of cats), followed by parasitological or bacteriological analyses on faeces (7.8 per cent of dogs, 6.8 per cent of cats). A change of diet was the most commonly provided advice, being recommended in 56.9 per cent of dogs and 45.8 per cent of cats. These findings were broadly consistent with SAVSNET's previous reviews of GI disease (Arsevska and others 2017; Sánchez-Vizcaíno and others 2015).

Spatial distribution of gastrointestinal disease

The spatial distribution of the relative risk for GI disease was evaluated in dogs and cats in England, Scotland and Wales for each season of the surveillance period between 1 October 2017 and 31 October 2018. For consultations with a valid owner postcode the centroid of each

postcode was used to indicate the likely residence of each recorded animal. Hence, these centroids were aggregated into 20km gridded cells encompassing England, Scotland and Wales, calculating the proportion of total consultations which included an animal mainly presenting for GI disease. Standard error (SE) for each cell was also calculated to provide a measure of relative confidence in findings due to variable geographic consultation coverage, with these values being used to formulate septile bi-variate maps, where the darkest red colours indicate highest proportions of GI disease (greater than 5.6 per cent and 3.7 per cent for dogs and cats respectively) (compared to median incidence) and lowest standard errors (Fig.1).

As previously noted in both dogs and cats (Sánchez-Vizcaíno and others 2015), we observed transient regions of increased GI disease incidence distributed fairly randomly throughout the country and in most seasons, as indicated by the darkest red areas in figure 1. These were most numerous for dogs. It is anticipated in future that SAVSNET will conduct more in-depth analyses of these transient increased incidence regions to ascertain presence or absence of a GI disease outbreak.

Gastrointestinal disease pharmacosurveillance

For the first time in this report we also analysed pharmaceutical product prescriptions given during all GI consultations recorded between April 1 2014 and October 31 2018 in dogs ($n = 124,159$ GI consultations), cats ($n = 32,902$) and rabbits ($n = 2,123$). A semi-automated text mining methodology was utilised to identify the active substance(s) dispensed in each consultation using the ‘product dispensed’ field of the EHR; these active substances were hence summarised into a hierarchical pharmaceutical classification system as previously described (Singleton and others 2018; Singleton and others 2017). For the purposes of this report, five pharmaceutical families of particular relevance to GI disease were analysed, including antibiotics authorised for systemic (oral or injectable) use; anti-inflammatories authorised for systemic use; any endoparasiticide or endectocide; gastrointestinally-active (GI-A) products (e.g. proton pump inhibitors), and euthanasia. Nutraceuticals advertised as being effective at treating primary GI disease including prebiotics, probiotics, kaolin etc. were also analysed.

For dogs, GI pharmaceutical products were prescribed in 37.5 per cent of GI consultations, systemic antibiotics in 36.9 per cent, systemic anti-inflammatories in 11.1 per cent, and endoparasiticides / endectocides in 6.9 per cent. For cats, GI-A products were prescribed in 29.2 per cent of GI consultations, systemic antibiotics in 25.7 per cent, systemic anti-inflammatories

in 18.3 per cent, and endoparasiticides / endectocides in 11.9 per cent. For rabbits, GI-A products were prescribed in 55.6 per cent of GI consultations, systemic antibiotics in 13.9 per cent, systemic anti-inflammatories in 39.1 per cent, and endoparasiticides / endectocides in 3.2 per cent. GI nutraceuticals were dispensed in 35.4 per cent of dog GI consultations, 17.3 per cent of cat, and 10.6 per cent of rabbit GI consultations. Dogs were euthanised in 0.2 per cent of GI consultations, compared to 0.7 per cent of cat and 1.4 per cent of rabbit GI consultations.

Temporal trends in prescription and dispensing frequency were also examined in dogs and cats (Fig.2). Over the 4.5 years analysed a decrease in the frequency with which systemic antibiotics and systemic anti-inflammatories were prescribed was noted in this population, with the opposite trend being noted for GI-A pharmaceutical products and GI nutraceuticals. No clear temporal variation in euthanasia frequency was seen in either species.

Laboratory-based investigations of *Tritrichomonas foetus* infection in companion animals

SAVSNET collated data from four participating UK-based veterinary diagnostic laboratories (VDL) between 4 January 2011 and 31 August 2018, with data being used to identify temporal and spatial trends in the proportion of faecal sample submissions that tested positive (as interpreted by the VDL) for presence of *T.foetus* by polymerase chain reaction (PCR) assay. In total there were 20,194 feline tests completed, with 13.5 per cent ($n=2,733$) testing positive. In addition, 42 tests were labelled as being of canine origin, with 9.5 per cent ($n=4$) testing positive.

Due to a low number of canine tests, temporal and spatial trends were examined for cats alone. Over the eight years analysed, we observed a relatively steady decline in the proportion of feline tests returning a positive *T.foetus* result (Fig.3). Whether this represents a true decrease in *T.foetus* prevalence, or a changing approach to diagnosis of this parasite in practice and/or VDLs remains to be determined. Considered in total, a greater proportion of tests conducted in winter returned a positive result (15.2 per cent of tests), followed by spring (14.1 per cent), autumn (13.2 per cent), and summer (11.7 per cent). Regarding spatial trends, collating all tests completed between 2011 and 2018, though varied coverage should be considered, both areas of relatively high and low positive test proportions were revealed in postcode areas for which we hold relatively high volumes of data (equating to low standard error), suggesting variable *T.foetus* infection risk in different regions of the country (Fig.4). Though to our knowledge it

has been some years since *T.foetus* infection in cats has been surveyed in the UK our findings are broadly similar to a 2007 study (Gunn-Moore and others 2007).

Update on main presenting complaint temporal trends in companion animals

An observed prevalence time series for three key main presenting complaints (pruritus, gastroenteric and respiratory) from November 2016 to November 2018 are shown in Figure 5, together with a seasonal trend line (dark grey line). The trend line was calculated using a Bayesian binomial generalised linear model trained on weekly prevalence between 2014 and 2018, as fully described previously (Arsevka and others 2018). Extreme prevalence observations describing weekly prevalence exceeding 99 per cent credible intervals, and moderate prevalence observations describing weekly prevalence exceeding 95 per cent credible intervals are displayed in red and orange respectively.

These results show continued seasonal prevalence fluctuations in both species, particularly apparent for pruritus in both dogs and cats, and respiratory disease in dogs. In dogs, this seasonal pattern for pruritus appeared extremely stable, with no evidence of moderate or extreme perturbations in recent expected levels of disease. Other syndromes were less stable, suggesting an extreme increase in gastroenteritis cases above expected levels for cats around August 2018, and for respiratory disease in dogs (summer 2018). It is currently unknown whether these findings represent a true increase in disease prevalence, or reflect the changing nature of participation in the SAVSNET project.

Global perspective

***Campylobacter jejuni* in dogs in the USA**

In our last surveillance report we reported on an outbreak of *Campylobacter* affecting both puppies in a national pet store chain and 118 people in 18 states of the USA, leading to the hospitalisation of 26 people. Tested isolates were considered resistant to many classes of antibiotic, the use of which in puppies was widespread in the pet store, often for prophylactic reasons. Further analysis has now identified the species involved as *C.jejuni* (Montgomery and others 2018), a relatively rare infection in dogs, which are more typically infected with *C.upsaliensis* (Parsons and others 2009). This outbreak highlights the zoonotic potential of *C.jejuni* in dogs, the impact of supplier chains on spreading infection, and the potential for widespread prophylactic use of antibiotics to drive resistance. The UK government carried out

an open consultation between August and September 2018 on plans to ban the sale of puppies (and kittens) in pet shops in England.

Imported rabies

The sad news of the recent death of a man in the UK of rabies, contracted from a cat bite in Morocco, reminds us both of the dangers still posed by this lethal virus, and that although most human cases are associated with dog bites, cats and other animals can also transmit the virus to people. This is the sixth such case of rabies in the UK associated with exposure abroad since 2000. Apart from a single rabies fatality in Scotland in 2002 in an unvaccinated bat handler infected with European bat lyssavirus 2a (Nathwani and others 2003), no humans have acquired rabies *within* the UK since 1902. Those people working with bats in the UK, those staying for a month or more in rabies affected countries and/or likely to contact rabies infected animals should discuss being vaccinated with their doctor. Public Health England (PHE) advises travellers not to touch animals in any of the many rabies-affected countries around the world. People that are bitten, scratched, or licked by an animal in a country with rabies, or by a bat in the UK, should take immediate action by washing the site with plenty of soap and water and seek immediate medical advice, even if previously vaccinated.

Imported monkeypox

Travel was also at the heart of a recent mini-outbreak of monkeypox in England this September affecting three people, two of which had recently travelled from Nigeria where they are believed to have acquired the infection independent of each other; the third case was a healthcare worker caring for one of the cases (PHE 2018). Monkeypox is a rare zoonosis related to smallpox (which itself has been eradicated globally) and cowpox. Although most infections are mild and most people recover, it can be fatal especially in young children and the immunosuppressed.

Update on *Tritrichomonas foetus* in cats

The organism

Tritrichomonas foetus is a single-celled protozoan parasite that can infect the distal ileum, caecum and colon of cats resulting in predominantly large intestinal diarrhoea. In cattle, *T.foetus* can infect the reproductive tract leading to reproductive disease (including endometritis, infertility and abortion), whilst in pigs it colonises the nasal cavity and GI tract. It is unclear whether isolates from different host species represent separate species. This agent is rarely

zoonotic, but good hygiene practice should be applied when handling infected cats or their waste products particularly by immunosuppressed individuals.

Transmission is via the faeco-oral route, with organisms remaining viable in moist faeces for a small number of days. Young cats (<1 year age) most commonly show clinical signs, although any age can be affected. Prevalence in cats with diarrhoea is variable, with younger cats and those from multi-cat households (especially breeding colonies) at increased risk.

Clinical signs

Most cats are presented with a chronic history of waxing and waning, malodorous, large intestinal diarrhoea with variably increased frequency, increased mucus, haematochezia, tenesmus, and flatulence. In some cats this can progress into faecal incontinence, perianal swelling and dermatitis. Cats are often otherwise well in themselves.

Diagnosis

Diagnosis is based on either direct microscopic visualisation of organisms (wet mount preparation), faecal culture (using the 'InPouch' system), or detection of organism DNA in faeces (whole or via colonic wash) by PCR. Microscopically, *T. foetus* has a similar size and shape to *Giardia* spp.; however, *T. foetus* has a rapid, jerking movement (c.f. slow, falling-leaf movement of *Giardia* spp.). Co-infections with *Giardia* spp. are possible. PCR is most sensitive, and is the recommended method of detection.

False negative results can occur, particularly when whole faeces are submitted for testing or if there is a delay in testing (for direct visualisation and culture). As the colonic mucus is the site of infection, obtaining a sample of this increases the sensitivity of detection in infected cats. Mucus may be collected from faecal motions, passed as part of the clinical disease process; a faecal loop may be used to obtain a sample of faeces and mucus directly from the colon; or (preferably) a colonic wash is performed (description and images available in Gookin and others 2017).

Treatment

Although clinical signs may improve on antibiotics, this is attributed to indirect effects on reducing *Trichomonas* numbers, and diarrhoea typically recurs shortly following discontinuation. Feeding of bland or high-fibre diets have also been suggested to be beneficial,

again possibly via indirect effects; however, there are little data to support this. Clinical signs can resolve without treatment but affected cats likely remain a reservoir of infection.

The only agent with proven efficacy against *T. foetus* is ronidazole, which is effective in around two thirds of cases (Xenoulis and others 2013). Current recommended doses are 20-30 mg/kg orally once daily for 14 days and should be based on accurate weight measurement (Gruffydd-Jones and others 2013). Doses in young kittens (not ≤ 12 weeks age) or cats with hepatic dysfunction should be reduced to 10 mg/kg to minimise risk of adverse effects. As it is teratogenic, ronidazole should not be administered to pregnant or nursing queens (NB: owners should wear gloves when administering). Administration of a probiotic (eg Pro-Kolin Enterogenic, Protexin) for four weeks is also recommended. Metronidazole should not be given concurrently due to increased risk of toxicity.

Adverse effects of ronidazole are primarily related to neurotoxicity (lethargy, inappetence, ataxia, tremors, and seizures) with vomiting less frequent. If adverse effects were to manifest, the ronidazole should be immediately discontinued. Obtaining informed, written, owner consent prior to treatment is strongly recommended.

Ronidazole is not currently available as a licensed product for use in cats. Currently, only two UK compounding pharmacies supply reformulated capsules or liquid direct to veterinary practices – Nova Laboratories (www.novalabs.co.uk) and Summit Veterinary Pharmaceuticals (www.svprx.co.uk).

Control

Treatment failures are possible, and potentially due to inappropriate dosage of medication, poor compliance, re-infection or resistance to ronidazole. To reduce the risk of re-infection and transmission, good hygiene practice should be in place, in particular the frequent emptying and cleaning of cat litter trays. If possible, infected cats should be isolated.

Treatment of all cats within a cattery in which a *T. foetus*-infected cat has been documented but is controversial due to risk of adverse effects, alongside the potential for treatment failure leading to re-infection.

Acknowledgements

SAVSNET is based at the University of Liverpool. It is currently funded by the Biotechnology and Biological Sciences Research Council and the British Small Animal Veterinary Association. The SAVSNET team is grateful to the veterinary practices and diagnostic laboratories that provide health data and without whose support these reports would not be possible. It wishes to thank Batt Laboratories, BioBest, CAPL, CTDS, CVS, Idexx, Lab Services, Langford Veterinary Services, NationWide Laboratory Services, PTDS, SRUC, TDDS, Teleos, Test A Pet and Microbiology Diagnostics Laboratory at University of Liverpool and Vet Solutions (the suppliers of RoboVet and PremVet). The team would also like to thank Susan Bolan, SAVSNET project administrator, for her help and support.

Tables

Table 1: Percentage of recorded clinical signs in 10,682 dog and 2,767 cat consultations presented with GI disease to veterinary practices in the UK (April 1, 2017 to October 31, 2018).*

Clinical sign	Number (%) of dogs	Number (%) of cats
Diarrhoea with blood	2697 (25.2)	325 (11.7)
Diarrhoea without blood	4594 (43.0)	994 (35.9)
Melaena	151 (1.4)	24 (0.9)
Vomiting with blood	354 (3.3)	95 (3.4)
Vomiting without blood	3916 (36.6)	1044 (37.7)
Weight loss / failure to gain weight	437 (4.1)	308 (11.1)
Poor appetite	1634 (15.3)	473 (17.1)
Other clinical signs	1097 (10.3)	387 (14.0)

* The same animal could present with more than one sign per consultation

Figures

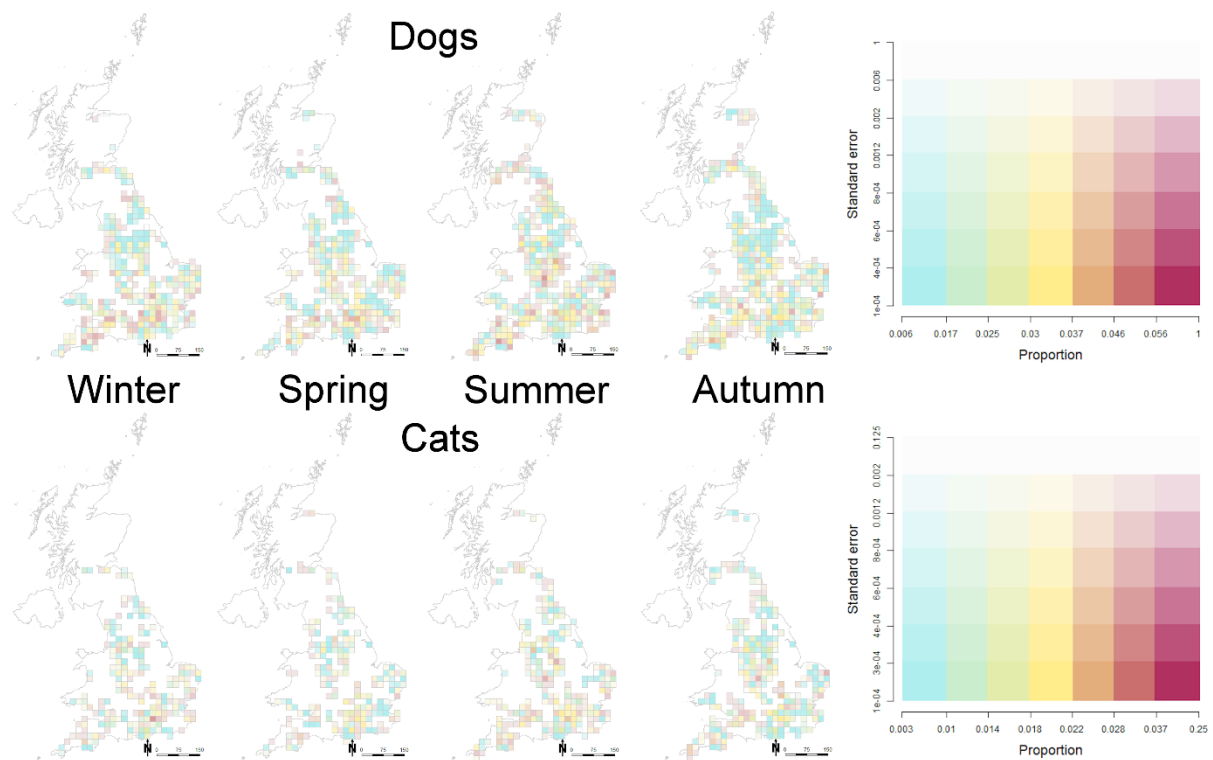


Figure 1: Septile bi-variate maps indicating proportion of total canine and feline consultations (1 Oct 2017 – 31 Oct 2018) indicated as including animals presenting mainly for investigation and/or treatment of GI disease, summarised by 20km gridded cells encompassing England, Scotland and Wales. Proportion has been modelled against standard error to provide a measure of relative confidence in findings according to the volume of data collected in each cell.

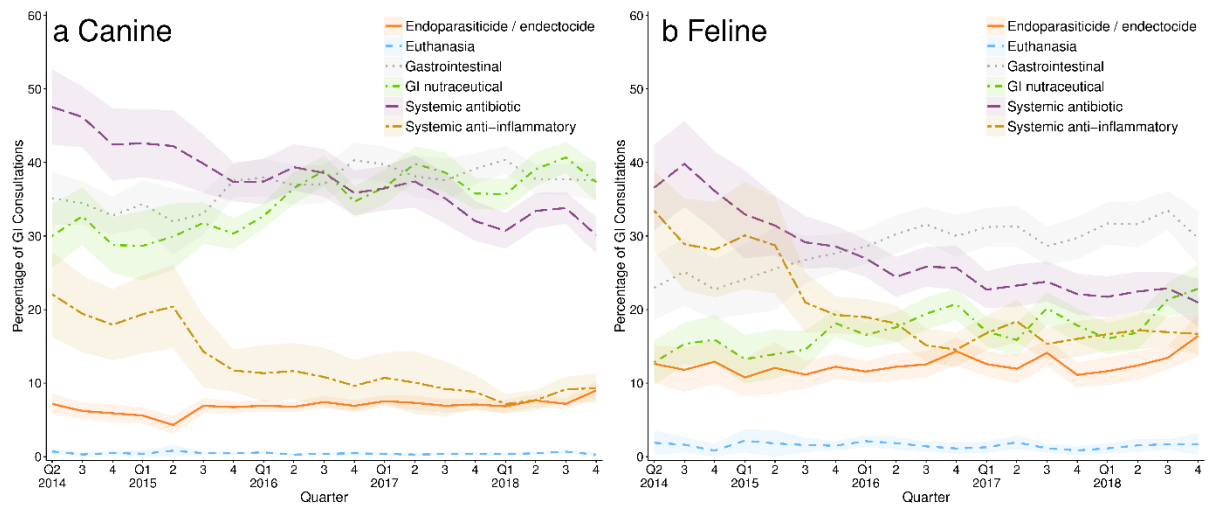


Figure 2: Percentage of canine and feline GI consultations where systemic antibiotics; systemic anti-inflammatories; endoparasiticides or endectocide, or GI-A products were prescribed, by quarter (Q2 2014 – Q4 2018). Also described are the percentage of GI consultations where a GI nutraceutical was dispensed, or the animal was euthanised. Shaded regions refer to 95% confidence intervals, calculated to adjust for clustering within veterinary practice site (bootstrapped estimated, n replicates = 5,000).

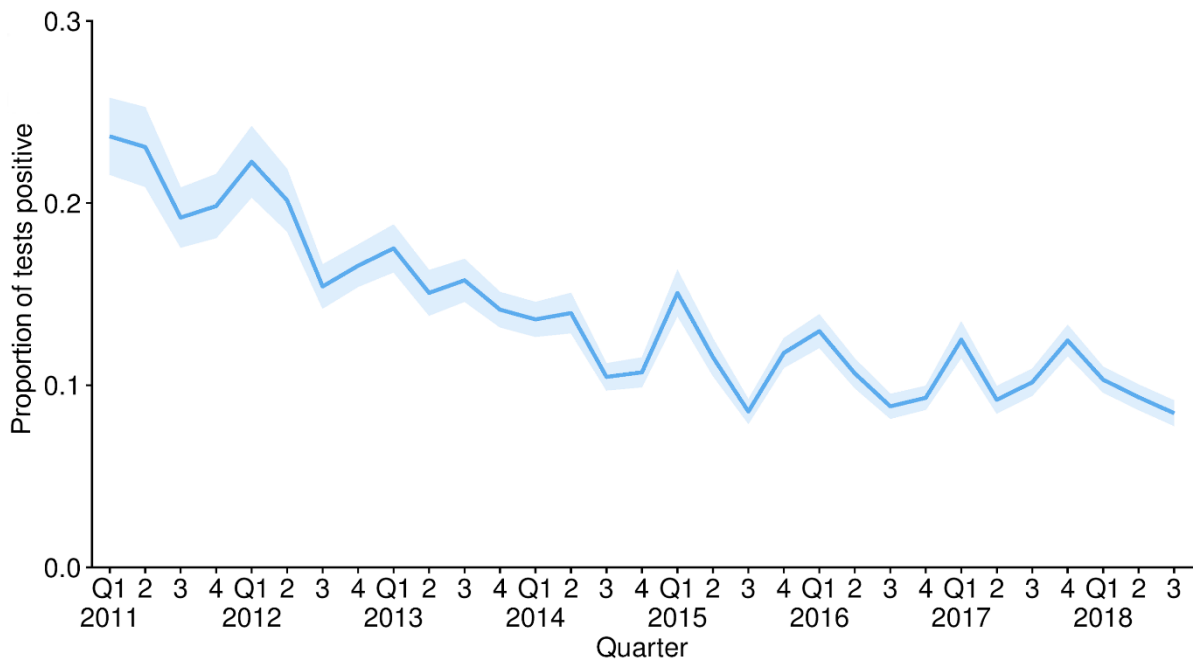


Figure 3: Percentage of feline faecal sample submissions that tested positive by PCR assay for presence of *T.foetus*, summarised by quarter and year (2011-2018). Data was collated from four veterinary diagnostic laboratories situated in the UK.

FELINE TRITRICHOMONAS FOETUS POSITIVE SAMPLES, 2011-2018

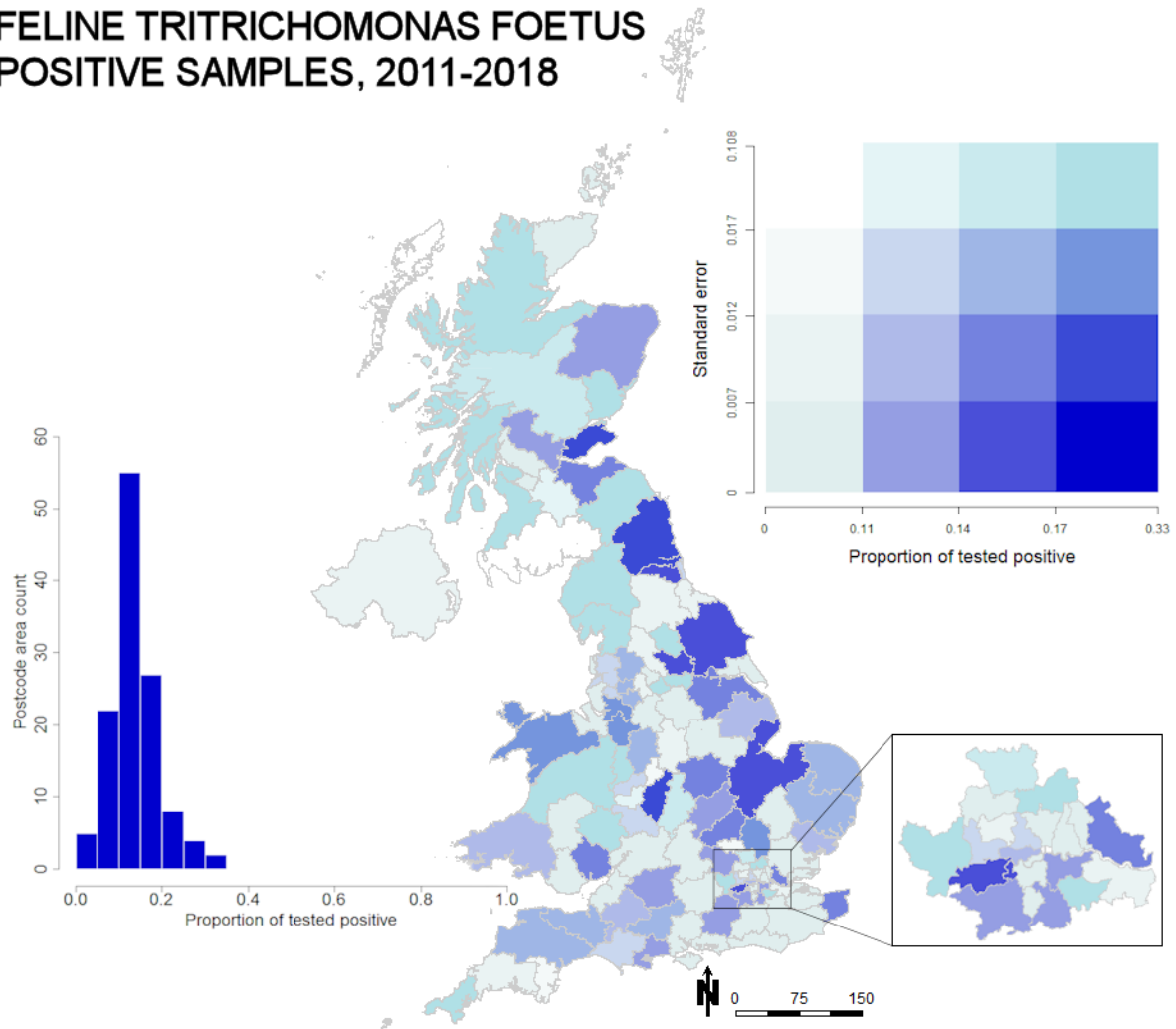


Figure 4: Postcode area quintile bivariate map summary of the proportion of feline faecal sample submissions which tested positive by PCR assay for presence of *T.foetus*, modelled against standard error to account for variable UK surveillance coverage. Samples tested between 2011 and 2018 were used, summarising data provided by four UK-based veterinary diagnostic laboratories. Postcode of the submitting veterinary practice site was used in this summary.

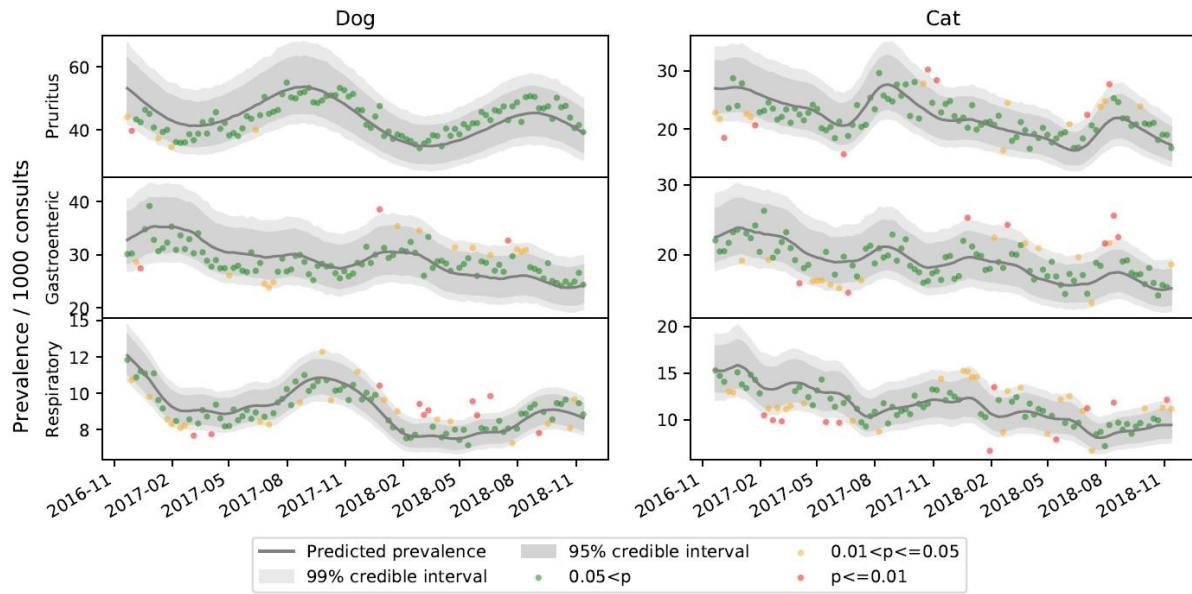


Fig 5: Observed prevalence for pruritus, gastroenteritis and respiratory disease in cats and dogs attending SAVSNET-participating practices from November 2016 to November 2018. Red points represent the extreme outliers (outside the 99 per cent credible interval [CI]), orange points represent the moderate outliers (outside the 95 per cent CI but within the 99 per cent CI), and green points represent the average trend (within the 95 per cent CI).

References

- ARSEVSKA, E., SINGLETON, D., SANCHEZ-VIZCAINO, F., WILLIAMS, N., JONES, P. H., SMYTH, S., HEAYNS, B., WARDEH, M., RADFORD, A. D., DAWSON, S., NOBLE, P. J. M. & DAVIES, R. H. (2017) Small animal disease surveillance: GI disease and salmonellosis. *Vet Rec* 181, 228-232
- ARSEVSKA, E., SINGLETON, D. A., JEWELL, C., PATERSON, S., JONES, P. H., SMYTH, S., BRANT, B., DAWSON, S., NOBLE, P. J. M., SANCHEZ-VIZCAINO, F. & RADFORD, A. D. (2018) Small animal disease surveillance: pruritus and *Pseudomonas* skin infections. *Vet Rec* 183, 182-187
- GOOKIN, J. L., HANRAHAN, K. & LEVY, M. G. (2017) The conundrum of feline Trichomonosis. *Journal of Feline Medicine and Surgery* 19, 261-274
- GRUFFYDD-JONES, T., ADDIE, D., BELAK, S., BOUCRAUT-BARALON, C., EGBERINK, H., FRYMUS, T., HARTMANN, K., HOSIE, M. J., LLORET, A., LUTZ, H., MARSILIO, F., MOSTL, K., PENNISI, M. G., RADFORD, A. D., THIRY, E., TRUYEN, U. & HORZINEK, M. C. (2013) Tritrichomoniasis in cats: ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery* 15, 647-649
- GUNN-MOORE, D. A., MCCANN, T. M., REED, N., SIMPSON, K. E. & TENNANT, B. (2007) Prevalence of *Tritrichomonas foetus* infection in cats with diarrhoea in the UK. *J Feline Med Surg* 9, 214-218
- MONTGOMERY, M. P., ROBERTSON, S., KOSKI, L., SALEHI, E., STEVENSON, L. M., SILVER, R., SUNDARARAMAN, P., SINGH, A., JOSEPH, L. A., WEISNER, M. B., BRANDT, E., PRARAT, M., BOKANYI, R., CHEN, J. C., FOLSTER, J. P., BENNETT, C. T., FRANCOIS WATKINS, L. K., AUBERT, R. D., CHU, A., JACKSON, J., BLANTON, J., GINN, A., RAMADUGU, K., STANEK, D., DEMENT, J., CUI, J., ZHANG, Y., BASLER, C., FRIEDMAN, C. R., GEISSLER, A. L., CROWE, S. J., DOWELL, N., DIXON, S., WHITLOCK, L., WILLIAMS, I., JHUNG, M. A., NICHOLS, M. C., DE FIJTER, S. & LAUGHLIN, M. E. (2018) Multidrug-Resistant *Campylobacter jejuni* Outbreak Linked to Puppy Exposure - United States, 2016-2018. *MMWR Morb Mortal Wkly Rep* 67, 1032-1035
- NATHWANI, D., MCINTYRE, P. G., WHITE, K., SHEARER, A. J., REYNOLDS, N., WALKER, D., ORANGE, G. V. & FOOKS, A. R. (2003) Fatal human rabies caused by European bat Lyssavirus type 2a infection in Scotland. *Clin Infect Dis* 37, 598-601
- PARSONS, B. N., CODY, A. J., PORTER, C. J., STAVISKY, J. H., SMITH, J. L., WILLIAMS, N. J., LEATHERBARROW, A. J., HART, C. A., GASKELL, R. M., DINGLE, K. E. & DAWSON, S. (2009) Typing of *Campylobacter jejuni* isolates from dogs by use of multilocus sequence typing and pulsed-field gel electrophoresis. *J Clin Microbiol* 47, 3466-3471
- PAYNE, P. A. & ARTZER, M. (2009) The biology and control of *Giardia* spp and *Tritrichomonas foetus*. *Veterinary Clinics: Small Animal Practice* 39, 993-1007
- PHE (2018) Health protection report volume 12, issue 33.
<https://www.gov.uk/government/publications/health-protection-report-volume-12-2018Access>, 2018
- SÁNCHEZ-VIZCAÍNO, F., JONES, P. H., MENACERE, T., HEAYNS, B., WARDEH, M., NEWMAN, J., RADFORD, A. D., DAWSON, S., GASKELL, R., NOBLE, P. J. M., EVERITT, S., DAY, M. J. & MCCONNELL, K. (2015) Small animal disease surveillance. *Veterinary Record* 177, 591-594
- SANCHEZ-VIZCAINO, F., NOBLE, P. M., JONES, P. H., MENACERE, T., BUCHAN, I., REYNOLDS, S., DAWSON, S., GASKELL, R. M., EVERITT, S. & RADFORD, A. D. (2017) Demographics of dogs, cats, and rabbits attending veterinary practices in Great Britain as recorded in their electronic health records. *BMC Vet Res* 13, 218

SINGLETON, D. A., SANCHEZ-VIZCAINO, F., ARSEVSKA, E., DAWSON, S., JONES, P. H., NOBLE, P. J. M., PINCHBECK, G. L., WILLIAMS, N. J. & RADFORD, A. D. (2018) New approaches to pharmacosurveillance for monitoring prescription frequency, diversity, and co-prescription in a large sentinel network of companion animal veterinary practices in the United Kingdom, 2014-2016. *Prev Vet Med* 159, 153-161

SINGLETON, D. A., SANCHEZ-VIZCAINO, F., DAWSON, S., JONES, P. H., NOBLE, P. J. M., PINCHBECK, G. L., WILLIAMS, N. J. & RADFORD, A. D. (2017) Patterns of antimicrobial agent prescription in a sentinel population of canine and feline veterinary practices in the United Kingdom. *Vet J* 224, 18-24

XENOULIS, P. G., LOPINSKI, D. J., READ, S. A., SUCHODOLSKI, J. S. & STEINER, J. M. (2013) Intestinal *Tritrichomonas foetus* infection in cats: a retrospective study of 104 cases. *Journal of Feline Medicine and Surgery* 15, 1098-1103