



Antimicrobial resistance in companion animals: trends, threats and takeaways

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Summary

Antimicrobial resistance (AMR) in companion animals is increasingly recognised as a threat to both animal and public health within the One Health framework. Although extensive research and surveillance initiatives have focused on AMR in humans and food-producing animals, comparatively limited attention has been given to companion animals, despite their close contact with people and potential role in transmission of antimicrobial-resistant organisms. This article synthesises current knowledge on AMR in dogs, cats and other companion species, highlighting patterns of resistance, surveillance initiatives across different regions and temporal trends in prevalence. The article further examines clinical implications of AMR for companion animal medicine based on available data, as well as the potential for interspecies transmission, and discusses important risk factors.

Keywords

Antimicrobial resistance – Companion animals – *Escherichia coli* – Methicillin-resistant – One Health – Raw meat-based diets – *Staphylococcus pseudintermedius* – Surveillance.

Required citation

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Introduction

Antimicrobial resistance (AMR) is one of the most pressing global health challenges of the 21st century. According to the 2021 Global Burden of Disease study, bacterial AMR was linked to 4.71 million deaths globally that year, with 1.14 million directly attributable to resistant infections [1].

While the literature on AMR in companion animals is increasing, companion animals remain under-represented in coordinated surveillance systems and policy initiatives, particularly when contrasted with livestock. These animals live in close proximity to humans, which creates opportunities for bidirectional exchange of resistant organisms and genes. Furthermore, antimicrobials are commonly prescribed in companion animal veterinary practice for the treatment of bacterial infections, including agents that are also classified as critically important for human medicine. Bacteria such as methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) and extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli* are increasingly reported in dogs and cats, often linked to recent antimicrobial exposure. Concomitantly, robust data on AMR dynamics and surveillance in this population are limited [2].

This article provides a concise overview of the current knowledge on AMR in companion animals, summarising existing surveillance efforts, prevalence and trends, clinical implications, zoonotic risks, and the factors associated with the occurrence of AMR and antimicrobial-resistant organisms (AROs) in this population.

Current trends and prevalence of antimicrobial resistance and antimicrobial-resistant organisms in dogs and cats

Data landscape: where are data coming from?

Data on AMR in dogs and cats remain patchy and potentially biased, as most available information is derived from diagnostic submissions, which often reflect chronic or recurrent infections or cases in which microbiological testing was clinically indicated [3]. Similar biases are also common in human AMR surveillance efforts. These data provide only a partial view of the resistance landscape, omitting cases of asymptomatic carriage that may play a key role in household-level transmission.

Existing surveillance efforts typically include dogs and, less frequently, cats (see [Supplementary materials](#)). Exotic companion animals, small mammals, shelter animals and stray populations are virtually absent. There is also limited standardisation in antimicrobial susceptibility testing methodologies, with variability in the use of standards and inconsistent definitions of multidrug resistance (MDR). This hampers the comparability of data across labs and countries.

Relevant sources of companion animal AMR data include national and regional surveillance programmes as well as peer-reviewed literature that summarises diagnostic submissions.

Surveillance programmes

Surveillance of AMR in companion animals has expanded worldwide, although their inclusion in coordinated national surveillance frameworks remains limited [2]. Across Europe, several programmes increasingly capture AMR data from dogs and cats ([Table 1](#)), monitoring pathogens such as *E. coli*, *Staphylococcus pseudintermedius* (SP) and MRSP, often with linkage to data on antimicrobial use. In addition, the European Antimicrobial Resistance Surveillance Network in Veterinary Medicine [4], currently under development, aims to establish a harmonised EU-wide framework for AMR surveillance in diseased animals, including dogs and cats. The Antimicrobial Resistance Surveillance Network for Pets [5] of the People's Republic of China provides one of the most comprehensive national datasets, offering an accessible online database of AMR trends in dogs and cats. In the United States of America and Canada, companion animals have historically been excluded from national surveillance frameworks; however, new initiatives are emerging, including a pilot programme within the Veterinary Laboratory Investigation and Response Network under the National Action Plan for

Combating Antibiotic-Resistant Bacteria in the USA and the development of Canada's Antimicrobial Resistance Network to integrate susceptibility testing data across sectors, including companion animals ([Table 1](#)). Despite these advances, large areas of the world, including much of Africa, Latin America and the Middle East and parts of Asia, remain poorly represented in formal companion animal AMR surveillance [6].

Escherichia coli

What is the situation in clinical isolates from dogs and cats?

Overall, third-generation cephalosporin (3GC) resistance in clinical *E. coli* from companion animals (mostly from urinary tract infections [UTIs]) varies significantly according to region [7]: ~5% in Northern Europe, 5–10% in Australia, 12–17% in the USA and Canada, >25% in Southern Europe, 42–45% in East Asia, 21% in Brazil, 37% in Argentina and up to 70% in Mexico. There is little 3GC data coming from Africa. Resistance levels appear to be stable when inspecting rates published in 2010–2025, although this evaluation was not within the scope of the present study ([Fig. 1](#); [Supplementary materials](#)).

Denmark, Finland, Germany and France report low 3GC resistance (~0–5%, 7–10%, ~3–4% and ~8%, respectively). In contrast, Southern European countries bear a higher AMR burden, with 3GC resistance rates in *E. coli* from UTIs consistently exceeding 20% in Spain, Portugal and Italy ([Fig. 1](#); [Supplementary materials](#)). In the USA, 3GC resistance ranged from 4.5% to 14% in 2008–2013 and averaged 16.5% in 2019–2021 [8,9]. In Australia, a nationwide survey of clinical *E. coli* (2013–2014) from dogs and cats estimated ~10% resistance to 3GCs in dogs and 5–6% in cats [10]. In New Zealand, canine UTI isolates tested between 2010 and 2012 demonstrated 11.8% resistance to cefovecin [11].

Resistance burdens in low- and middle-income countries and some Asian countries are comparatively higher. In Asia, resistance to 3GCs in *E. coli* from dogs with UTIs is high, with rates exceeding 30% in Thailand, 42–45% in the Republic of Korea and ~18–20%

in HKSAR¹ [12-14]. In Brazil, 20.9% of extra-intestinal *E. coli* isolates from treated dogs were ESBL producers, most carrying *bla*_{CTX-M-15} [15]. In Colombia (2018–2019), 6.6% ESBL-producing urinary isolates were detected [16], while in Argentina, 37% of clinical *E. coli* isolates from dogs and cats were resistant to 3GCs, mostly from urine (80%) [17]. Resistance against 3GC in the People's Republic of China was >50% in 2012–2017, with recent data (2018–2021) indicating lower but still concerning rates [5].

What about healthy dogs?

Antimicrobial-resistant *E. coli* are also detected in apparently healthy dogs and cats. In low-resistance settings, healthy companion animals with no recent antimicrobial exposure typically show low phenotypic resistance and an absence of major zoonotic pathogens, including ESBL-producing *E. coli*. Nonetheless, clinically relevant resistance mechanisms can occur at low frequency; for example, AmpC (*bla*_{CMY-2})-producing *E. coli* have been identified in healthy dogs, indicating community circulation of resistance genes independent of antimicrobial administration [18].

Diseased animals typically exhibit higher AMR levels than healthy counterparts, likely reflecting antimicrobial exposure and healthcare-associated selection [18,19]. Overall, while disease status is a major determinant of resistance prevalence, the role of healthy companion animals as community reservoirs of AMR is not fully comprehended, nor are the drivers for AMR presence in this population. Interestingly, the roles of diet and previous healthcare exposure in colonisation by AROs are increasingly recognised, as detailed below.

What about zoonotic potential?

There is genetic similarity of resistant *E. coli* strains between humans and companion animals at the country level, reflecting regional variability and supporting theories of bidirectional transmission or exposure to common sources [20]. Carriage rates of ESBL-producing *E. coli* in Europe are approximately 6% in dogs and 5% in cats – levels comparable to those reported for human faecal colonisation [7]. While transmission

1. HKSAR: Hong Kong, Special Administrative Region of the People's Republic of China.

epidemiology will likely vary among individual strains and settings, most documented transmission events involving clinically relevant and antimicrobial-resistant *E. coli* appear to occur from humans to animals. This is consistent when crossing the distinct profiles of antimicrobial use between species and the type of strains circulating in both populations. For example, carbapenems are not approved for veterinary use in nearly all parts of the world, yet carbapenem-resistant Enterobacteriaceae (CRE), including *E. coli* and *Klebsiella pneumoniae*, have been detected in both clinical cases and asymptomatic companion animals [20]. These findings support the hypothesis that CRE in companion animals are primarily acquired from human sources, rather than emerging independently in animal populations. However, once introduced, CRE can be detected within veterinary settings, with evidence of spread within veterinary facilities where carbapenems are not routinely used [21].

Extra-intestinal pathogenic *E. coli* (ExPECs) cause the majority of antimicrobial-resistant *E. coli* infections in humans worldwide, including bloodstream and UTIs, and are dominated by high-risk lineages such as ST131, ST69, ST405 and ST410 ([Table I](#)). Many of these same lineages are also encountered in companion animals. There is an overall dominance of ST372, which remains antimicrobial-susceptible. Although transmission dynamics are complex, household studies demonstrate that ExPECs can be shared between humans and companion animals, with phylogenetically indistinguishable strains persisting within households for years. Notably, sequence type ST131, the predominant human ExPEC pandemic lineage, is detected among ESBL-producing *E. coli* from dogs and cats, accounting for approximately 10–40% of resistant isolates [22]. Close contact between humans and companion animals in household and veterinary settings may facilitate cross-species sharing of ST131 strains, as supported by documented household- and clinic-associated transmission events [23,24]. Importantly, the distribution of CTX-M types in ST131 from companion animals typically mirrors that of humans in the same region, supporting the spillover role of dogs [25]. Nevertheless, transmission dynamics of other strains such as ST372 (canine-associated) and ST410 (a recognised One Health clone) are not fully comprehended [26].

Staphylococcus pseudintermedius

What is the situation in clinical isolates from dogs and cats?

Surveillance data from multiple countries show wide variation in the isolation rates of MRSP in companion animals ([Fig. 2](#); [Supplementary materials](#)), with rates ranging from

4.5% in Finland to 86% in South Africa, and higher in SP from cats than dogs. MRSP show several epidemic clones. ST71 is widespread in Europe and associated with MDR and nosocomial spread [27]. ST45 is another frequent clone in companion animals and occasionally humans.

Globally, MRSP prevalence and clonal dominance have shown dynamic shifts. While ST71 remains widespread, it is gradually being replaced by ST258 in regions like Northern Europe [27]. Other emerging clones include ST123 in Portugal and ST496, originally described in Australia but now reported in Europe [20,27,28]. In the USA and Canada, the once-dominant ST68 has been largely replaced by a more diverse array of clones, such as ST45, ST155, ST181, ST496 and ST551. While these shifts may reflect antimicrobial selective pressures and local prescribing practices, declines of dominant clones without a clear replacement warrant further investigation, particularly since displaced strains were often multidrug resistant.

In cats with clinical signs of infection, SP is far less prevalent than in dogs but is nonetheless identified as an opportunistic pathogen. High-risk MRSP clones such as ST71 and ST551, both associated with broad resistance and zoonotic potential, were detected primarily in cats with clinical disease [29].

What about healthy dogs and cats?

Colonisation of healthy dogs with SP is common, with reported rates ranging from 37% to 92%, especially in the nasal cavity, oral mucosa and perineum. MRSP are less prevalent in healthy dogs and cats (0–4.5%) than in their clinical counterparts, and less prevalent in cats than dogs [30].

What about clinical relevance?

The clinical relevance of MRSP compared to methicillin-susceptible SP (MSSP) is related to therapeutic challenges posed by MDR associated with MRSP. In terms of clinical outcome of infections, mortality and morbidity does not differ significantly between MRSP and MSSP, suggesting that MRSP is not intrinsically more virulent when appropriate treatment is implemented [31]. Yet therapeutic challenges arise because MRSP isolates are frequently resistant to multiple antimicrobial classes, limiting empirical treatment options [27]. As a result, timely culture and susceptibility testing are critical for guiding effective therapy.

A multicentre case–control study compared dogs with MRSP and MSSP infections, most commonly presenting with pyoderma or otitis [31]. Recent antimicrobial exposure was the strongest risk factor for MRSP, highlighting the role of prior empirical therapy in resistance selection. In terms of clinical outcomes, mortality and morbidity did not differ significantly between MRSP and MSSP infections.

What about zoonotic potential?

Transmission of MRSP occurs readily within households with multiple companion animals and in veterinary settings, facilitated by direct contact and contaminated environments [32]. Human colonisation with MSSP is also common, indicating that transmission is not restricted to MRSP strains alone.

Transmission of SP between animals and humans has been reviewed in detail in two literature reviews [20,33]. Although human infections remain relatively uncommon compared to those caused by methicillin-resistant *Staphylococcus aureus*, they are increasingly reported and can present as wound infections, surgical site infections, or more invasive disease in immunocompromised individuals. The genomic similarity of SP isolates from canine and human hosts highlights SP's capacity for cross-species transmission. The magnitude of effect sizes is yet to be determined, but it will likely be dependent on pathogen genomics.

Transmission of MRSP to humans is strongly associated with close contact with colonised or infected dogs, particularly when animals are affected by pyoderma or otitis, which increase bacterial shedding. Infected or colonised dogs can continue to carry MRSP for weeks after clinical resolution, prolonging the period of risk for owners and facilitating environmental contamination within households. Veterinary clinics also represent an important setting for interspecies transmission: MRSP-naïve dogs have been shown to acquire the pathogen during hospitalisation, while veterinary staff and clinic environments act as secondary reservoirs. Notably, several high-risk MRSP clones, such as ST71 in Europe, ST181 in the USA, and the emerging multidrug-resistant ST496, have been implicated in both canine and human infections, raising concern for sustained global dissemination and zoonotic spillover [27,34]. Details on other AROs and exotic companion animals are provided in the [Supplementary materials](#).

Risk factors, diet and antimicrobial resistance

In addition to antimicrobial exposure, other drivers contribute to the emergence and persistence of AMR in companion animals. Environmental contamination and household

transmission play a significant role, particularly when humans have been exposed to antimicrobials or are colonised with AROs [20]. Other contributors include inadequate infection control in veterinary hospitals, high-density living environments such as shelters, and international travel or companion animal trade, which may introduce resistant strains across borders [35]. Veterinary clinics and hospitals represent important settings for the acquisition and dissemination of AROs in companion animals. Multiple outbreak investigations and observational studies have demonstrated nosocomial transmission of ESBL-producing Enterobacterales and methicillin-resistant staphylococci (including MRSP) between hospitalised animals, veterinary staff and contaminated environmental surfaces [36-38]. Hospitalisation has been identified as an important risk factor for colonisation with multidrug-resistant *E. coli* and *K. pneumoniae*. Several studies have documented acquisition or detection of ESBL-producing Enterobacterales during veterinary hospital stays, with resistant strains persisting for weeks to months after discharge in a subset of animals [36,38]. Importantly, prolonged carriage following hospitalisation creates opportunities for introduction of these organisms into household environments, where onward transmission to humans or environmental reservoirs has been documented [39]. Together, these findings suggest that veterinary hospitals may contribute to the maintenance and dissemination of resistant bacteria beyond the clinical setting, particularly when colonisation persists after discharge.

Furthermore, the feeding of raw meat-based diets (RMBDs) to companion animals has emerged as a hot topic of discussion when it comes to drivers of AMR in companion animals. Unlike processed foods for companion animals, RMBDs do not involve cooking, pasteurisation or other pathogen-reducing treatments, making them a potential source of transmission of both pathogenic and multidrug-resistant bacteria to companion animals and their human caregivers. Nearly 70% of RMBD samples may exceed European Union microbiological standards for Enterobacterales, and >60% may carry AROs, including ESBL producers [40]. Dogs fed raw diets are nearly three times as likely to shed antimicrobial-resistant *E. coli* in their faeces [40]. This carriage will be relevant from a public health standpoint given the characteristics of household transmission as well as direct human exposure through direct handling of food.

Current knowledge gaps and research priorities in companion animal antimicrobial resistance

Despite increasing AMR literature in companion animals, important gaps persist. Current surveillance is geographically uneven, with limited or no structured data from large parts

of Africa, Latin America, the Middle East and Asia, constraining global risk assessment. Even within regions with established programmes, data are often derived from diagnostic submissions, resulting in heterogeneity in study populations, laboratory methods and interpretative criteria, which limits cross-study and cross-country comparability.

From a One Health perspective, surveillance and interspecies transmission dynamics of frequent animal ExPEC clones (e.g. ST372, ST41, ST73) remain important gaps, as these organisms can become antimicrobial resistant. Similarly, further efforts should be put into investigating transmission dynamics of MRSP between dogs and humans. Finally, targeted studies evaluating the effectiveness of infection prevention and control measures in veterinary clinics, as well as interventions aimed at reducing household transmission, are important gaps.

Conclusion

While the role of companion animals in AMR has received relatively little attention, a survey of literature offers insights into patterns of resistance and prevalence trends, clinical implications, transmission dynamics and risk factors. Among key findings, surveillance data reveal considerable regional variability in 3GC resistance and MRSP prevalence in companion animals, while resistance levels appear relatively stable at a global level. For Gram-negative bacteria, resistance levels in companion animals tend to mimic those of human bacteria in the same areas, demonstrating their role as sentinels and potential reservoirs of AMR. In addition, there is evidence of shifts in bacterial population structures, as emerging MRSP clones replace previously dominant lineages. Companion animals may also harbour methicillin-resistant *S. aureus*, overlapping with strains circulating in humans; however, available evidence suggests that colonisation in companion animals is often transient.

Clinically, the presence of MRSP limits therapies by reducing first-line treatment options. There is little evidence supporting worse clinical outcomes when appropriate therapies have been implemented. Finally, concerning risk factors, RMBDs have emerged as an important potential driver of AMR in companion animals. The feeding of contaminated foods as part of RMBDs increases risk of companion animal colonisation with AROs, which may, in turn, increase the likelihood of household transmission of high-risk clones. Taken together, these findings demonstrate the integral role of companion animals in AMR and highlight the importance of including them in coordinated surveillance systems and policy initiatives.

Résistance aux antimicrobiens chez les animaux de compagnie : tendances, menaces et points à retenir

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Résumé

La résistance aux antimicrobiens (RAM) chez les animaux de compagnie est de plus en plus reconnue comme une menace pour la santé animale et la santé publique dans le cadre de l'approche « Une seule santé ». Si la RAM chez l'humain et chez les animaux servant à la production de denrées alimentaires a fait l'objet de nombreux travaux de recherche et initiatives de surveillance, l'attention accordée à cette question chez les animaux de compagnie a été relativement limitée, alors même qu'ils sont en contact étroit avec les personnes et qu'ils peuvent jouer un rôle dans la transmission de micro-organismes résistants aux antimicrobiens. Les auteurs font le point sur les connaissances actuelles en matière de RAM chez le chien, le chat et d'autres espèces d'animaux de compagnie, en soulignant les profils de résistance, les initiatives de surveillance mises en place dans différentes régions et les tendances ressortant de l'évolution de la prévalence dans le temps. L'article examine également les conséquences cliniques de la RAM pour la médecine vétérinaire des animaux de compagnie à partir des données disponibles, ainsi que le potentiel de transmission inter-espèces, et analyse les facteurs de risque importants.

Mots-clés

Alimentation à base de viande crue – Animaux de compagnie – *Escherichia coli* – Résistance à la méthicilline – Résistance aux antimicrobiens – *Staphylococcus pseudintermedius* – Surveillance – Une seule santé.

Resistencia a los antimicrobianos en animales de compañía: tendencias, amenazas y conclusiones

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Resumen

La resistencia a los antimicrobianos (RAM) en los animales de compañía se reconoce cada vez más como una amenaza tanto para la sanidad animal como para la salud pública en el marco del enfoque «Una sola salud». Si bien se han implementado numerosas iniciativas de investigación y vigilancia centradas en la RAM en los seres humanos y los animales destinados a la producción de alimentos, la atención que se ha prestado a los animales de compañía es relativamente limitada, a pesar del estrecho contacto que mantienen con las personas y su posible papel en la transmisión de organismos resistentes a los antimicrobianos. Este artículo sintetiza los conocimientos actuales sobre la RAM en perros, gatos y otras especies de animales compañía, destacando patrones de resistencia, iniciativas de vigilancia aplicadas en diferentes regiones y tendencias temporales en la prevalencia. También examina las implicaciones clínicas de la RAM para la medicina de animales de compañía, basándose en los datos disponibles, así como el potencial de transmisión entre especies, y analiza los factores de riesgo importantes.

Palabras clave

Animales de compañía – Dietas a base de carne cruda – *Escherichia coli* – Resistencia a los antimicrobianos – Resistente a la meticilina – *Staphylococcus pseudintermedius* – Una sola salud – Vigilancia.

Supplementary materials

Supplementary materials associated with this article are available online at the following link: <https://data.mendeley.com/datasets/5dggz3yyzv/1>.

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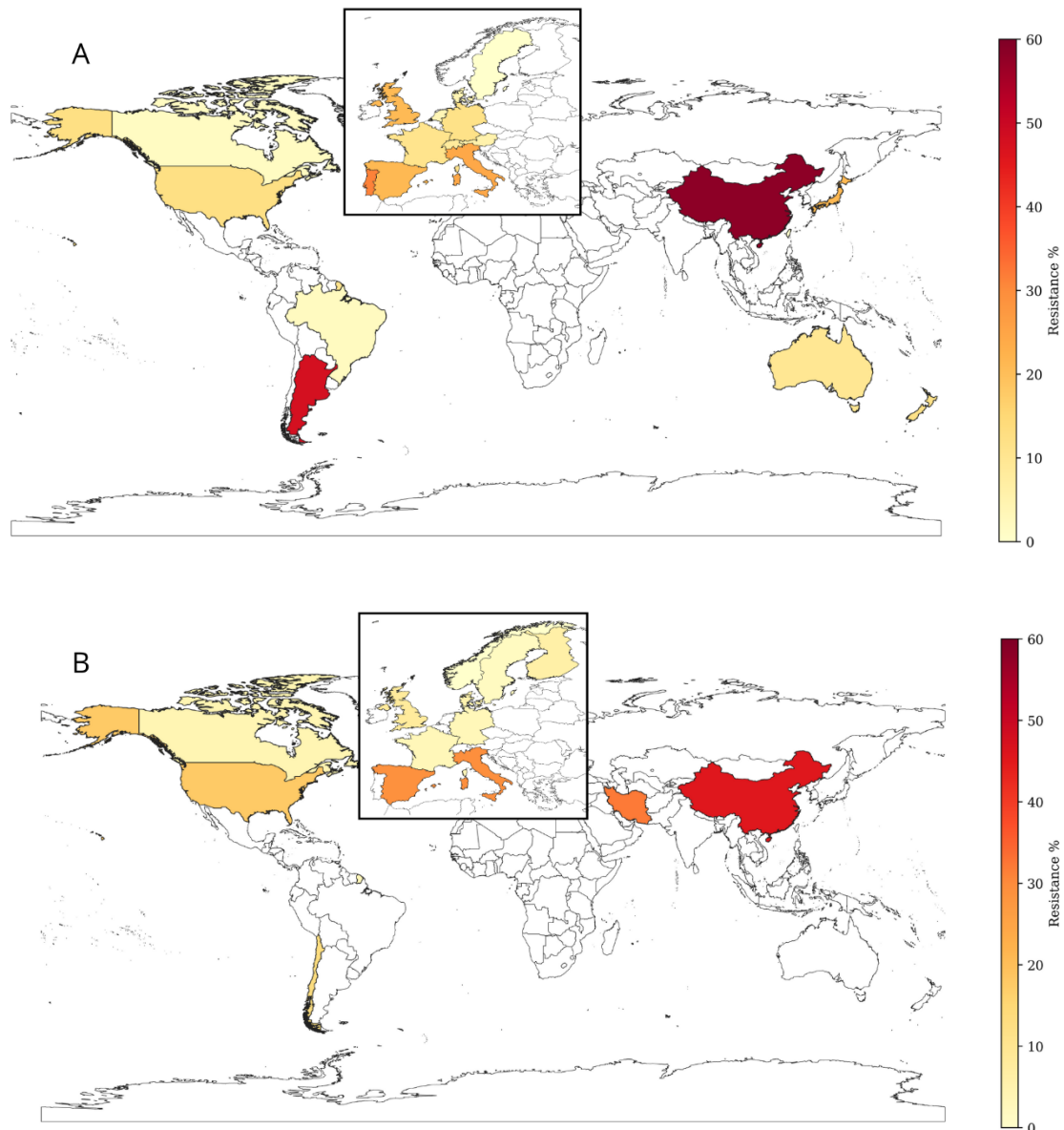
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Table I**Extended-spectrum beta-lactamase-producing *Escherichia coli* sequence types from clinical samples of companion animals**

Country/region	Relevant STs	Notes	References
Global	ST131, ST38, ST68, ST405, ST617, ST648	High diversity of STs across continents; ST131 and ST38 widespread in companion animals; evidence suggests potential human–companion animal exchange and household transmission	[7]
Australia	ST131 and others	ST131 present in companion animal infections; evidence of human-associated lineages in companion animals	[41]
Japan	ST131	ST131 constitutes a large fraction of clinical ESBL <i>E. coli</i> in dogs/cats	[7]
Chinese Taipei and China (People’s Rep. of)	ST131, ST38 and others	Hospital and community-associated circulation reported; both clinical and faecal samples show ESBL carriage	[7,22]
Brazil	B2 phylogroup and ST131 reported	Studies report ESBL and MDR in clinical infections	[15]
France	ST131/B2 phylogroup lineages	Overlap with human ExPEC lineages	[42]
United States of America	ST131 and others	ST131-associated CTX-M-15 emerged in the mid-2000s in human clinical isolates and has been detected in companion animals in later studies	[7]

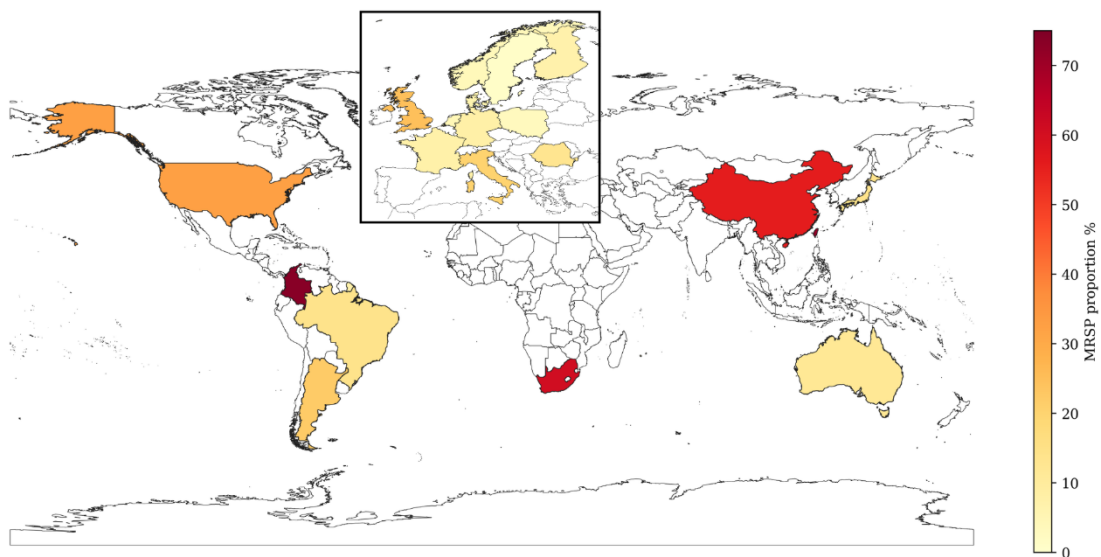
ESBL: extended-spectrum beta-lactamase
ExPEC: extra-intestinal pathogenic *Escherichia coli*
MDR: multidrug resistance
ST: sequence type



For details on the methodology, consult the [Supplementary materials](#).

Figure 1

Reported third-generation cephalosporin resistance in *Escherichia coli* clinical isolates predominantly from urinary tract infections in companion animals (predominantly dogs) worldwide, 2000–2016 (A) and 2016–2025 onwards (B)



MRSP: methicillin-resistant *Staphylococcus pseudintermedius*

For details on the methodology, consult the [Supplementary materials](#).

Figure 2

Prevalence of methicillin-resistant *Staphylococcus pseudintermedius* in clinical isolates from companion animals worldwide