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Current Situation of Antimicrobial-Resistant Bacteria in Companion Animals and the One Health Approach

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One Health in AMR



Japan Nosocomial Infections Surveillance (**JANIS**)

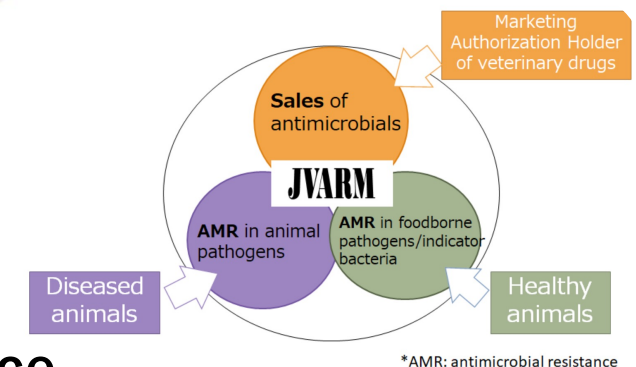
Ministry of Health, Labour and Welfare, Japan



- Livestock
- Aquatic animals
- Companion animals

Japanese Veterinary Antimicrobial Resistance Monitoring System (**JVARM**)

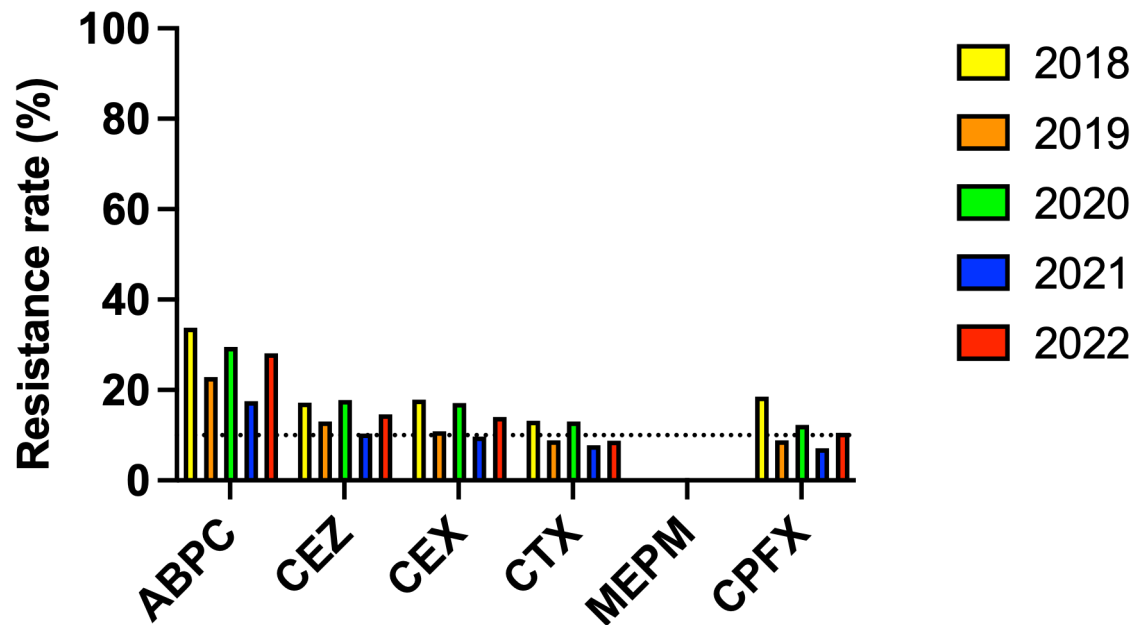
Ministry of Agriculture, Forestry and Fisheries, Japan



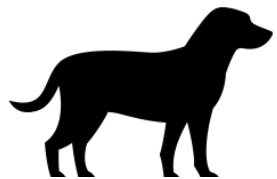
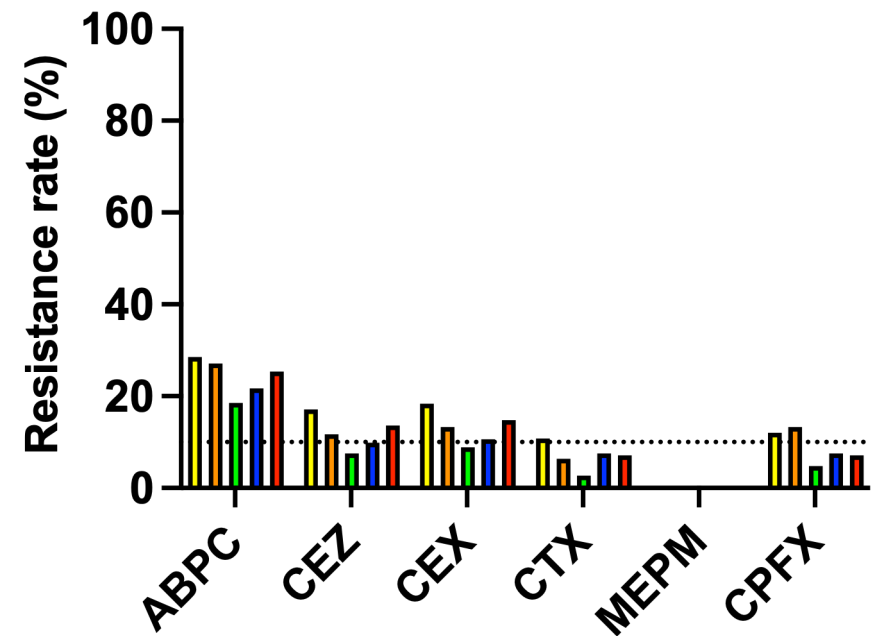
Antimicrobial susceptibility of *E. coli* in healthy companion animals, Japan

JVARM

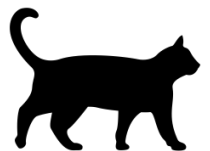
E. coli (healthy dogs)



E. coli (healthy cats)



Cephalosporin-R : 7-15%
Fluoroquinolone-R : 7-10%

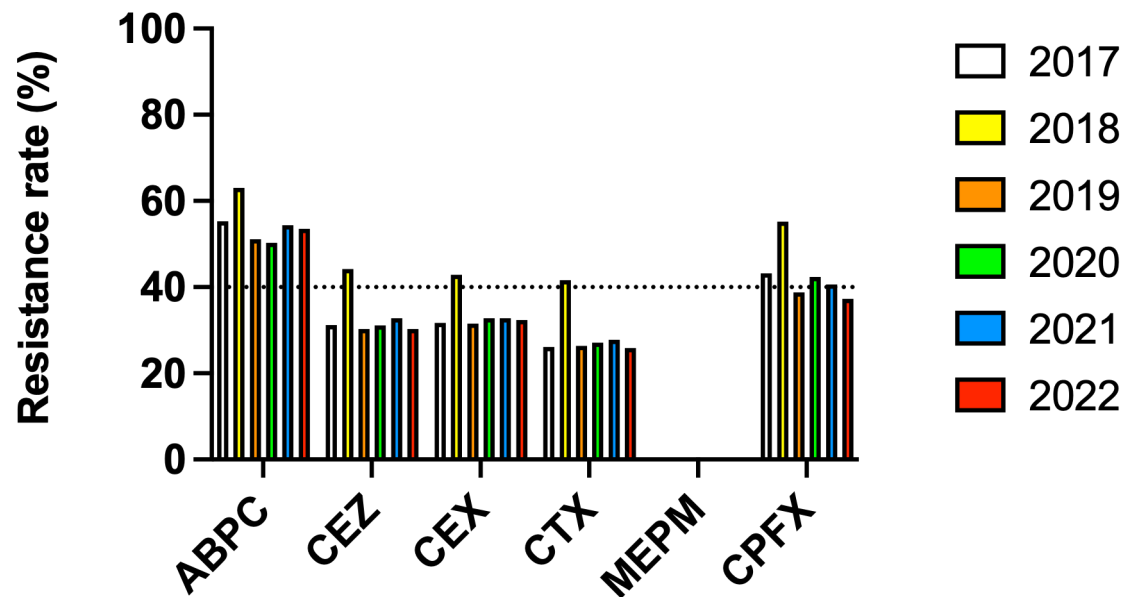


Antimicrobial susceptibility of *E. coli* in diseased companion animals, Japan

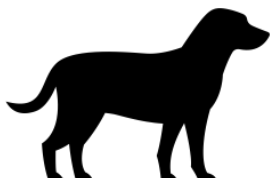
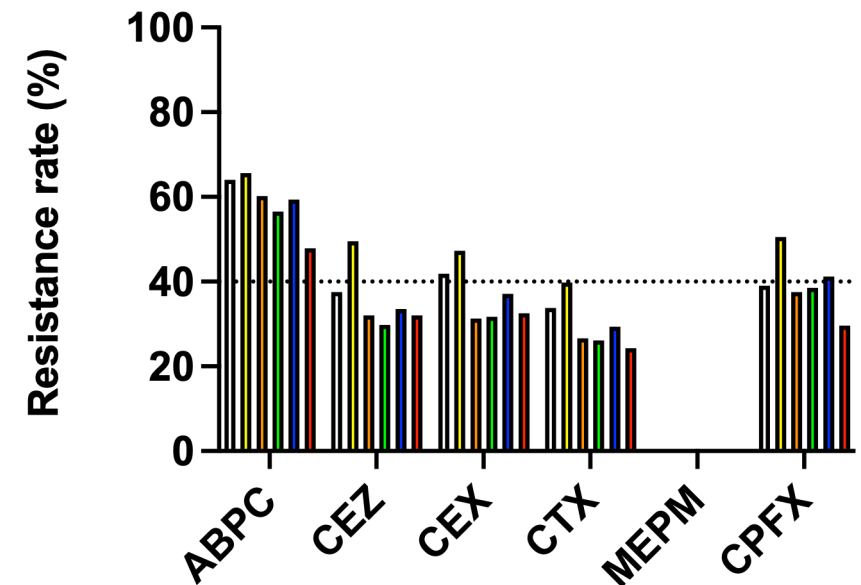
Only tell the antimicrobial susceptibilities by JVARM

JVARM

E. coli (Diseased dogs)



E. coli (Diseased cats)



Healthy

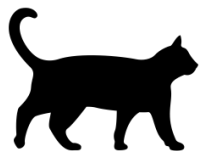
Cephalosporin-R : 7-15% vs

Fluoroquinolone-R : 7-10% vs

Diseased

24-33%

30-37%



Molecular epidemiology of antimicrobial resistance within a One Health framework

<Our Mission>

- To complement the national AMR monitoring.
- To evaluate the detail of the AMR and compared between companion animals and those from humans.
- To assess the risk of transmission of AMR between humans and companion animals.
- To contribute to risk assessment of health impacts on humans and companion animals.



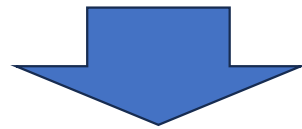
Strengthen AMR control efforts



Molecular epidemiology of antimicrobial resistance within a One Health framework

<Our focus>

- Fluoroquinolone-resistant *E. coli*
- Carbapenem non-susceptible *Pseudomonas aeruginosa*
- Cephalosporin-resistant *Klebsiella pneumoniae*



Strengthen AMR control efforts



Molecular epidemiology of antimicrobial resistance within a One Health framework

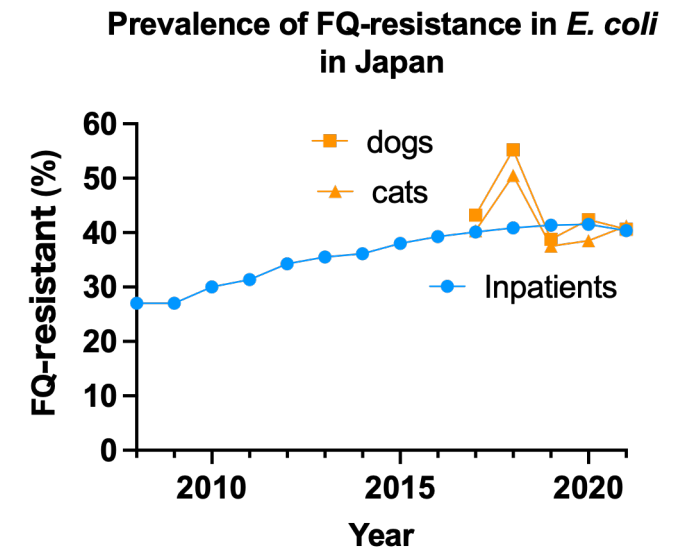
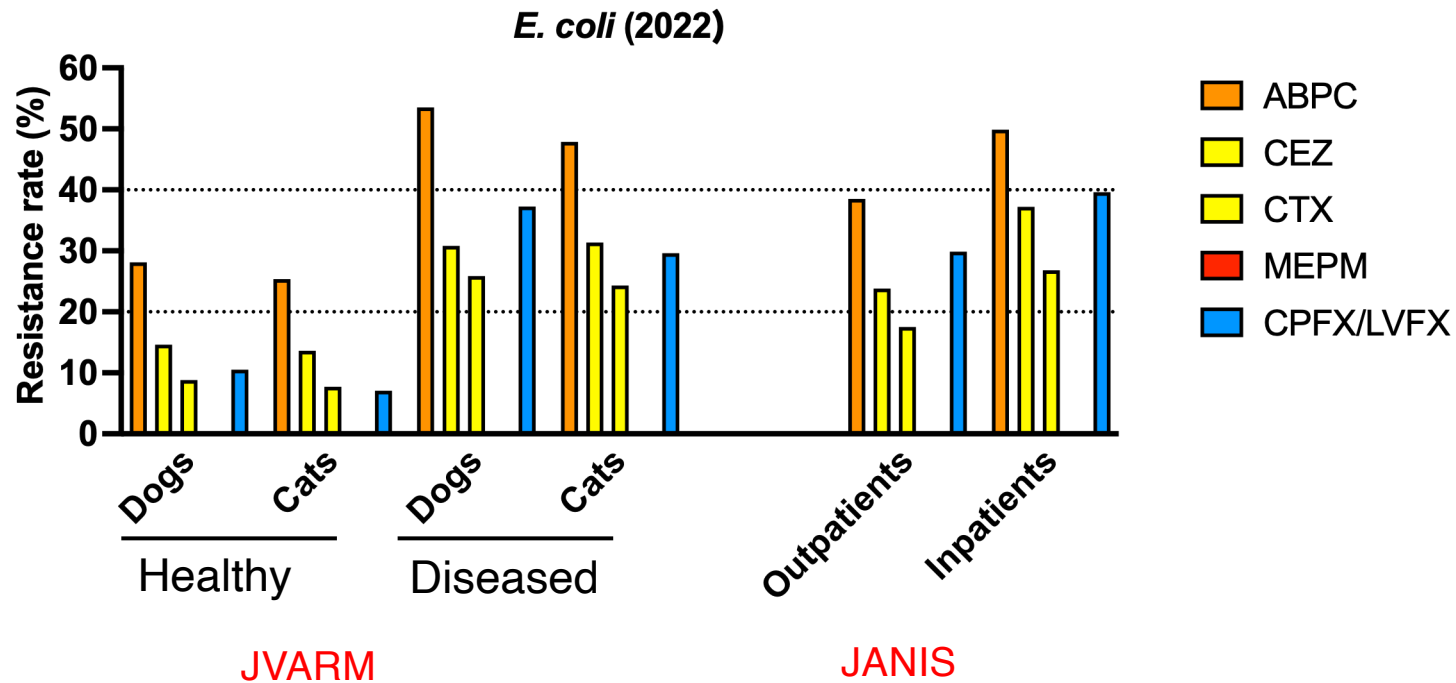
<Our focus>

Fluoroquinolone(FQ)-resistant *E. coli*

D4: Aiko Maeda

E. coli : Causes urinary tract infection and blood stream infection etc
in humans and companion animals

AMR rates of *E. coli* in Japan

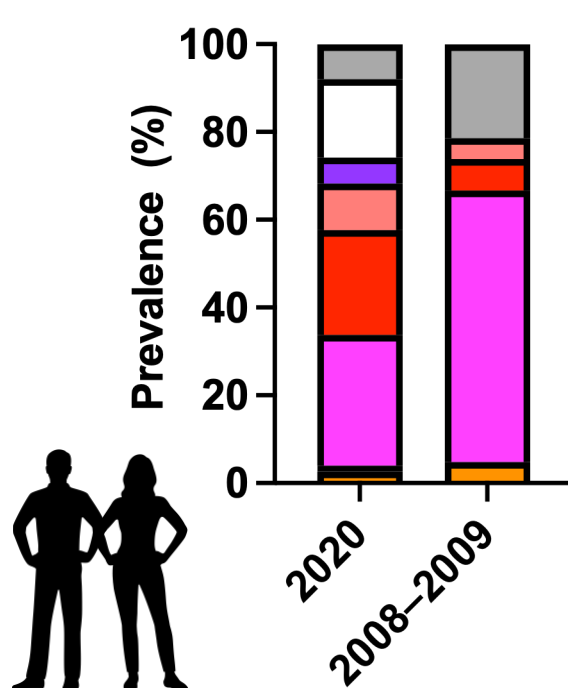


Similar AMR rates
between diseased-dogs/cats and patients

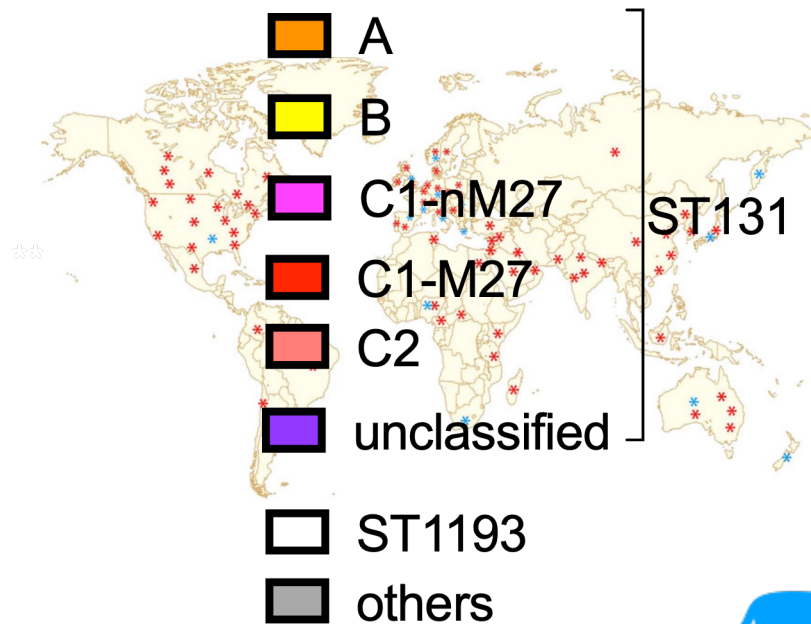
ST131, a pandemic FQ-R *E. coli* clone in human

ST131 in FQ-R *E. coli* in Sapporo

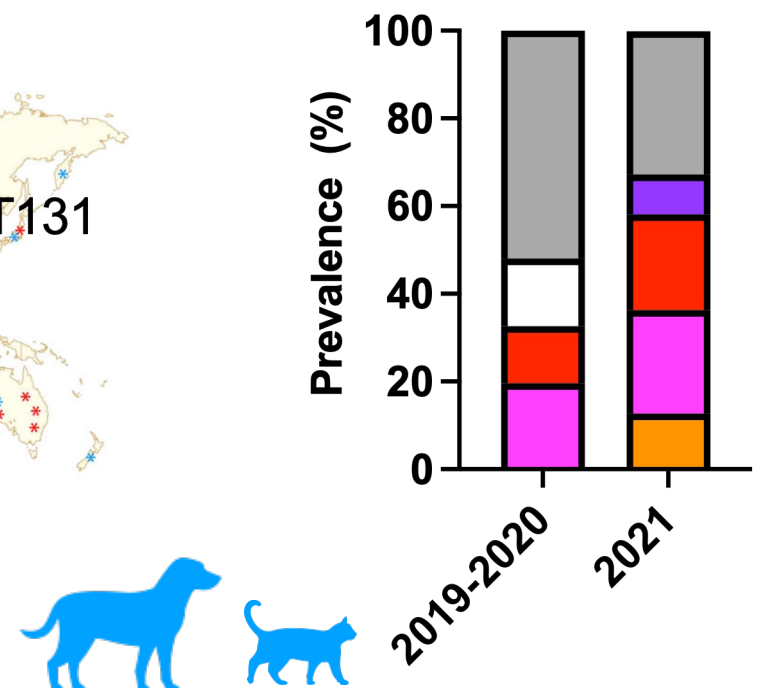
Human clinical specimens



Fukushima Y et al, J Glob Antimicrob Resist. 150-155, 2021



Fecal samples in dogs/cats



Sato T et al, Antibiotics. 10(12):1463, 2021

Similar ST131 trend between human and dogs/cats
How is the transmission risk ?



<This study>
using Sapporo,
a city with a
population of 2 million,
as a model

We aim to assess the spread of
FQ-R E. coli
and elucidate its transmission dynamics.



Visit Sapporo

FQ-resistant *E. coli* isolates

Obtained from multiple sample groups in Sapporo City and its vicinity (2021–2022).

- **Human patients : clinical specimens**

- University hospital : 206 samples
- Clinics in the community : 189 samples

- **Healthy humans : fecal samples** 177 samples

- **Dogs and cats (visited to animal clinics) : fecal samples** 79 samples

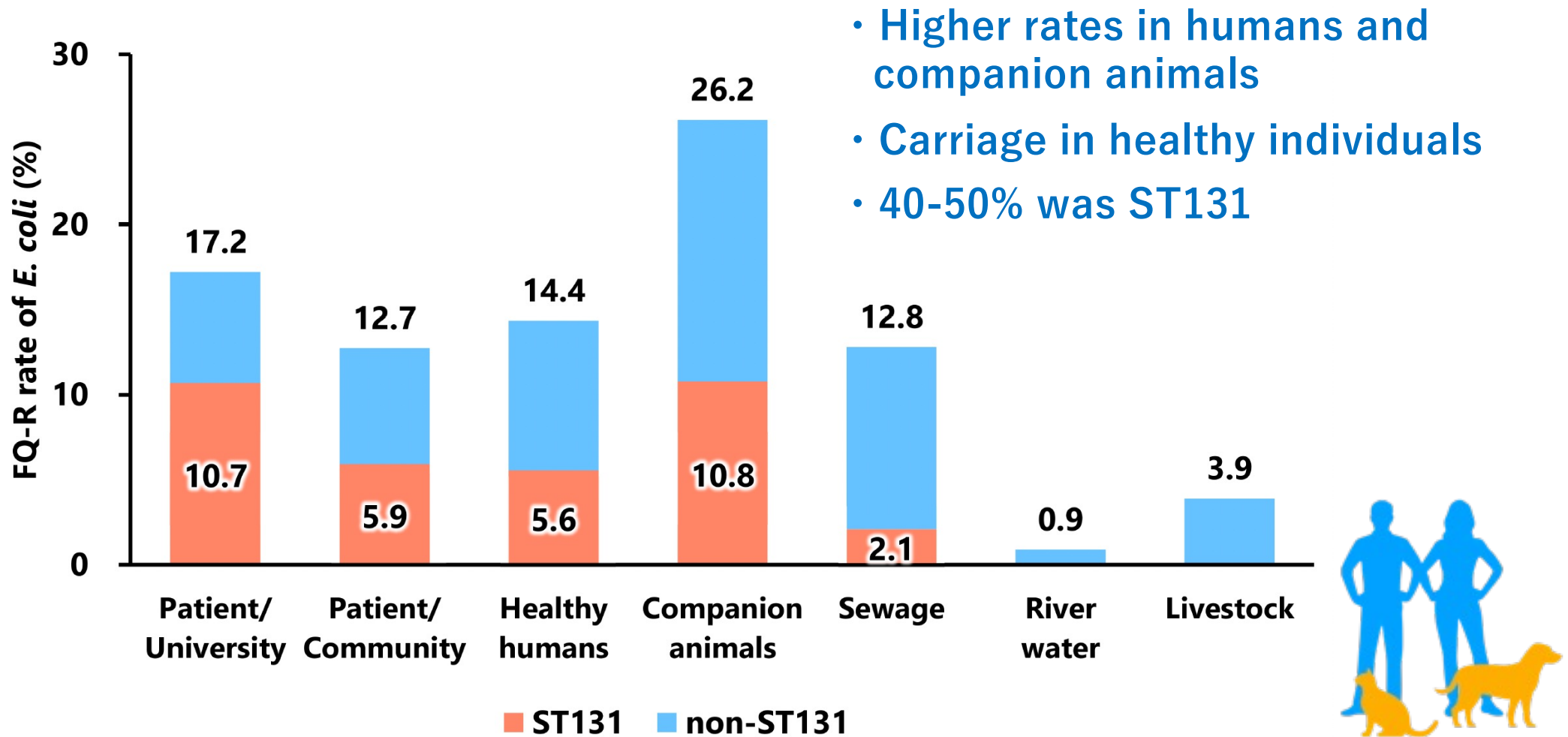
- **Livestock : fecal samples**

- Cattle; 108 samples
- Pigs ; 25 samples
- Broiler ; 25 samples

- **Sewage** : 3 samples

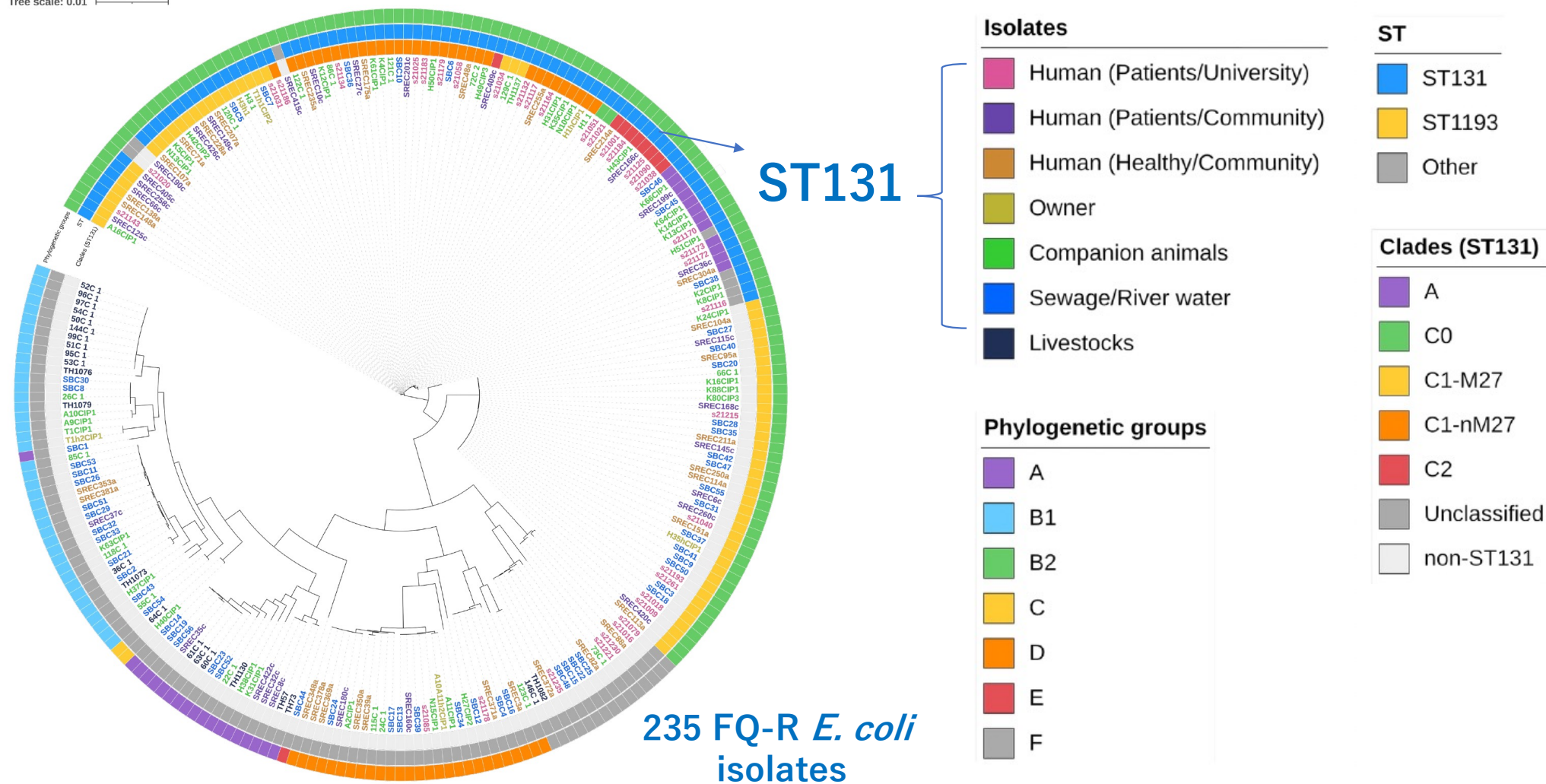
- **River water** : upstream, downstream, effluent each 2 sample

FQ-R rates of *E. coli* isolates collected in Sapporo



Pan-genome analysis of FQ-R *E. coli* isolates collected in Sapporo

Tree scale: 0.01



Accessory genome/SNP analysis of ST131

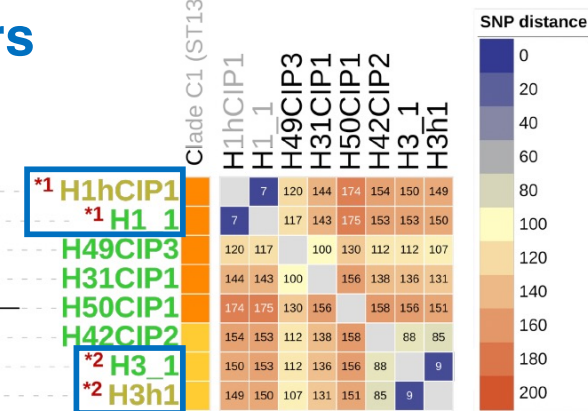
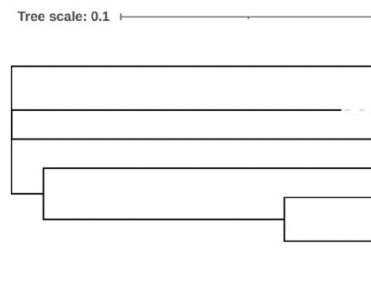
Most of the clusters were consisted by patients, healthy humans, and companion animal isolates

How is the transmission risk ?

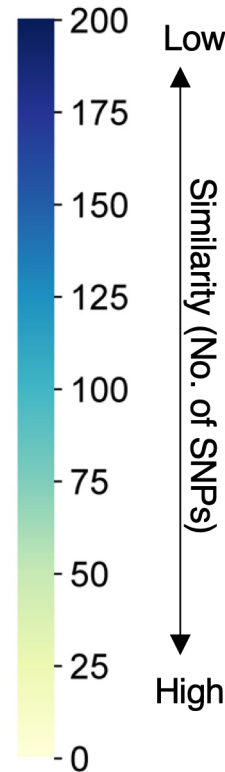
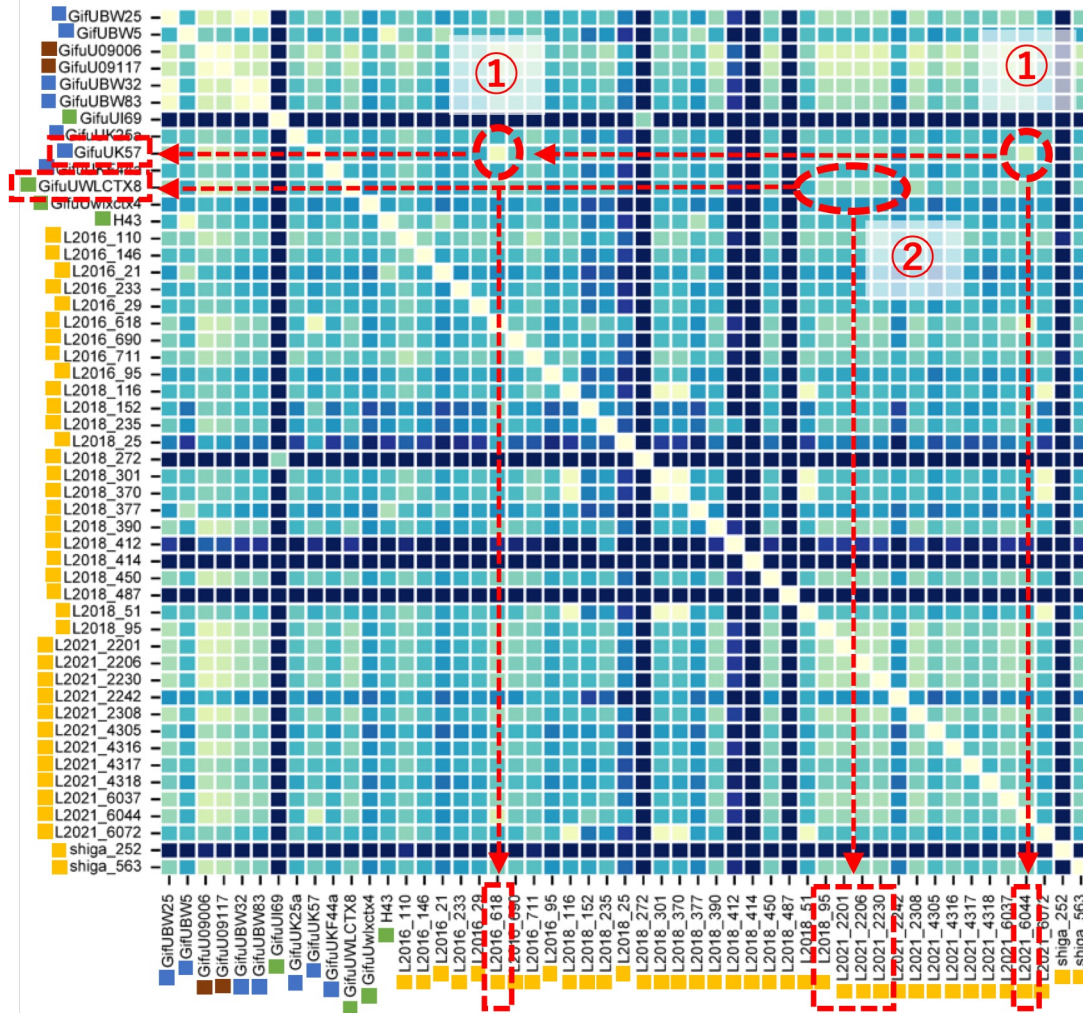


At the animal clinic level, the closest genetic similarity was observed among pets and their owners (SNP = 7-9)

88 ST131 isolates



ST131 isolated from environment in Japan



<ST131>

- Humans
- Wildlife
- River/lake water
- Dogs/cats

Ex. close genetic similarity

①: Patient – river water

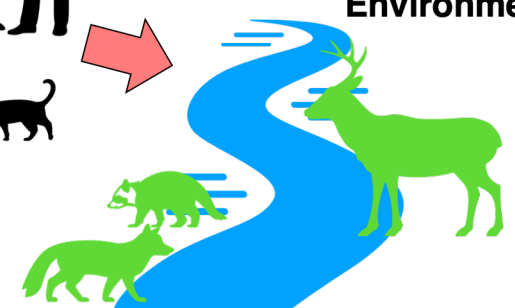
②: Patient - raccoon

Human society



Dissemination of
AMR pandemic to
Environment

Environment



Sato T and Asai T et al, One Health. 18:100715, 2024

Molecular epidemiology of antimicrobial resistance within a One Health framework

<Our study>

Carbapenem non-susceptible *Pseudomonas aeruginosa*



Postdoc.
Jirachaya Toyting-Hiraishi

<humans>

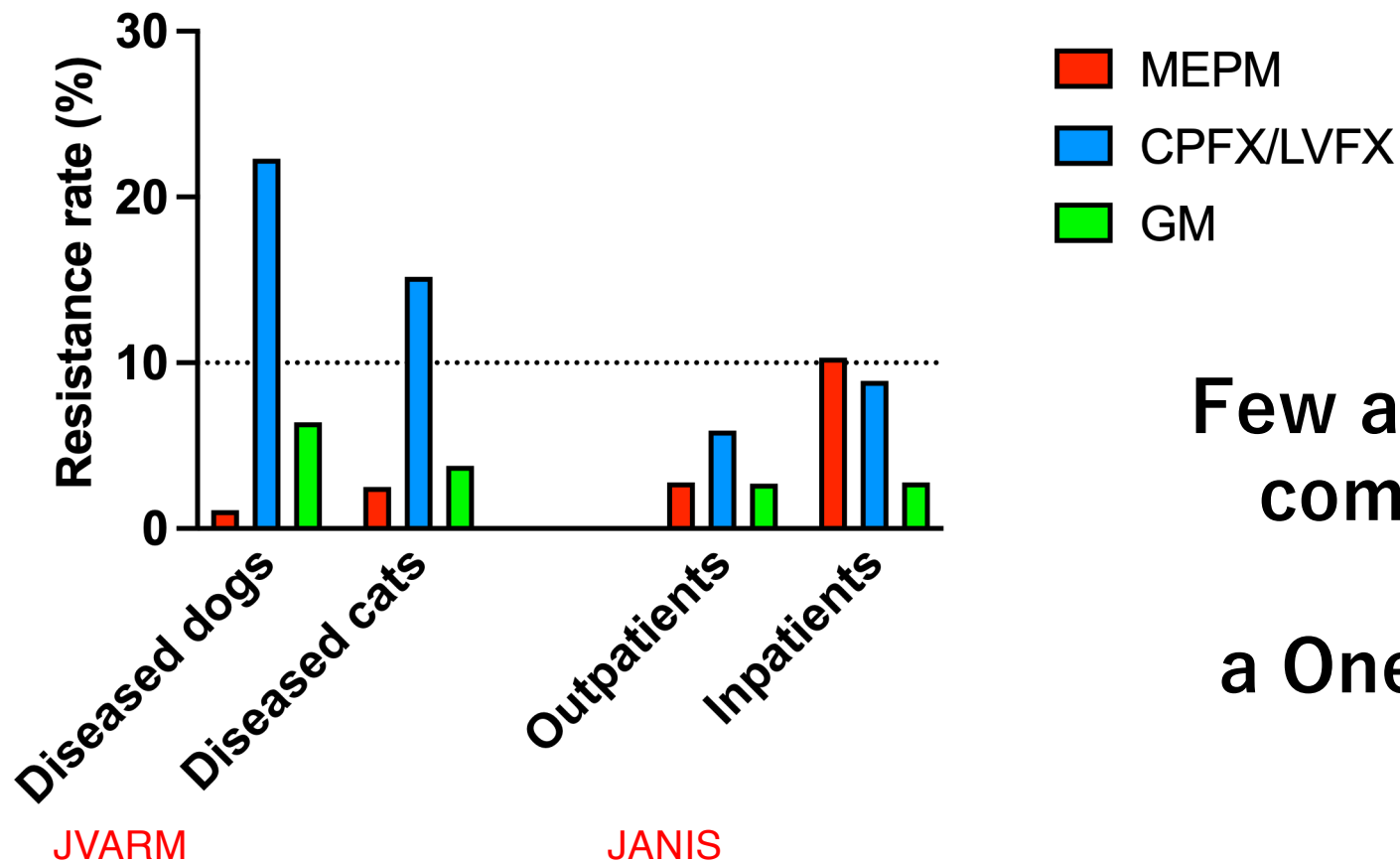
- Hospital-acquired infections and ventilator-associated pneumonia,
- High morbidity and mortality in cystic fibrosis and immunocompromised patients

<Companion animals>

- Otitis, pyoderma, keratitis, respiratory tract infections, urinary tract infections and wound infections.

AMR rates of *P. aeruginosa* in Japan

P. aeruginosa (2021)



Few antimicrobials are comparable across sectors in a One Health context

材 料

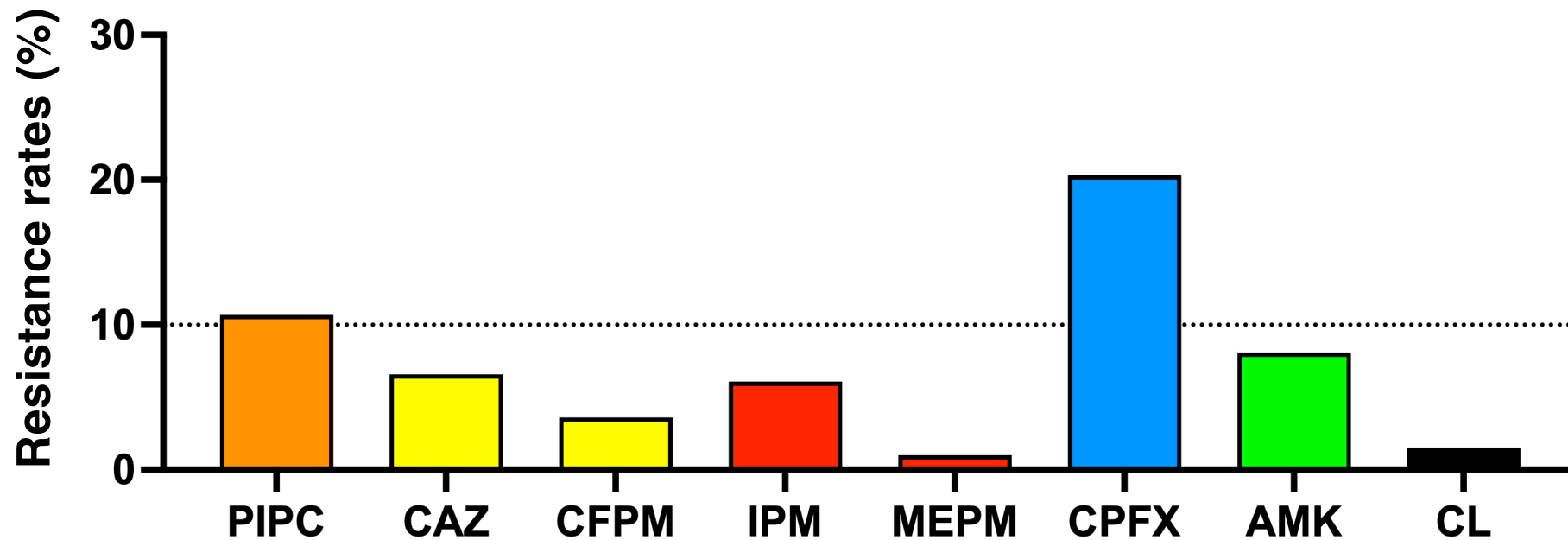
- ✓ *P. aeruginosa* clinical isolates
- ✓ Collected from companion animal clinics across Japan (2023)
- ✓ Clinical specimens : urine, pus, nasal discharge etc
- ✓ 197 isolates: Dogs (n=99) • Cats (n=98)

方 法

- ✓ Antimicrobial susceptibility
- ✓ Multilocus Sequence Typing (MLST) analysis
- ✓ Coregenome SNP analysis
 - <Comparison with human isolates>
 - Japan : NCBI data
 - Other countries: Bacterial and Viral Bioinformatics Resource Center (BV-BRC)

Antimicrobial susceptibility in *P. aeruginosa* isolates derived from companion animals in Japan

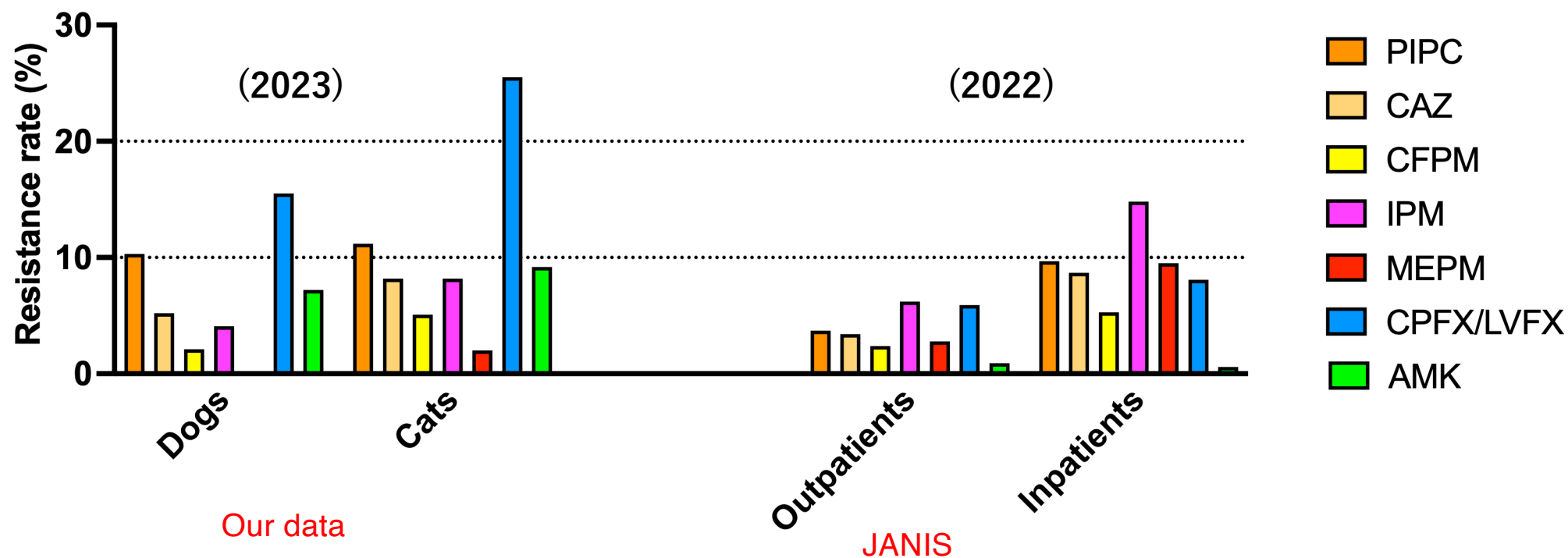
P. aeruginosa (dogs + cats)



Toyting-Hiraishi J et al., J Antimicrob Chemother. 480(11):3043-3056, 2025

Comparison of Resistance rates (Companion animals vs Humans), Japan

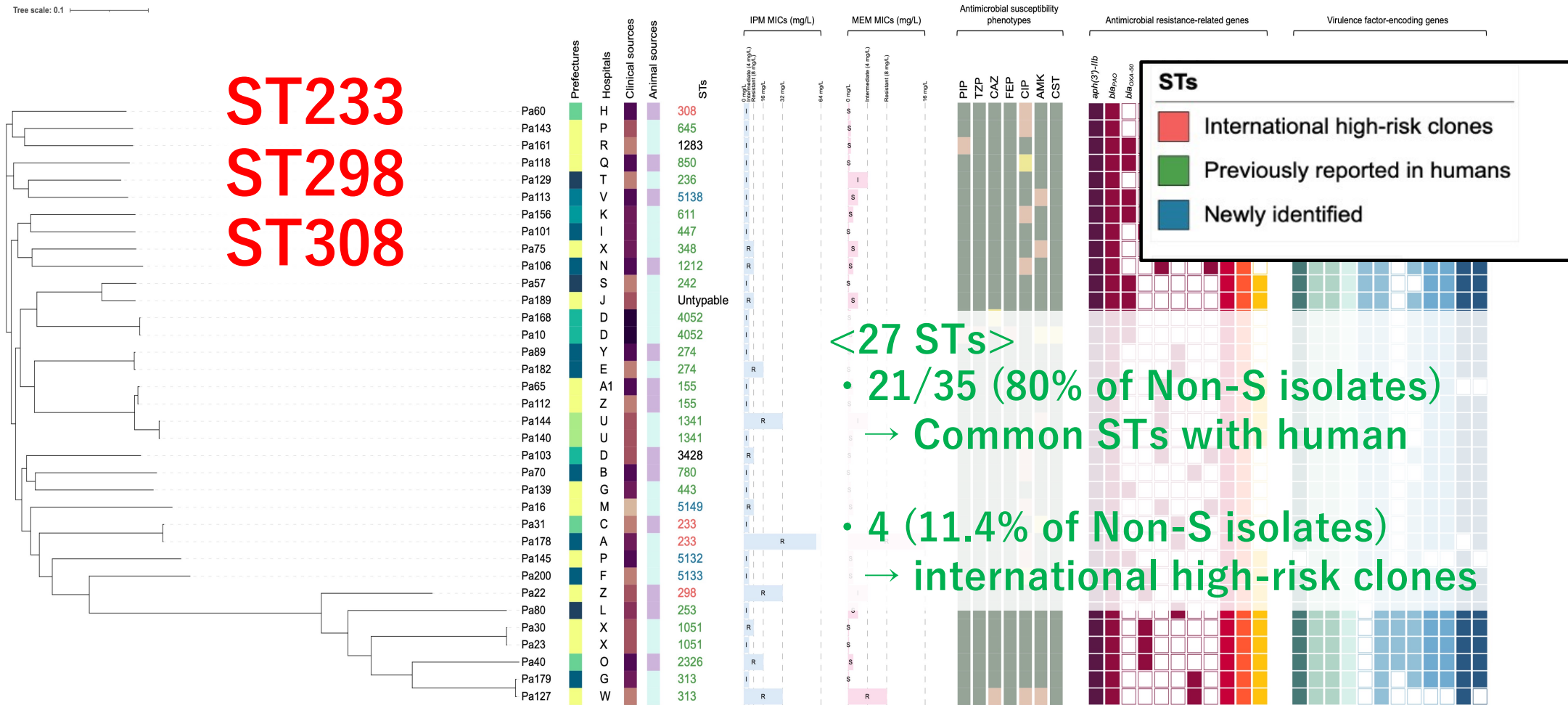
P. aeruginosa



FQ-R
Diseased dogs/cats > Patients

Carbapenem-R
Patients $\geq$ Diseased dogs/cats

Coregenome SNP analysis of carbapenem non-susceptible *P. aeruginosa* isolates from companion animals in Japan



Toyting-Hiraishi J et al., J Antimicrob Chemother. 480(11):3043-3056, 2025

Review



International Journal of Antimicrobial Agents

Volume 56, Issue 6, December 2020, 106196



Pseudomonas aeruginosa epidemic high-risk clones and their association with horizontally-acquired β -lactamases: 2020 update

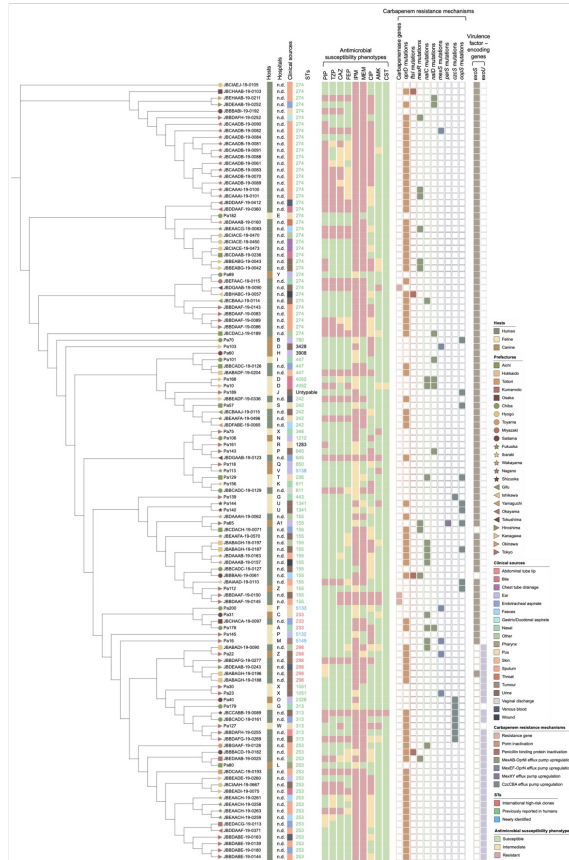
Ester del Barrio-Tofiño, Carla López-Causapé, Antonio Oliver*

Servicio de Microbiología, Hospital Universitario Son Espases, Instituto de Investigación Sanitaria Illes Balears (IdISBa), Palma de Mallorca, Spain

Pseudomonas aeruginosa global clones associated with multidrug-resistant (MDR) and extensively drug-resistant (XDR) phenotypes, denominated high-risk clones, are a growing threat in hospitals worldwide. Here we provide a 2020 update on nosocomial MDR/XDR high-risk *P. aeruginosa* clones. According to their prevalence, global spread and association with MDR/XDR profiles and regarding extended-spectrum β -lactamases (ESBLs) and carbapenemases, the worldwide top 10 *P. aeruginosa* high-risk clones includes ST235, ST111, ST233, ST244, ST357, ST308, ST175, ST277, ST654 and ST298. ST235

Carbapenem non-susceptible *P. aeruginosa* isolates derived from companion animals in Japan

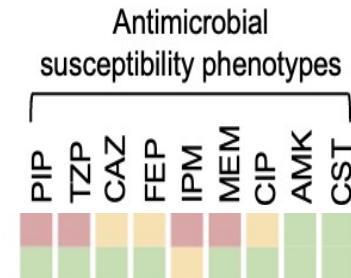
Coregenome SNP analysis



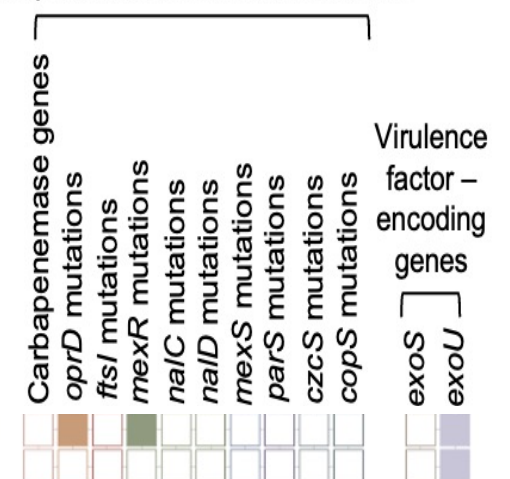
Patient strain (JBEDAAB-19-0025)
Canine strain (Pa80)

→ **13 SNPs**

ST253



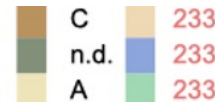
Carbapenem resistance mechanisms



Patient strain (JBCHAC-19-0097)
Canine strain (Pa178)

→ **51 SNPs**

ST233



Toyting-Hiraishi J et al., J Antimicrob Chemother. 480(11):3043-3056, 2025

Summary: Current Situation of Antimicrobial-Resistant Bacteria in Companion Animals and the One Health Approach

< FQ-resistant *E. coli* >

- ✓ Resistance rates in companion animals are comparable to those observed in humans.
- ✓ Approximately half of the isolates belong to the human pandemic clone (ST131) and show high genetic similarity to human strains.
- ✓ ST131 isolated from nature (river / wildlife) with high genetic similarity with humans.

These suggest a high likelihood of community and environmental spreads of the pandemic AMR clone in FQ-R *E. coli*.

Summary: Current Situation of Antimicrobial-Resistant Bacteria in Companion Animals and the One Health Approach

< Carbapenem non-susceptible *P. aeruginosa* >

- ✓ Resistance rates to cephalosporins and FQ are higher than those in humans.
- ✓ 80% of carbapenem-non-susceptible isolates share the same STs as human isolates (11% are high-risk clones).
- ✓ Some isolates show high genetic similarity to each other.

Overall risk is not considered high; however, some strains may have the potential for direct or environmental transmission.

Summary: Current Situation of Antimicrobial-Resistant Bacteria in Companion Animals and the One Health Approach

The genetic similarity between AMR bacteria from companion animals and those from humans varies by bacterial species.

A more detailed, species- and resistance-specific One Health approach is necessary to advance and strengthen AMR countermeasures.