

One Health Approach to understanding and managing animal derived antimicrobial resistant bacteria

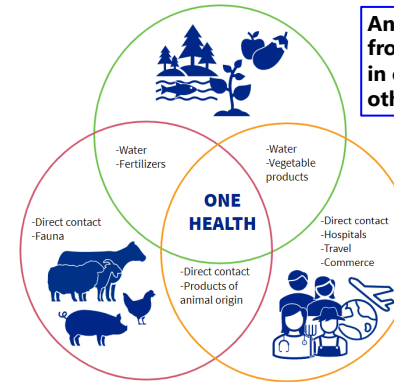
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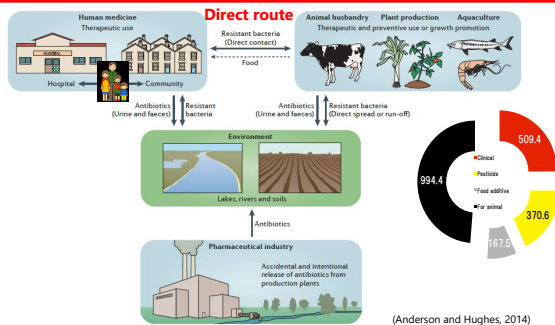
Antibiotic resistance arising from the use of antibiotics in one field can spread to other fields !



The issue of antibiotic resistance requires a One Health approach.!

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Antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs) are spreading from animals to humans.



One Health approach against antibiotic resistance are required.

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Today's topics

- **Potential transmission of AMR in the One Health context**
- **AMR countermeasures from a One Health perspective**

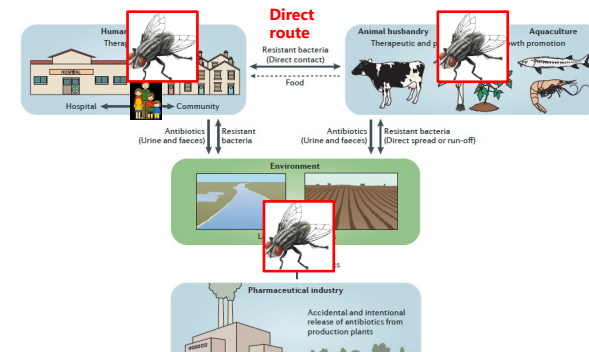
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Today's topics

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Circulation of ARB/ARGs



Files are important reservoir and carriers of ARB/ARGs ? ?

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Flies move freely between food-producing animals and humans (sometimes 20Km)



To clarify the role of the flies in the spread of **ESBL(Extended Spectrum Beta Lactamase)-producing bacteria** from food-producing animals to humans.

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We isolated *E. coli* from
91 houseflies (*Musca domestica*),
68 false stable flies (*Muscina stabulans*),
72 stable flies (*Stomoxys calcitrans*),
and 93 samples of cattle feces from the same cattle barn.

	Origin	Isolation rate
	Houseflies (n=91)	43%
	False stable flies (n=68)	68%
	Stable flies (n=72)	0%
	Cattle feces (n=91)	68%

No *E. coli* were obtained from the 72 stable flies.

Both houseflies and false stable flies feed on cattle feces.
By contrast, stable flies are blood-feeding insects

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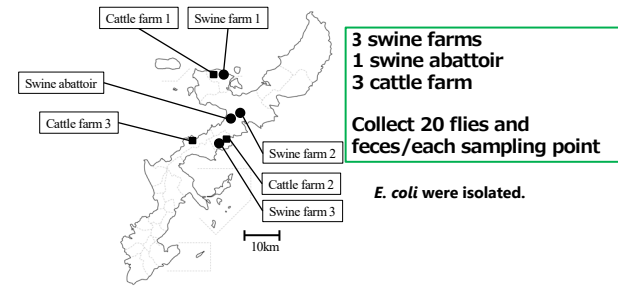
Determination of ARGs

<i>bla</i> _{CTX-M} group	Housefly (n=20)	False stable fly (n=8)	Cattle feces (n=6)
<i>bla</i> _{CTX-M-1} group	11	5	6
<i>bla</i> _{CTX-M-2} group	1	3	0
<i>bla</i> _{CTX-M-9} group	6	0	0

All *bla*_{CTX-M-1} group gene was identical to *bla*_{CTX-M-15}.
All isolates harbored the *bla*_{CTX-M-15} genes contained *bla*_{TEM} and *tetA*.

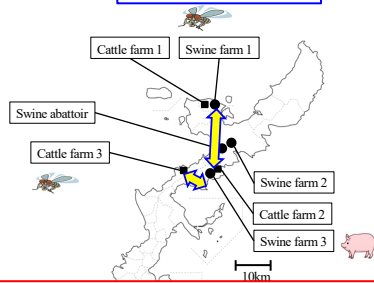
ESBL plasmids are being transmitted between cattle and flies on the farm.

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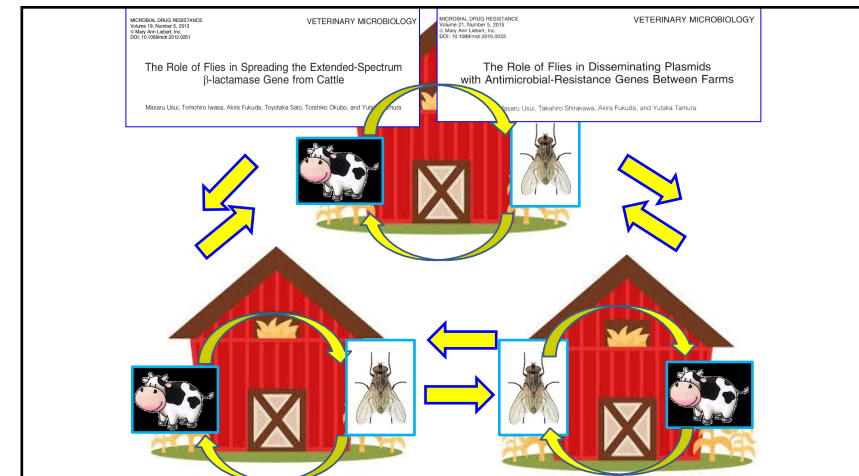
Plasmid analysis



Similar tetracycline-resistant plasmids were observed in different farms and different origin.

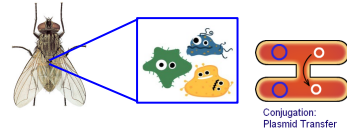
Houseflies would carry the ARGs

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Flies often contain pathogenic bacteria such as *Shigella* sp., *Vibrio cholera*, *E. coli* O157:H7, *Staphylococcus aureus*, and *Salmonella* sp.

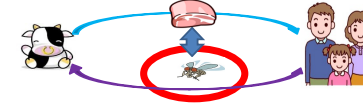


Antibiotic resistance genes harboring plasmids are capable of transfer to the other bacteria in fly intestine ?

To clarify the transmission of antimicrobial resistance genes in the houseflies intestine, we used the laboratory strain of houseflies in the laboratory.

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▼ Antibiotic resistance genes were transferable in houseflies intestine



Horizontal transmission of antimicrobial resistance genes could occur in the houseflies intestine.

Houseflies intestine contain pathogenic bacteria

In houseflies intestine, ARGs are capable of transfer to pathogenic bacteria

MICROBIAL DRUG RESISTANCE
Volume 22, Number 4, 2016
© 2016 Wolters Kluwer Health | Lippincott Williams & Wilkins
DOI: 10.1093/mic/drw012

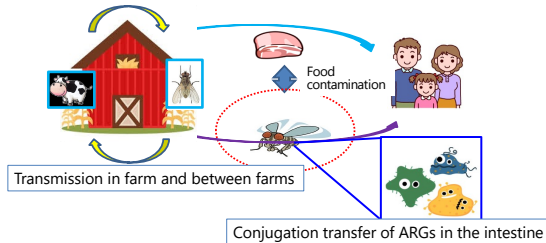
VETERINARY MICROBIOLOGY

Horizontal Transfer of Plasmid-Mediated Cephalosporin Resistance Genes in the Intestine of Houseflies (*Musca domestica*)

Akira Fukuda, Masaru Ueda, Torahiko Okubo, and Yutaka Tamura

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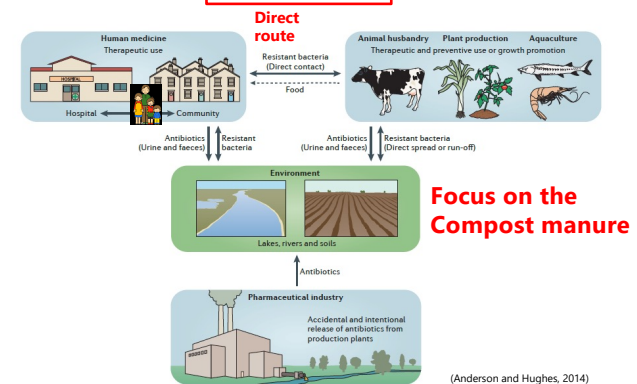
The role of the flies in spreading ARG/ARGs



To decrease the spreading of the ARG/ARGs in/from farms, improving the environments including blockade houseflies are important

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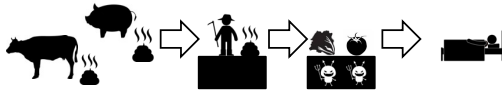
Circulation of ARB/ARGs



(Anderson and Hughes, 2014)

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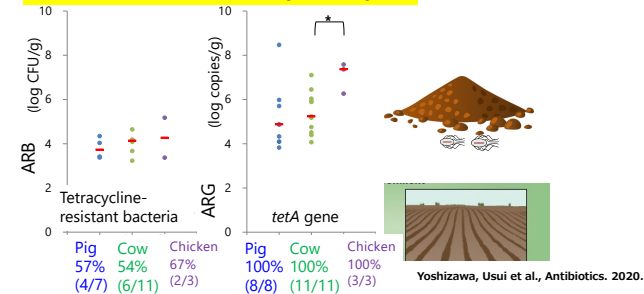
- Manure compost contains some of pathogens including bacteria
- Transferring ARB and ARGs in manure compost to humans via foods are considered



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Detection of ARB/ARG from compost

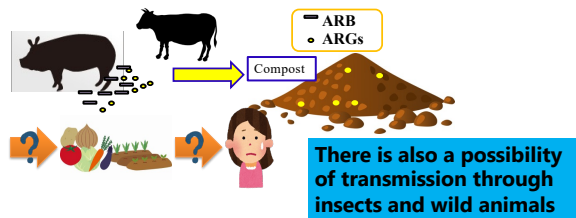
The current status of farm compost in Japan



ARB/ARG are present in compost

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- Even with proper composting, ARB/ARGs may still remain
- To reduce the risk of transmission, efforts to minimize ARB/ARGs in the compost are necessary



Composting methods that contribute to controlling ARB are needed

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Composting methods as a countermeasure against AMR

• Vermicomposting

Usui et al., J Hazard Mater Adv. 100491. 2024.

• Hyperthermophilic composting

Usui et al., Waste Manag Bullet. 2, 241-248. 2024.

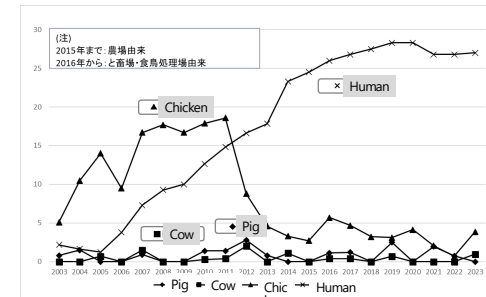
• Applying additives

Enami, Usui et al., Environ Technol Innov. 34.103590. 2024.



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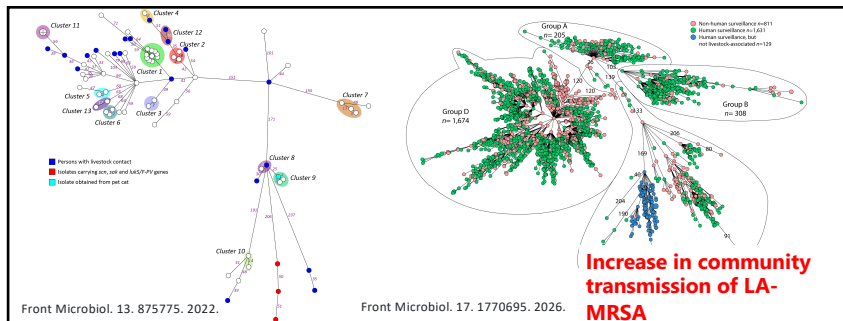
From One Health Trends Survey



Trends in third-generation cephalosporin resistance rates of *E. coli* derived from humans and livestock

There is no frequent transmission of ARB between humans and livestock animals

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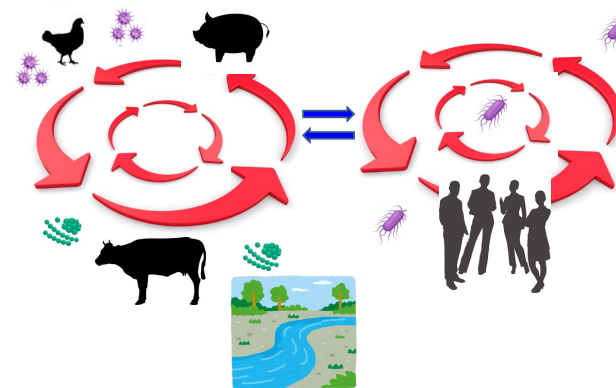
Increase in community transmission of LA-MRSA

There is not frequent transmission of ARB between humans and livestock.

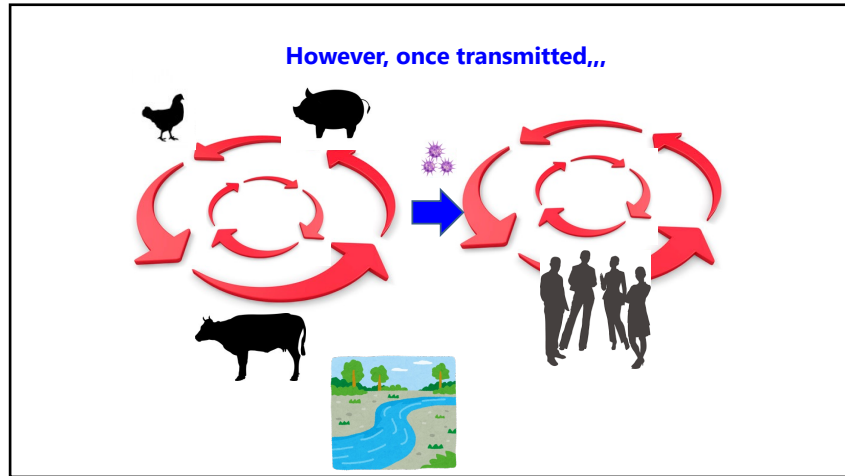
However, once transmitted, ARB can spread among humans, so it is essential to prevent transmission as much as possible.

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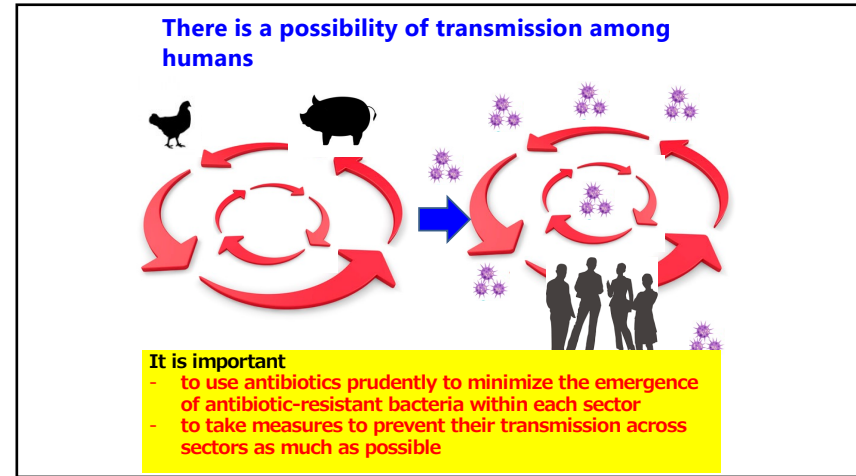
ARB primarily spread and disseminate within their respective domains



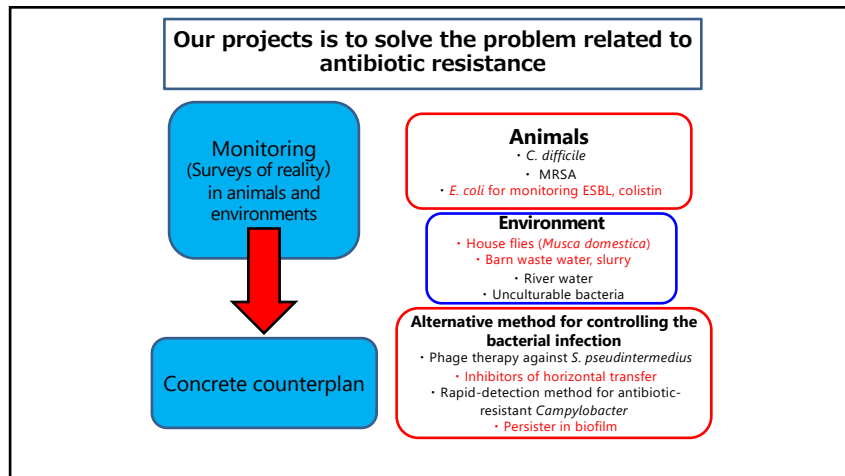
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Acknowledgments

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