Bundesinstitut für Risikobewertung

Antimicrobial resistance comparison in *Escherichia coli* between diagnostic submissions and isolates of healthy broilers, turkeys and calves from surveillance and monitoring systems in Germany and France

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Monitoring Antimicrobial Resistance and Drug Usage in the Human and Livestock Sector and Foodborne Antimicrobial Resistance in Six European Countries

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Associated Data

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Abstract

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Introduction

Antimicrobial resistance (AMR), associated with antimicrobial use (AMU), is a major public concern. Surveillance and monitoring systems are essential to assess and control the trends in AMU and AMR. However, differences in the surveillance and monitoring systems between countries and sectors make comparisons challenging. The purpose of this article is to describe all surveillance and monitoring systems for AMU and AMR in the human and livestock sectors, as well as national surveillance and monitoring systems for AMR in food, in six European countries (Spain, Germany, France, the Netherlands, the United Kingdom and Norway) as a baseline for developing suggestions to overcome current limitations in comparing AMU and AMR data.

Lack of harmonization

AMR

- Types of data collected (Clinical/Non clinical)
- Type of samples (caecal, faecal, tissue)
- Laboratory methodology (e.g.DD or MIC)
- Different standard used

(Standards may vary / others may be involved)

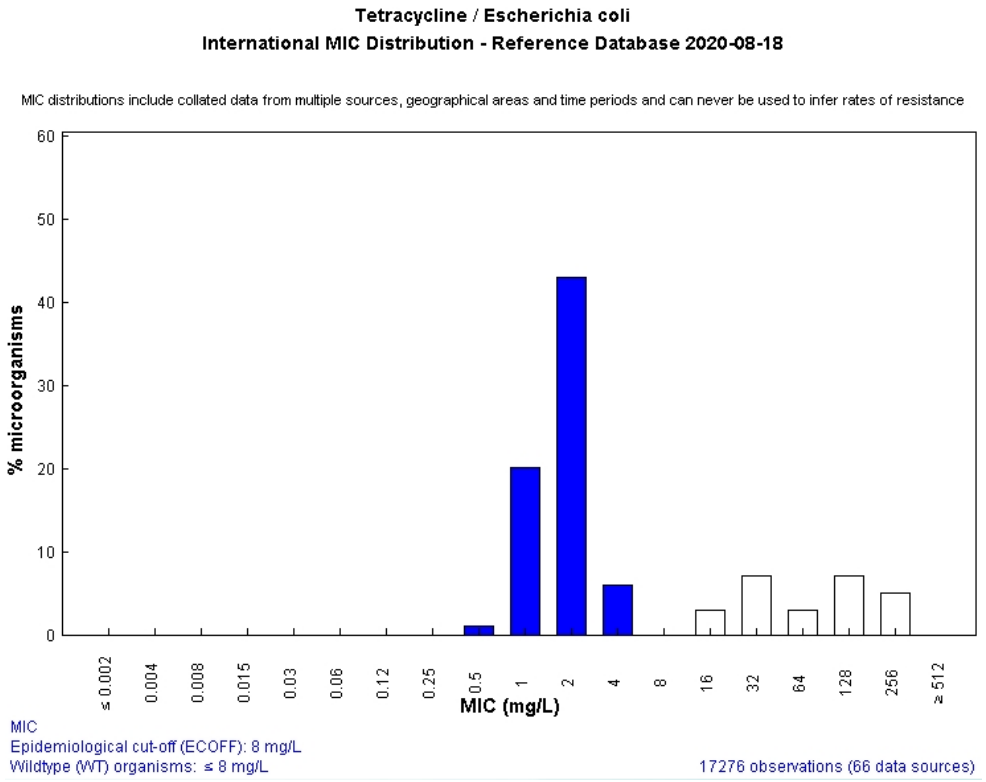
- Evaluation criteria (ECOFF vs CBP)
- Type of results
- Antimicrobial panels and animal types

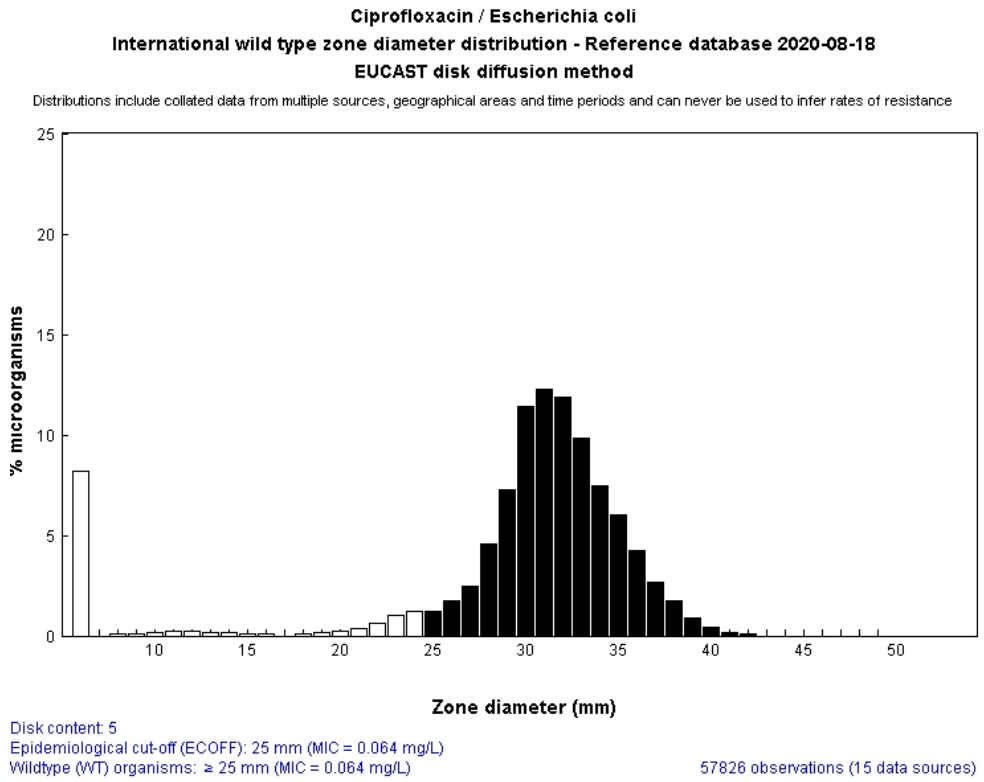
Data collection and descriptive analyses

Country	Data type		AST method	Laboratory Methodology	Source
Germany	Clinical	Quantitative	MIC	Harmonized ISO 20776-1	Germ-Vet
	Non-clinical	Quantitative	MIC	Harmonized ISO 20776-1	ZOMO
France	Clinical	Quantitative	DD	CASFM	RESAPATH
	Non-clinical	Quantitative	MIC	Harmonized ISO 20776-1	ANSES
UK	Clinical	Quantitative	DD	BSAC	Scanning Surveillance of Vet Pathogens
	Non-clinical	Quantitative	MIC	Harmonized ISO 20776-1	EU Harmonized Surveillance System

Countries	Data type
Germany	Clinical vs. Non-clinical
UK	Clinical vs. Non-clinical
France	Clinical vs. Non-clinical

Normalized Resistance Interpretation method (NRI)





Antimicrobials	ECOFFs (mg/L)	NRI cut-offs (mg/L)
Ampicillin	>8	>16
Gentamicin	>2	>2
Nalidixic acid	>8	>8
Tetracycline	>8	>4

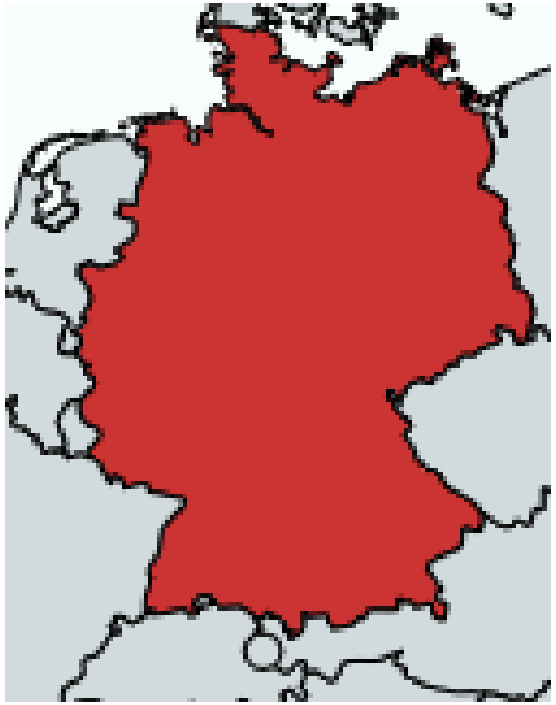
Hypothesis

It would be reasonable to expect the level of resistance to be higher in clinical isolates compared to non-clinical isolates, as diseased animals may carry bacteria resistant to regular antimicrobial treatments

Analyses

- For each antimicrobial (ampicillin, nalidixic acid, tetracycline and gentamicin), each country (Germany vs. France) and each animal category (broilers, turkeys and calves), the data type variable (clinical vs. non-clinical) and year (2014, 2015, 2016 and 2017) were included as independent variables.

Was there more resistance in clinical or in non-clinical *E. coli* isolates within country?



Analysis results

France

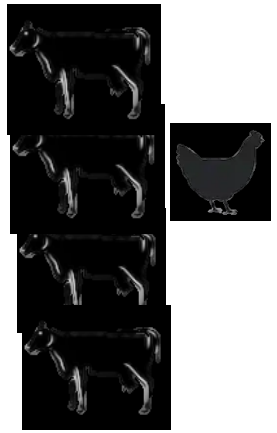
- Higher resistance in clinical isolates

Ampicillin:

Gentamicin:

Tetracycline:

Nalidixic acid:



Germany

- Higher resistance in clinical isolates

Ampicillin:

Gentamicin:

Tetracycline:

Nalidixic acid:

	Ampicillin-Calf	Gentamicin-Calf	Tetracycline-Calf	Nalidixic acid-Calf	Gentamicin-Broiler		Ampicillin-Calf	Gentamicin-Calf	Tetracycline-Calf	Nalidixic acid-Calf
CI max	6.39	7.78	1.83	7.63	4.76		6.43	37.02	3.7	14.44
CI min	3.97	3.20	1.19	4.05	1.33		3.63	9.1	2.14	6.82
OR	5.03	4.85	1.48	5.49	2.36		4.82	17.22	2.81	9.81

Analysis results

France

- Higher resistance in non-clinical isolates

Ampicillin 

Tetracycline: 

Germany

- Higher resistance in non-clinical isolates

Ampicillin: 

Gentamicin: 

Tetracycline: 

	Ampicillin-Broiler	Ampicillin-Turkey	Tetracycline-Broiler	Tetracycline-Turkey	Ampicillin-Broiler	Ampicillin-Turkey	Tetracycline-Broiler	Tetracycline-Turkey	Gentamicin-Turkey
CI max	0.43	0.5	0.64	0.42	0.64	0.54	0.85	0.56	0.94
CI min	0.27	0.29	0.42	0.27	0.31	0.3	0.35	0.3	0.26
OR	0.34	0.38	0.52	0.34	0.45	0.4	0.55	0.41	0.5

Limitations

Data on non-clinical isolates		Data on clinical isolates	
Germany	France	Germany	France
Mandatory	Mandatory	Voluntary	Voluntary
Isolate collection at the slaughterhouse	Isolate collection at the slaughterhouse	Isolate collection during the lifetime or at time of death	Isolate collection during the lifetime or at time of death
Isolate collection at a fixed age	Isolate collection at a fixed age	Isolate collection at different ages	Isolate collection at different ages
Caecal samples	Caecal samples	Diverse sample origin	Diverse sample origin
Data representative for the population	Data representative for the population	Data representative for the samples examined in the laboratories contributing to the system	Data representative for the samples examined in the laboratories contributing to the system
Data analyzed from 1 laboratory	Data analyzed from 1 laboratory	Data analyzed from 1 laboratory	Data analyzed from several laboratories

Conclusions

- The NRI identifies the wild-type distribution providing approximate epidemiological cut-offs that allow comparing quantitative results from different non-harmonized AMR systems.
- This method might be regularly used in veterinary medicine and in One Health studies until international harmonization of AMR in clinical isolates is achieved.
- The higher presence of resistance in one data type (i.e. clinical or non-clinical isolates) is strongly associated with the relationship between the animal species and the antimicrobial.
- This work suggests that it is not enough to analyse data on non-clinical isolates to show the resistance level of a country for a drug in an animal type. Data on clinical isolates should also be considered.

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