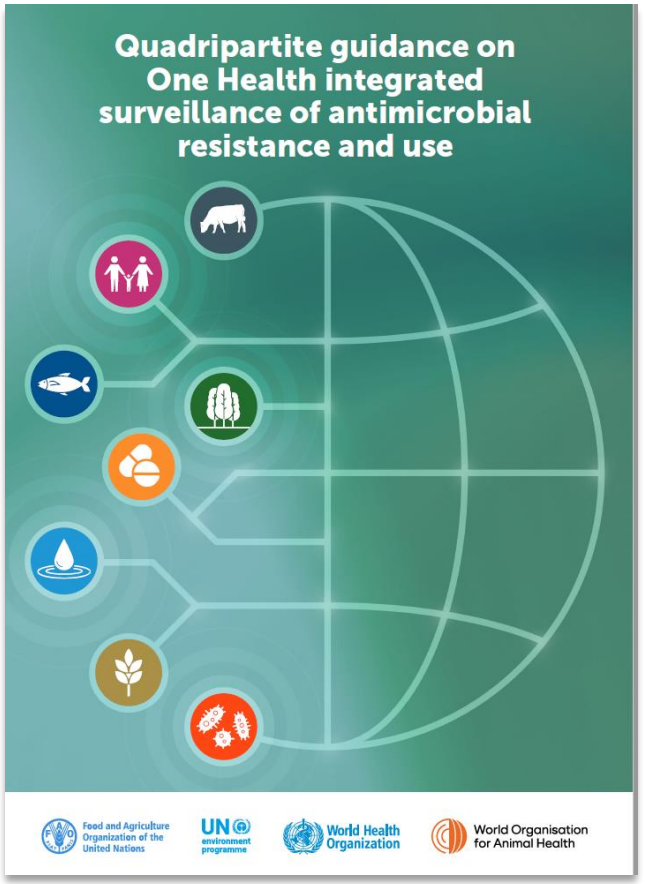
Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

Goals and objectives of One Health Integrated Surveillance of AMR and AMU –OHISA-



Quadripartite Collaboration on One Health

Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

Agriculture **Environment** **Human Health** **Animal Health**

One Health

The Quadripartite Joint Secretariat on AMR

Political Declaration of the UNGA High-level Meeting on Antimicrobial Resistance

UN General Assembly High-Level Meeting on antimicrobial resistance 2024

Surveillance and Monitoring

Commitment 98
Strengthen **national capacities** for sustainable, sector-specific, **integrated and interoperable surveillance systems** for antimicrobial resistance and antimicrobial use…

Commitment 99
Encourage all countries to **report quality surveillance data on antimicrobial resistance and antimicrobial use** by 2030, through existing global surveillance systems through GLASS, ANIMUSE and InFARM for future use in Quadripartite GISSA (in dev)

GISSA - Global Architecture for Integrated AMR and AMU Surveillance

Quadripartite Global Systems

Health System

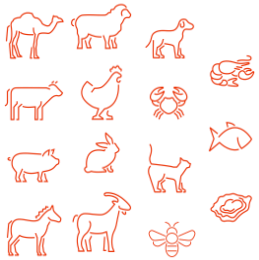
World Health Organization

GLASS
Global Antimicrobial Resistance and Use Surveillance System

AMR/AMU

Agricultural System

World Organisation for Animal Health



ANIMUSE Global Database

AMU

Food and Agriculture Organization of the United Nations

AMR
in animals and food

AMU
in plant production and protection

Environmental health

UN environment programme

AMR and Residues

Global Integrated Surveillance for AMR and AMU

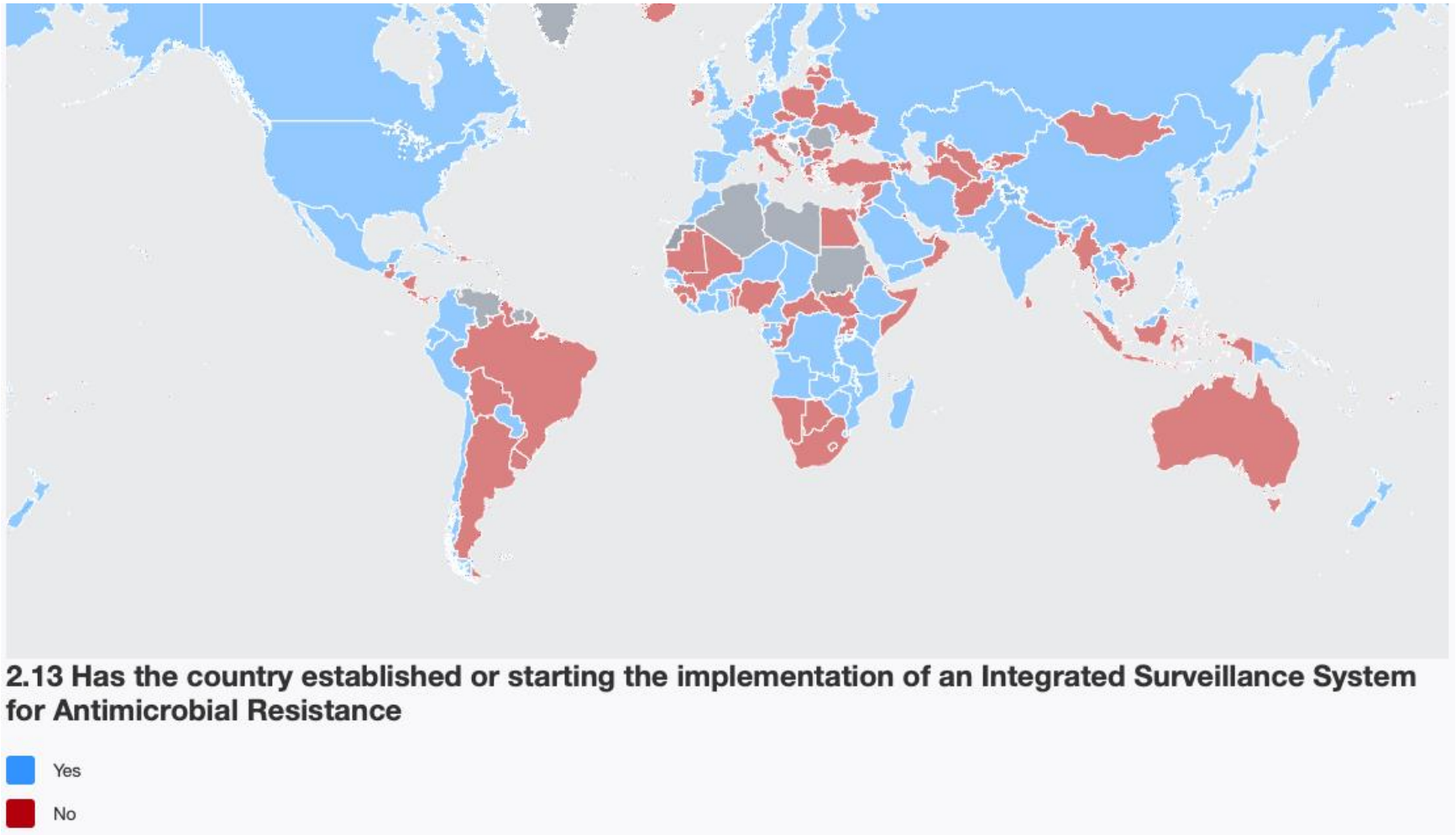
Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

The Quadripartite guidance on One Health integrated surveillance of AMR/U



Global Database for Tracking Antimicrobial Resistance (AMR)
Country Self- Assessment Survey (TrACSS): Integrated Surveillance of AMR and AMU

National-level Integrated AMR and AMU Surveillance – foundation for global surveillance systems

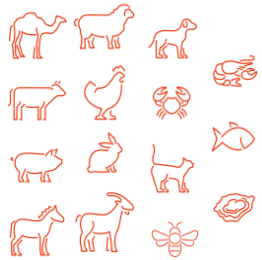
Health System

World Health Organization

GLASS
Global Antimicrobial Resistance and Use Surveillance System

Agricultural System

World Organisation for Animal Health



ANIMUSE Global Database

Food and Agriculture Organization of the United Nations

Environmental health

UN environment programme

AMR/AMU	AMU	AMR in animals and food	AMU in plant production and protection	AMR and Residues

National-level Integrated Surveillance for AMR and AMU

Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

One Health Integrated Surveillance of AMR and AMU Quadripartite Guidance

Establishing the goals and objectives of the system

Goal: The protection of public health, animal health and welfare, environmental health and ensuring food security, livelihoods and fair practices in food trade.

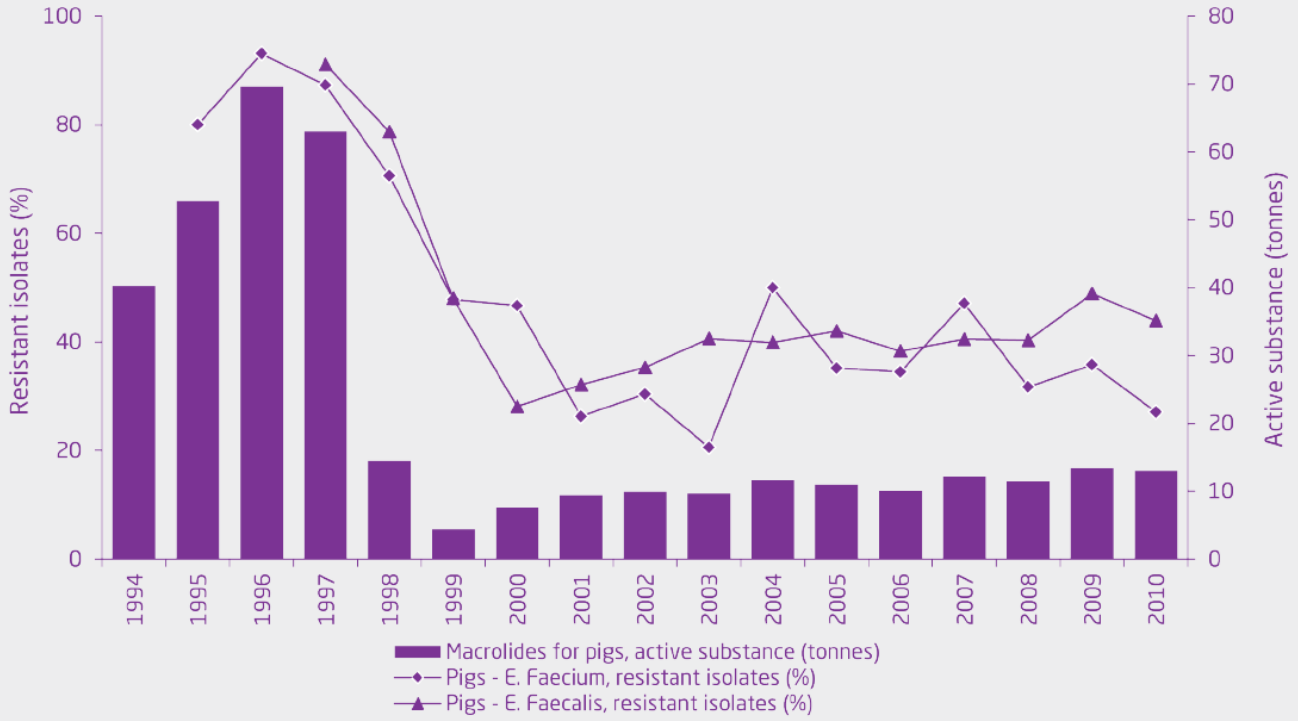
Objective#1, Provide information on patterns, trends and potential associations between AMR and AMU

- Harmonized data collection across sectors on the following data components:
  - AMR – obtain data and characterize frequencies and trends of resistance, identify notable resistance patterns (specific bacteria-antibiotic combination, antimicrobial resistance genes)
  - AMU – obtain data to find patterns and trends
- AMU-AMR integrated analysis and reporting – identify notable trends and patterns within and across sectors

Example # 1- The Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP)

Resistance to erythromycin follows the consumption

Macrolides are one group of antimicrobial agents that the World Health Organization has indicated as critically important antimicrobial agents for human therapy. The consumption of macrolides in pigs has decreased over the past 15 years, but it is still used. The resistance to one of the macrolides, erythromycin, has followed the decrease in the total consumption of macrolides, showing an association between consumption and resistance.



DANMAP - Data for action

Data components used:
AMU (use of macrolides) in animals
AMR (resistance to macrolides) in animals

Example #2: Consumption of fluoroquinolones in food-producing animals and probability of resistance to ciprofloxacin in *Campylobacter jejuni* in humans

Figure I: Schematic overview of the potential associations between antimicrobial consumption and antimicrobial resistance in humans and food-producing animals investigated in this report

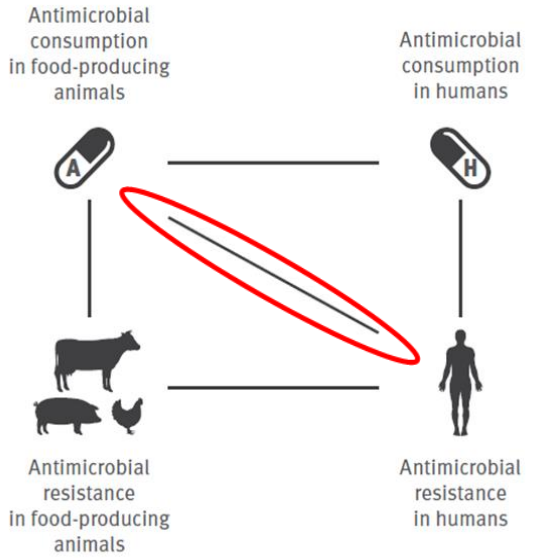
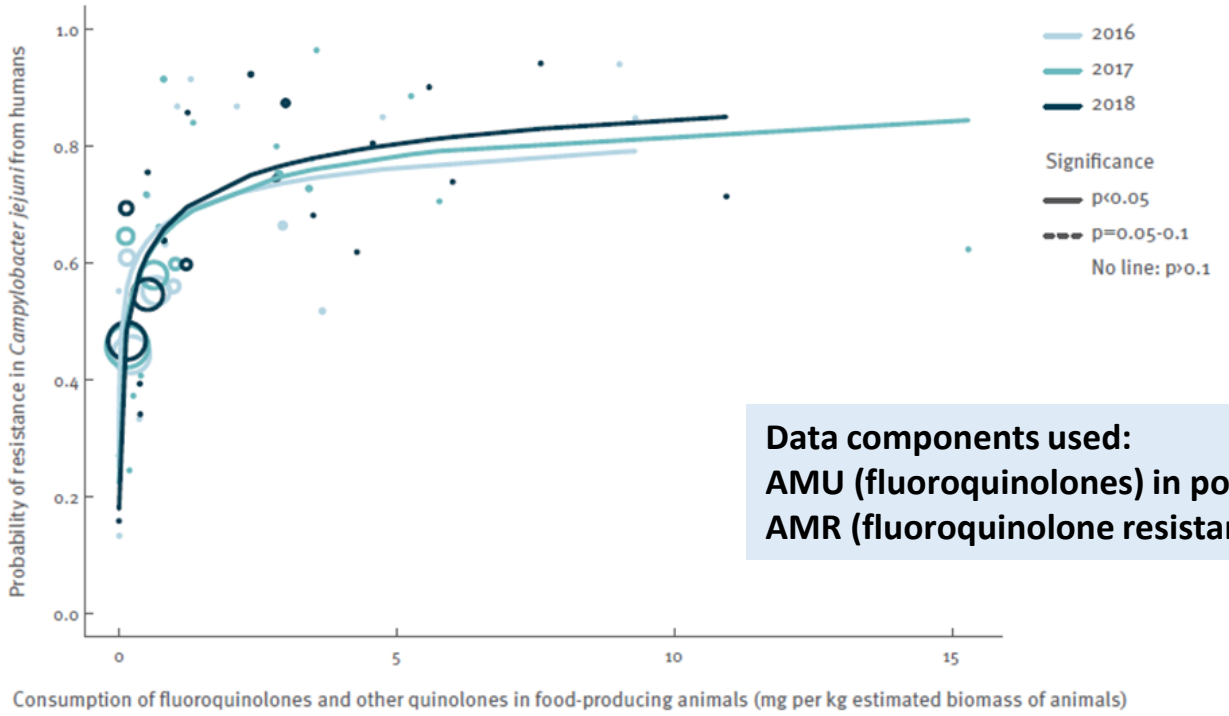


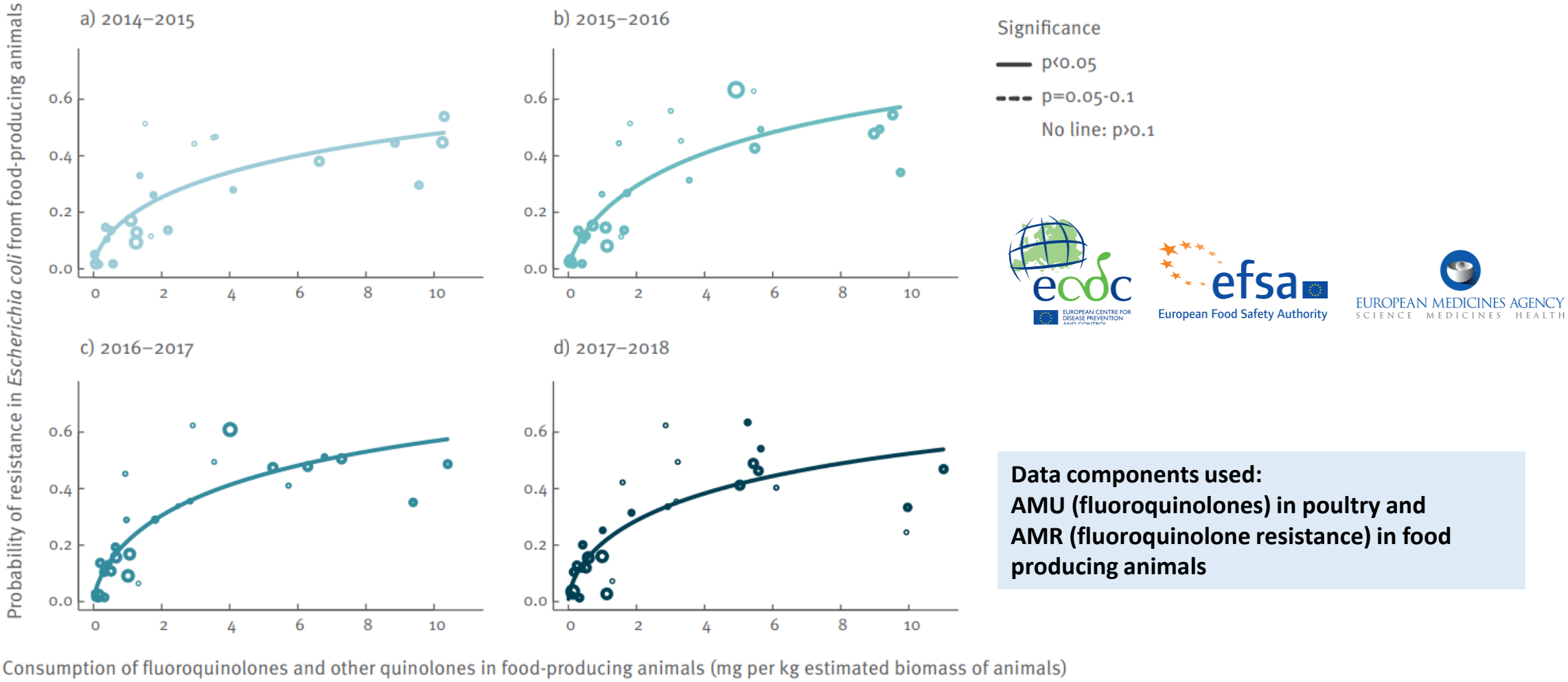
Figure 28: Consumption of fluoroquinolones and other quinolones in food-producing animals and probability of resistance to fluoroquinolones in *Campylobacter jejuni* from humans, EU/EEA, 2016–2017 (see also Table 38)



Data components used:
AMU (fluoroquinolones) in poultry and
AMR (fluoroquinolone resistance) in humans

https://www.ema.europa.eu/en/veterinary-regulatory-overview/antimicrobial-resistance-veterinary-medicine/analysis-antimicrobial-consumption-resistance-jiacra-reports

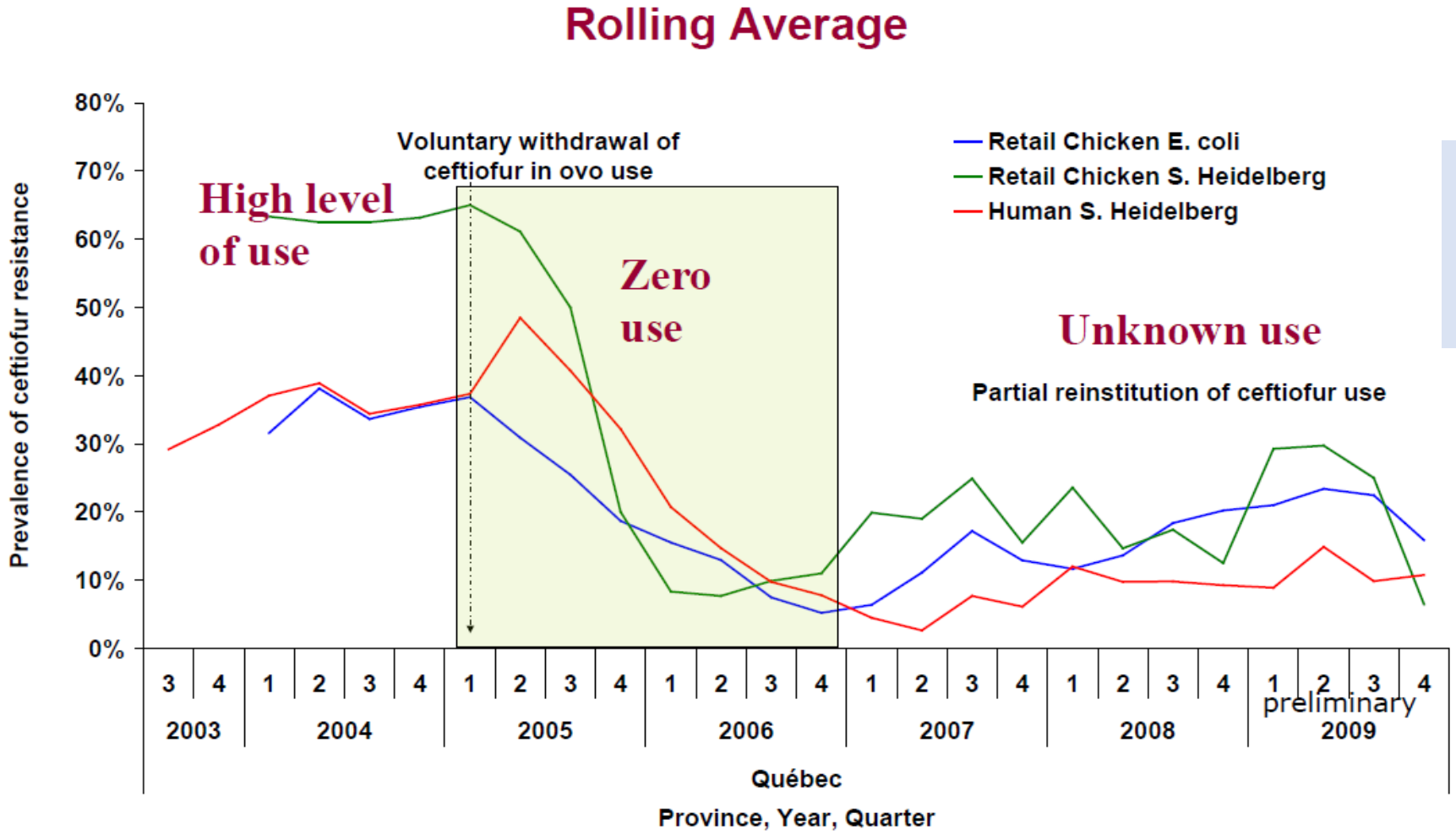
Example #3. Consumption of fluoroquinolones in food-producing animals and probability of resistance to ciprofloxacin in indicator *Escherichia coli*



Data components used:
AMU (fluoroquinolones) in poultry and AMR (fluoroquinolone resistance) in food producing animals

https://www.ema.europa.eu/en/veterinary-regulatory-overview/antimicrobial-resistance-veterinary-medicine/analysis-antimicrobial-consumption-resistance-jiacra-reports

Example #4. Ceftiofur Resistance in Chicken *E. coli* and Human and Chicken *Salmonella* Heidelberg (Québec) CIPARS 2003-2009



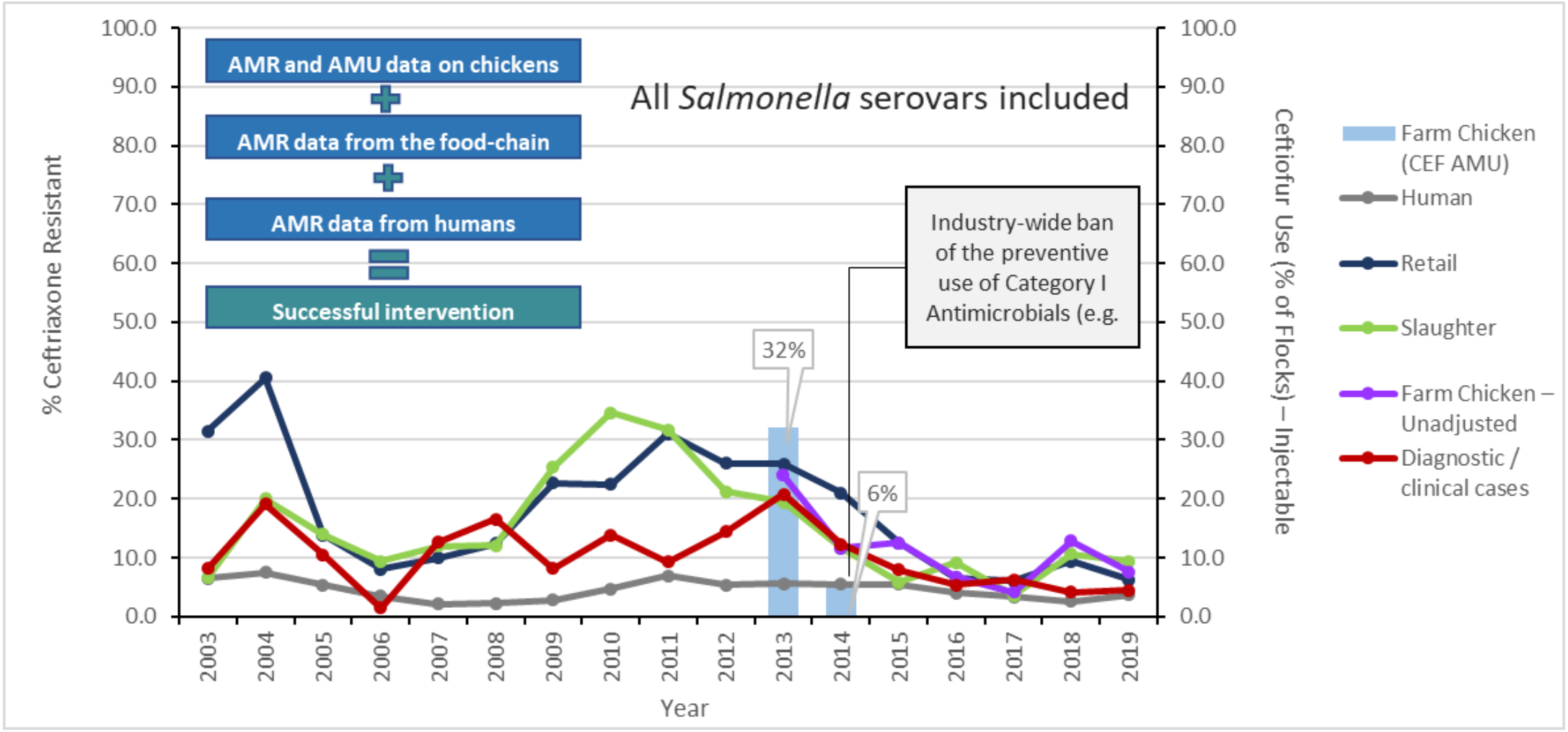
Data components used:
AMR (3rd gen. cephalosporins) in humans
AMR (3rd gen. cephalosporins) in animals
AMU (3rd gen. cephalosporins) in animals*

*industry feedback

Dutil el al. Emerg Infect Dis 2010; 16(1): 48-54

(R. Irwin, PHAC)

Example #4. Ceftiofur Resistance in Chicken *E. coli* and Human and *Chicken Salmonella* Heidelberg (Québec) - beyond 2009



https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-report-2022.html

Objective #2. Support and inform risk analysis for AMR

- Surveillance data
  - Provides baseline data throughout the risk analysis process.
- Explore potential relations between AMU and AMR in microorganisms (humans, food-producing animals, crops, food, feed, feed ingredients)
- Risk profiling and risk assessment
- Measure the effect of interventions
- Identify trends (post-intervention)

Compendium of Codex Standards to minimize and contain foodborne AMR

Code of Practice to Minimize and Contain AMR

Guidelines for **risk analysis** of foodborne AMR

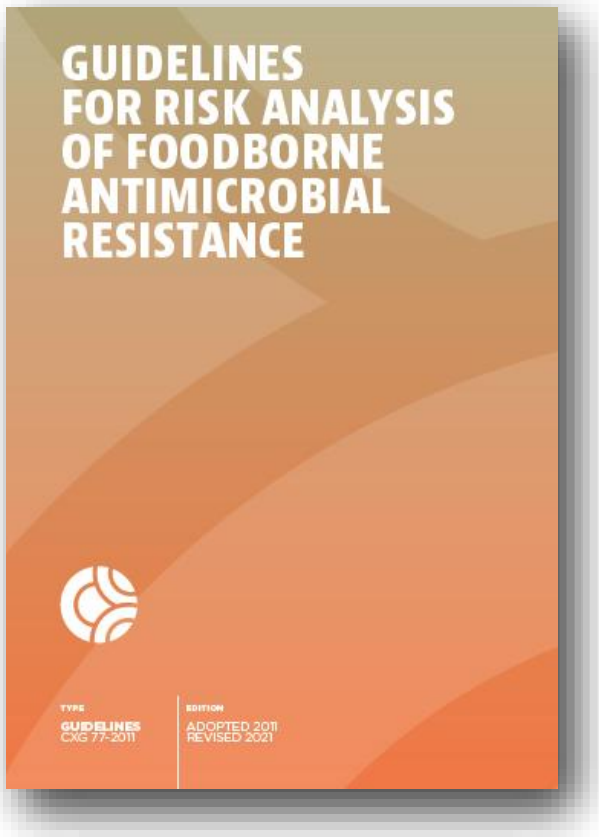
Guidelines for **integrated monitoring and surveillance** of foodborne AMR

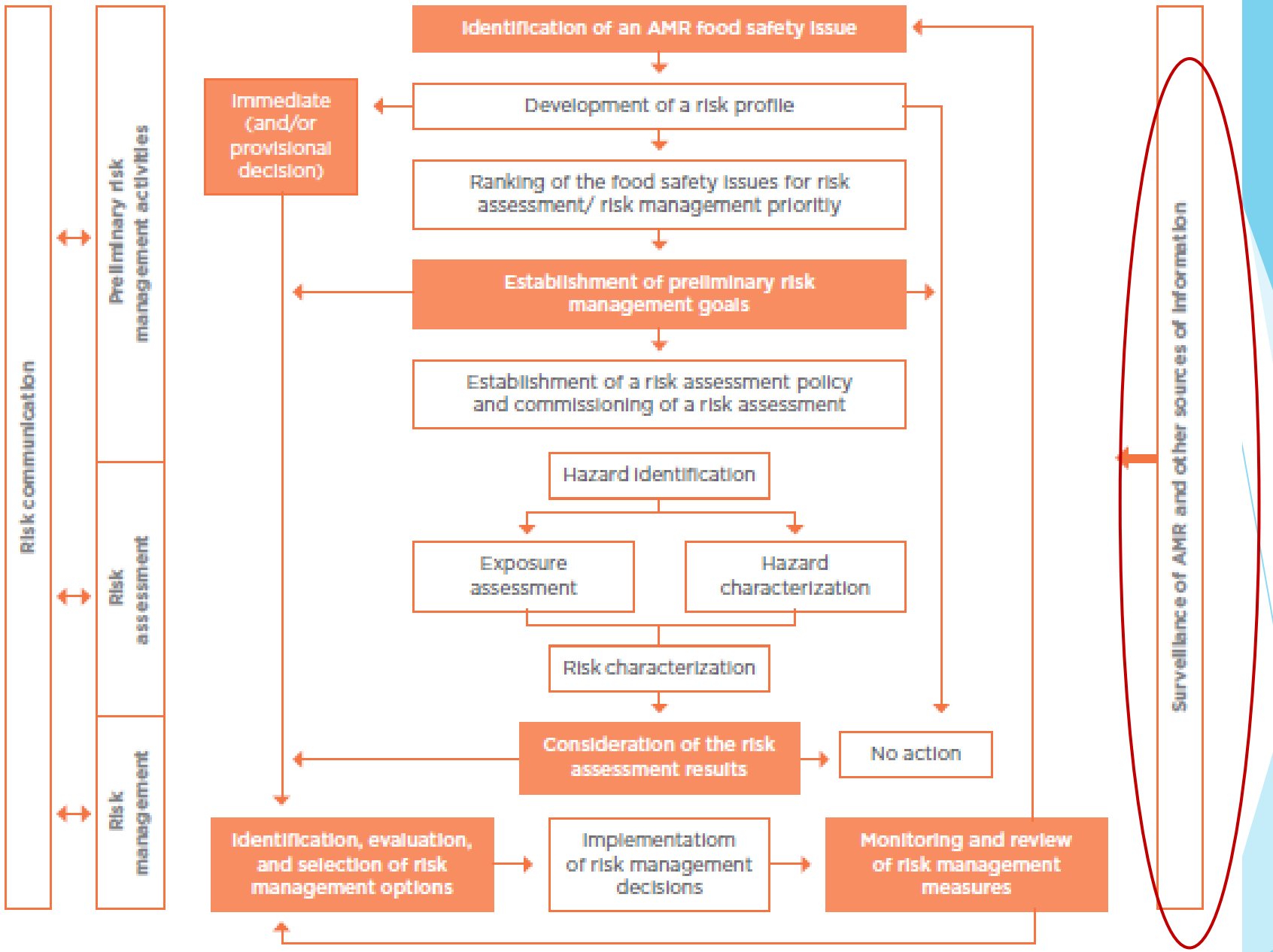
General principles of food hygiene

Codex Maximum Residue Limits

Code of practice for good animal feeding

Principles and guidelines for microbiological risk assessments





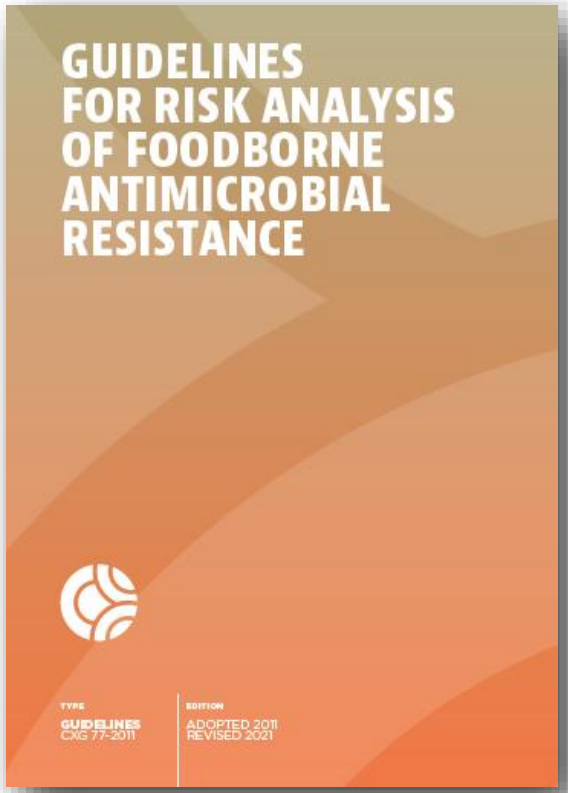
Note: the boxes in orange highlight the key decision points in the framework of foodborne AMR risk analysis

Food and Agriculture Organization of the United Nations

UN environment programme

World H Organization

for Animal Health



Review > Epidemiol Infect. 2019 Nov 4;147:e296. doi: 10.1017/S0950268819001778.

Ceftiofur-resistant *Salmonella enterica* serovar Heidelberg of poultry origin – a risk profile using the Codex framework

Carolee Carson [1], Xian-Zhi Li [2], Agnes Agunos [1], Daleen Loest [1], Brennan Chapman [3], Rita Finley [1], Manisha Mehrotra [2], Lauren M Sherk [4], Réjean Gaumond [5], Rebecca Irwin [1]

Affiliations + expand

PMID: 31679543 PMCID: PMC683657

Free PMC article

RESEARCH ARTICLE | JUNE 30 2022

The CODEX Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance are Incompatible with Available Surveillance Data

Daniel Taylor; Gavin J. Fenske; Jane G. Pouzou; Solenne Costard; Francisco J. Zagmutt

J Food Prot (2022)

https://doi.org/10.4315/JFP-22-038 **Article history**

Food Standards Agency
food.gov.uk

Modelling framework to quantify the risk of AMR exposure via food products: example of chicken and lettuce

January 2022

Carbapenem-resistant *Escherichia coli* from shrimp and salmon available for purchase by consumers in Canada: a risk profile using the Codex framework

Daleen Loest[1], F. Carl Uhland[1*], Kaitlin M. Young[1], Xian-Zhi Li[2], Michael R. Mulvey[3], Richard Reid-Smith[1], Lauren M. Sherk[1] and Carolee A. Carson[1]

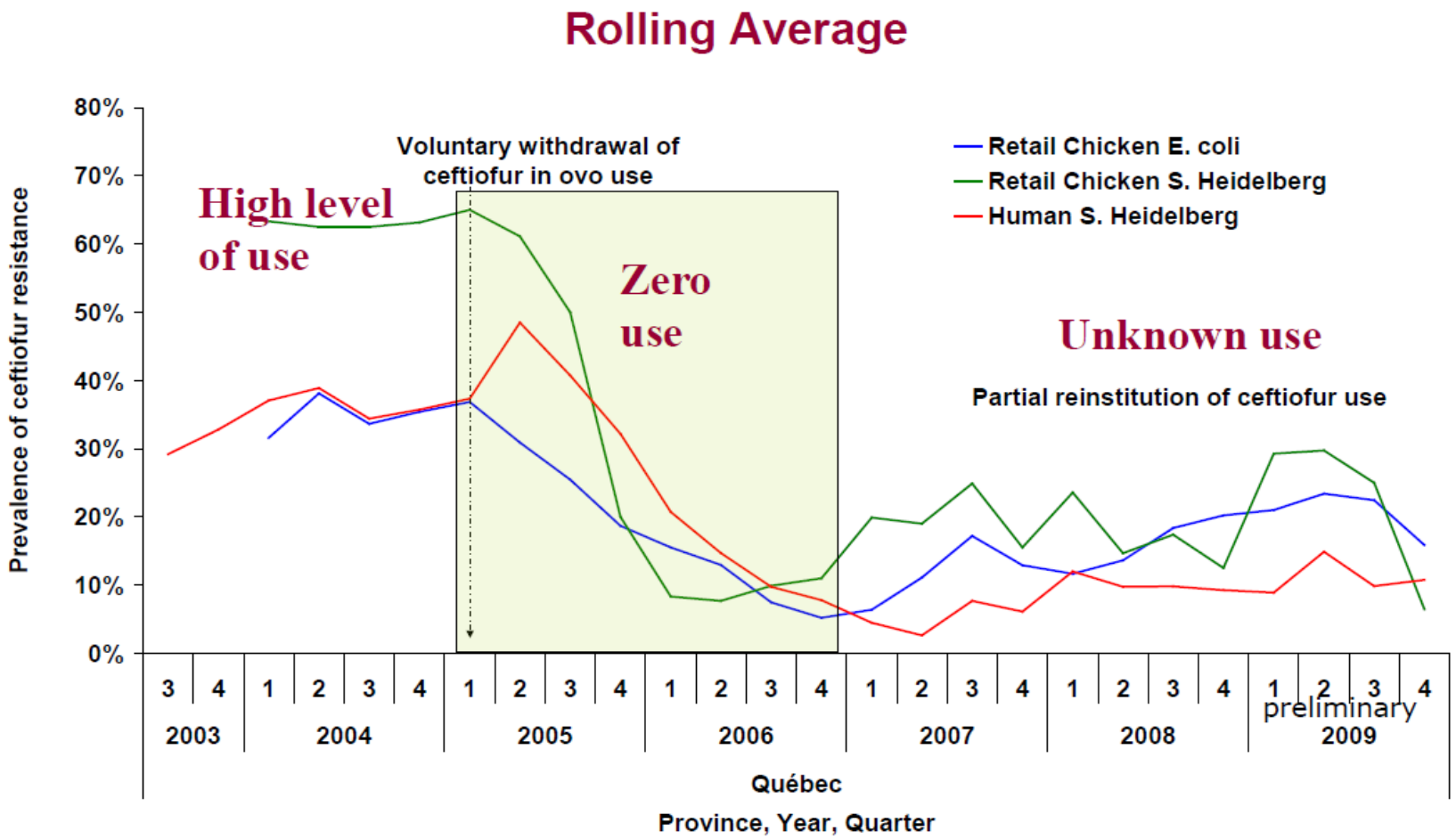
Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

From previous example - risk profiling requires AMU and AMR data (the microorganism, the antibiotic, and the product to which the hazard was detected)



(R. Irwin, PHAC)

Dutil et al. Emerg Infect Dis. 2010 Jan;16(1):48-54

Risk profiling objective: to provide the current state of knowledge regarding the food safety issue and identified risk management options

Description of the AMR food safety issue – ceftiofur resistant *Salmonella* Heidelberg of poultry origin

S. Heidelberg

- serovar that tends to cause more severe illness than other *Salmonella* serovars

hazard

3rd Gen. Cephalosporins (3GCS)

- High-priority critically important antimicrobial for treatment of various infections (people & animals)

Antimicrobial to which resistance is expressed

Chickens

- Meat source commonly consumed by Canadians
- Source of *S.* Heidelberg

Commodity to which hazard is identified

Objective #3. Alert competent authorities about emerging and re-emerging AMR and changes in patterns of AMU

- AMR: marked increased and emerging risks (AMR microoorganisms, MGEs and antimicrobial compounds) :
  - Identify emerging risks
  - Respond swiftly before they spread
- AMU
  - Documentation/evidence of selection pressure -> drivers of AMR
  - Stewardship
  - Between sector variations in use (e.g., HPCIA's) and impact on food safety or MDR infections in humans
- Antimicrobial compounds and their metabolites
  - Detects increasing use and use of new antimicrobial compounds at interfaces with the environment.

Monitoring AMU in both human and animals, example of integration from Canada

There was a different spectrum of antimicrobials sold for use in animals compared to people

Human					Antimicrobial Class	Animal				
2019	2020	2021	2022	2023		2019	2020	2021	2022	2023
0.45	0.46	0.46	0.47	0.47	carbapenems					0.00
2.28	2.29	2.14	2.33	2.28	3-4 gen cephalosporins	0.15	0.15	0.16	0.15	0.16
5.60	4.63	4.24	4.38	4.16	fluoroquinolones	0.08	0.04	0.06	0.09	0.11
19.75	17.12	15.13	17.90	20.28	penicillin beta-lactamase inhibitor combinations	0.24	0.26	0.27	0.28	0.27
16.82	14.78	14.27	14.04	14.21	1-2 gen cephalosporins	0.29	0.31	0.34	0.33	0.32
0.08	0.07	0.07	0.06	0.06	aminoglycosides	0.68	0.73	1.34	0.78	0.84
2.32	2.13	1.93	1.74	1.61	lincosamides	4.10	4.01	4.63	4.59	3.59
4.76	2.87	2.19	3.09	3.17	macrolides	10.23	10.00	9.04	9.26	8.93
29.88	21.15	19.37	26.75	28.31	penicillins	9.45	10.87	12.43	9.07	8.40
6.26	6.08	5.80	5.49	5.51	sulfonamides	7.11	6.77	6.35	7.80	7.88
2.92	2.57	2.64	2.61	2.60	tetracyclines	43.73	48.14	45.60	45.03	43.33
6.26	6.37	6.48	6.58	7.03	other	11.85	12.48	11.41	11.69	12.48

CIPARS

Milligrams adjusted for biomass

0.00 — 45.00

Note: The only medically important antimicrobial class sold for use on crops are aminoglycosides (Source: HC-PMRA).

Animal = food animals, horses, and cats and dogs

Data sources: CARSS (IQVIA) and CIPARS-VASR

Others for **humans** includes: bacitracins, 5th generation cephalosporins, fosfomycins, fusidic acid, glycopeptides, lipopeptides, monobactams, nitrofurans, nitroimidazoles, oxazolidinones, phenicols, and polymyxins.
Others for **animals** includes: aminocoumarins, aminocyclitols, amphenicols, β-lactamase inhibitors, cyclic polypeptides, fusidic acid, glycopeptides, nitrofurantoins, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, polymyxins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis

https://cahss.ca/CAHSS/Assets/Documents/CIPARS%202024%20Stakeholder%20Webinar%20Integrated%20deck%20EN_FINAL.pdf

Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

Alert competent authorities about emerging and re-emerging AMR

Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

Yi-Yun Liu, Yang Wang*, Timothy R Walsh, Ling-Xian Yi, Rong Zhang, James Spencer, Yohei Doi, Guobao Tian, Baolei Dong, Xianhui Huang, Lin-Feng Yu, Danxia Gu, Hongwei Ren, Xiaojie Chen, Luchao Lv, Dandan He, Hongwei Zhou, Zisen Liang, Jian-Hua Liu, Jianzhong Shen*

Summary

Background Until now, polymyxin resistance has involved chromosomal mutations but has never been reported via horizontal gene transfer. During a routine surveillance project on antimicrobial resistance in commensal *Escherichia coli* from food animals in China, a major increase of colistin resistance was observed. When an *E coli* strain, SHP45, possessing colistin resistance that could be transferred to another strain, was isolated from a pig, we conducted further analysis of possible plasmid-mediated polymyxin resistance. Herein, we report the emergence of the first plasmid-mediated polymyxin resistance mechanism, MCR-1, in Enterobacteriaceae.

Lancet Infect Dis 2016; 16: 161–68

Published Online November 18, 2015 http://dx.doi.org/10.1016/S1473-3099(15)00424-7

See Comment page 132

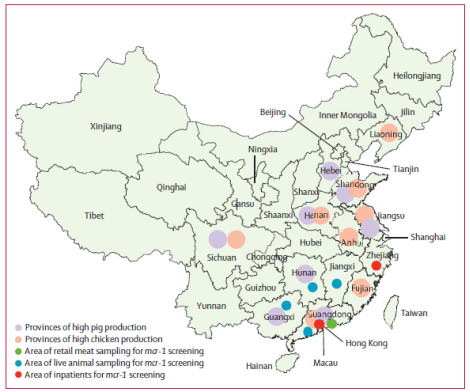


Figure 1: Map of China

	Year	Positive isolates (%)/number of isolates
Escherichia coli		
Pigs at slaughter	All	166 (20·6%)/804
Pigs at slaughter	2012	31 (14·4%)/216
Pigs at slaughter	2013	68 (25·4%)/268
Pigs at slaughter	2014	67 (20·9%)/320
Retail meat	All	78 (14·9%)/523
Chicken	2011	10 (4·9%)/206
Pork	2011	3 (6·3%)/48
Chicken	2013	4 (25·0%)/16
Pork	2013	11 (22·9%)/48
Chicken	2014	21 (28·0%)/75
Pork	2014	29 (22·3%)/130
Inpatient	2014	13 (1·4%)/902
Klebsiella pneumoniae		
Inpatient	2014	3 (0·7%)/420

Table 2: Prevalence of colistin resistance gene *mcr-1* by origin

https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(15)00424-7/abstract

International Journal of Hygiene and Environmental Health 216 (2013) 346–354

Contents lists available at SciVerse ScienceDirect

International Journal of Hygiene and Environmental Health

journal homepage: www.elsevier.com/locate/ijheh

Mini-Review

Escherichia coli O104:H4 outbreak from sprouted seeds

J.M. Soon[a,b,*], P. Seaman[c], R.N. Baines[a,1]

[a] School of Agriculture, Royal Agricultural College, Cirencester, GL7 6JS Gloucestershire, United Kingdom
[b] Faculty of Agro Industry, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia
[c] 17 Gillian Close, Aldershot, Hampshire GU12 4HU, United Kingdom

ARTICLE INFO

Article history:
Received 23 January 2012
Received in revised form 13 June 2012
Accepted 26 July 2012

Keywords:
Farm food safety
Foodborne disease
Reporting system
Hand hygiene
Training

ABSTRACT

From May to July 2011, one of the largest reported outbreaks of haemolytic uraemic syndrome (HUS) and bloody diarrhoea caused by the Shiga toxin-producing *Escherichia coli* (STEC) O104:H4 occurred in Germany and France. The hypothetical origin of the outbreak strain was a combined enteroaggregative *E. coli* and an enterohaemorrhagic *E. coli* with the ability to resist multi-antibiotics and produce Shiga-toxin 2. The combination of aggregative ability, antibiotic resistance and the production of Shiga-toxin 2 significantly affected the severity of the symptoms presented. Since humans may be the primary reservoir, it is likely that contamination could have occurred through contact with infected individuals. Farm food safety management, and hand hygiene training programmes are crucial to primary production to prevent or reduce risks of contamination.

https://www.sciencedirect.com/science/article/abs/pii/S1438463912001010?via%3Dihub

Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

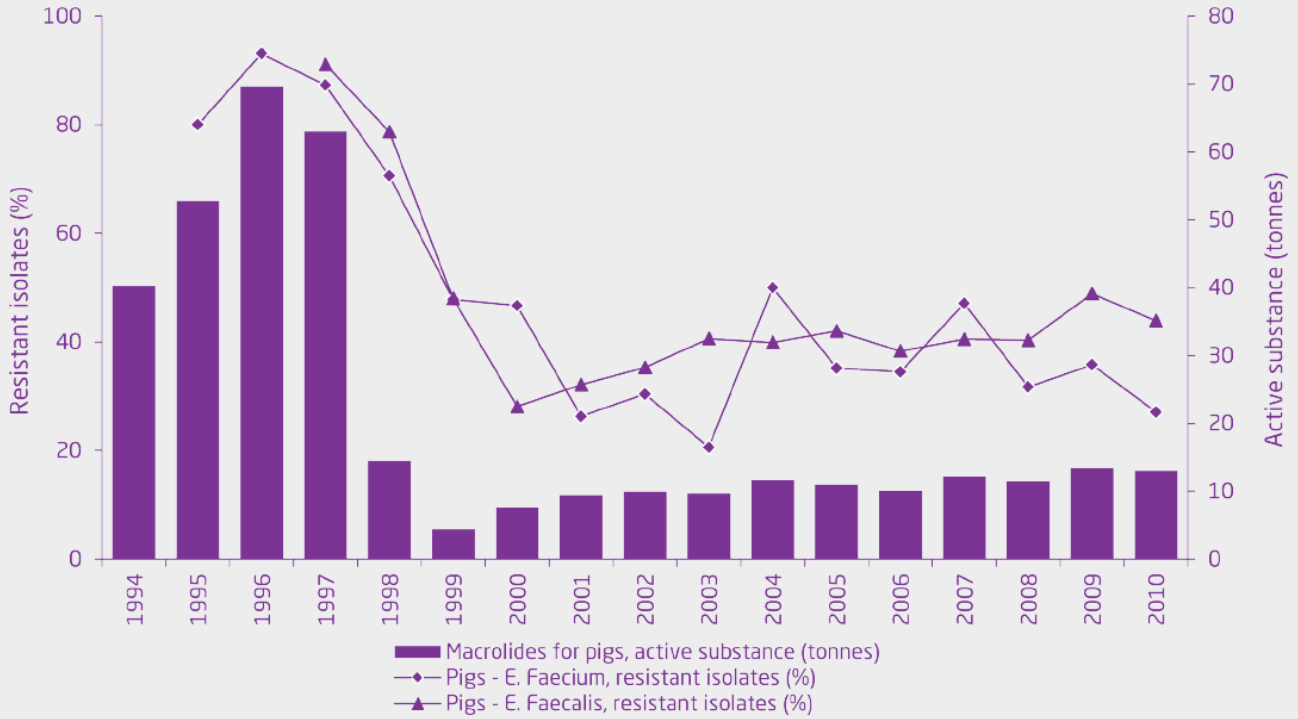
Objective #4. Inform the development of and assess the effectiveness of interventions to address AMR and improve public health and sector-specific outcomes

- To measure, assess, reformulate and improve appropriate, responsible use of antimicrobials in all sectors to ensure that AMU targets are reached without compromising human, animal or plant health
- To obtain more evidence of the impact of AMR at the interfaces of the One Health sectors through research and innovation
- To identify areas on which to focus (human, financial resources, prioritized interventions)

The Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP)

Resistance to erythromycin follows the consumption

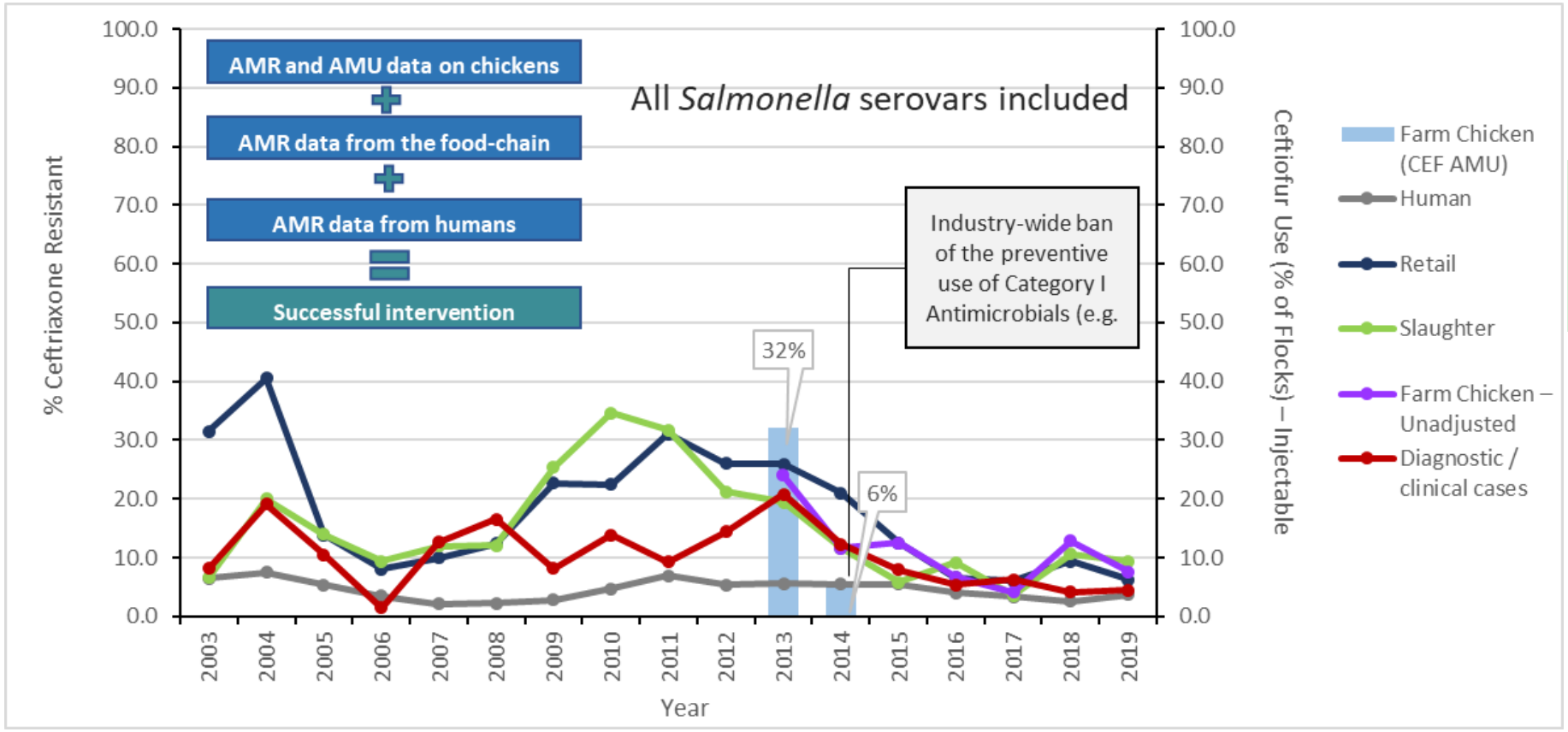
Macrolides are one group of antimicrobial agents that the World Health Organization has indicated as critically important antimicrobial agents for human therapy. The consumption of macrolides in pigs has decreased over the past 15 years, but it is still used. The resistance to one of the macrolides, erythromycin, has followed the decrease in the total consumption of macrolides, showing an association between consumption and resistance.



DANMAP - Data for action

Intervention: Surveillance data enabled monitoring of AMU and AMR trends before and after the intervention

Ceftiofur Resistance in Chicken *E. coli* and Human and Chicken *Salmonella* Heidelberg (Québec) - beyond 2009

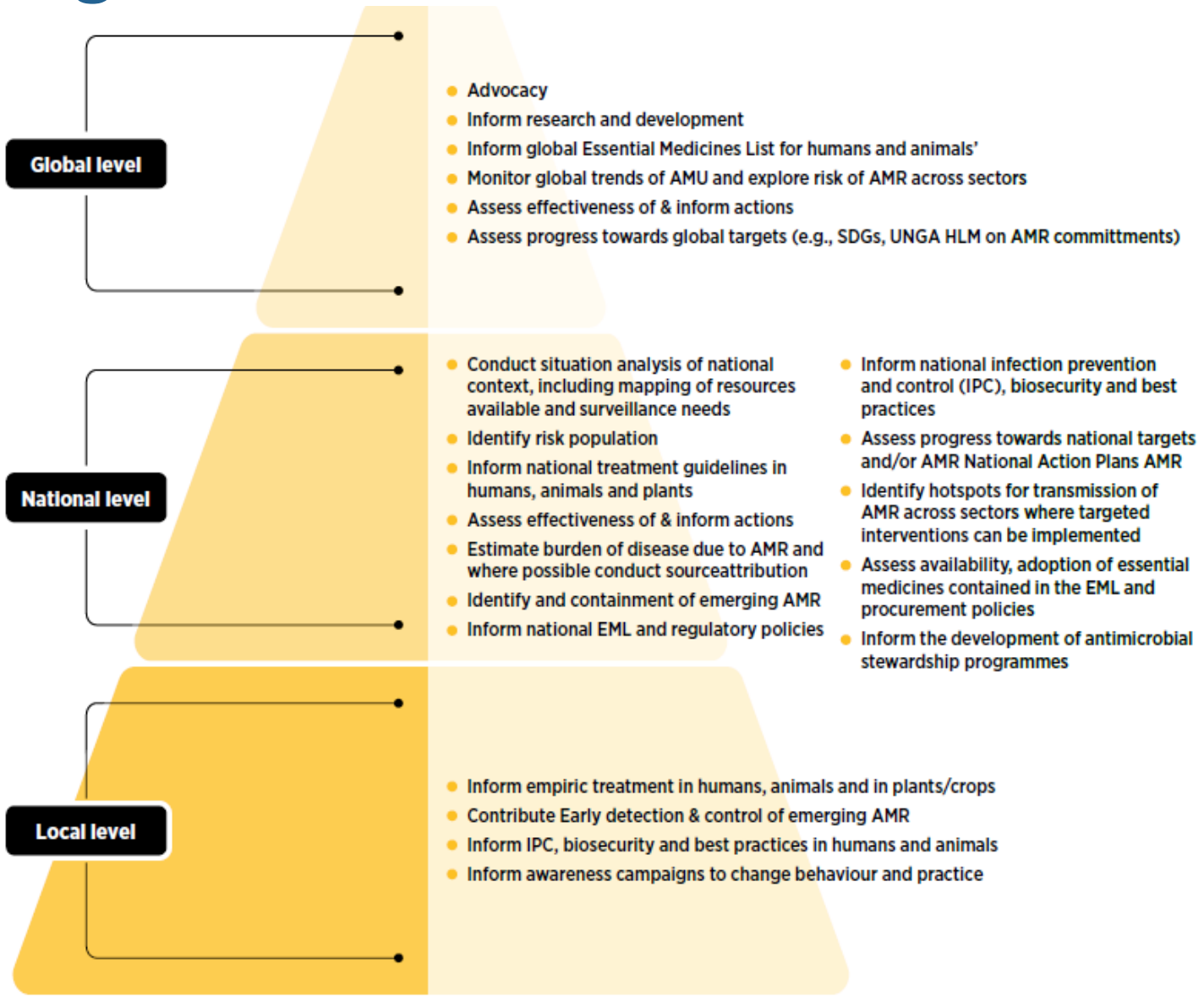


Intervention: Surveillance data enabled monitoring of AMU and AMR trends before and after the intervention

https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-report-2022.html

Food and Agriculture Organization of the United Nations
UN environment programme
World Health Organization
World Organisation for Animal Health

Integrated surveillance can inform action



The outcomes of integrated surveillance can inform local, national or global action

Food and Agriculture Organization of the United Nations

UN environment programme

World Health Organization

World Organisation for Animal Health

Take away message!

High-quality sectoral AMU and AMR data are fundamental for integrated surveillance. They serve multiple One Health purposes/objectives and drive effective, evidence-based decision-making.

Comments and discussion