





7.

Resistance in indicator bacteria

7. Resistance in indicator bacteria

Highlights

In 2025, the occurrence of **fully susceptible indicator *E. coli*** increased further in broilers to 66%, remained stable in pigs at 41%, and decreased from 93% to 88% in cattle compared with 2024.

The occurrence of **multidrug-resistant (MDR) indicator *E. coli*** remained stable in broilers (13%) and pigs (34%), while in cattle it increased to 11%, returning to levels observed before the marked decline reported in 2024. Combined resistance to ampicillin, sulfamethoxazole and tetracycline (ASuT) continued to be a common MDR profile in pigs.

Compared with 2024, **resistance levels in *E. coli*** from broilers and pigs changed only marginally (1 to 3 percentage points) for most antimicrobials. In cattle, resistance to ampicillin, trimethoprim, chloramphenicol, sulfamethoxazole and tetracycline increased, returning to levels similar to those observed in 2021-2022.

Resistance to ciprofloxacin in indicator *E. coli* from broilers continued its downward trend and reached 9% in 2025. Resistance to fluoroquinolones remained very low in cattle (<1%) and pigs (2%). No resistance to colistin, meropenem, or third-generation cephalosporins was detected among indicator *E. coli* isolates.

The specific monitoring of **ESBL/AmpC-producing *E. coli*** detected an increase in occurrence in Danish pigs from 18% in 2023 to 22% in 2025, while prevalence in cattle, beef and pork remained largely unchanged, fluctuating by only 1 to 2 percentage points. ESBL/AmpC-producing *E. coli* continued to occur more frequently in imported pork (10%) than in Danish pork (1%).

No **carbapenemase-producing (CP) *E. coli*** were detected in any retail meat samples. Among ESBL/AmpC-producing isolates, resistance to colistin, meropenem and tigecycline remained absent. From 2023 to 2025, ciprofloxacin resistance and resistance to cefepime increased among ESBL/AmpC-producing *E. coli* from pigs, by 6 and 9 percentage points respectively, while ertapenem resistance was no longer detected.

Among **enterococci** from pigs, the proportion of fully susceptible isolates was 18% for *E. faecalis* and 10% for *E. faecium*. Compared with previous monitoring years, resistance increased for several antimicrobials, most notably erythromycin, chloramphenicol and daptomycin in *E. faecalis*, and ampicillin, ciprofloxacin and quinupristin/dalfopristin in *E. faecium*. Notably, resistance to linezolid or tigecycline were detected among few enterococci. No vancomycin resistance was detected.

7.1 Introduction

Escherichia coli and *Enterococcus* are included in the DANMAP programme to monitor the occurrence of antimicrobial resistance (AMR) in different reservoirs throughout the food chain for the following reasons: i) they are present as commensals in the gut microbiota of healthy animals and humans, ii) they can acquire antimicrobial resistance both via mutations in chromosomal genes and horizontal transfer of antimicrobial resistance genes, and iii) they have the potential to cause infections in both animals and humans, and to transfer antimicrobial resistance to pathogenic bacteria of the same or other species.

E. coli exhibiting resistance to third generation cephalosporins via the production of extended-spectrum beta-lactamases (ESBLs) and AmpC beta-lactamases (AmpCs) are among the fastest spreading antimicrobial resistance threats in both humans and food-producing animals worldwide.

Carbapenemase-producing *Enterobacteriaceae* (CPE) pose a great threat to human health, as carbapenems are last-line antimicrobial drugs for the treatment of infections caused by multidrug-resistant Gram-negative bacteria.

Isolation and antimicrobial susceptibility testing of indicator *E. coli*, indicator enterococci and ESBL-, AmpC- and carbapenemase (CP)-producing *E. coli* are performed in accordance with the rules for the EU harmonised monitoring of antimicrobial resistance [Decision 2020/1729/EU].

In 2025, isolates were obtained from randomly selected caecal samples collected from healthy broilers, cattle (calves under one year of age), and fattening pigs at slaughter. Additionally, for the specific monitoring of ESBL-, AmpC- and CP-producing *E. coli*, fresh meat from pigs and cattle was collected at retail.

Details on sampling, analysis, susceptibility testing and interpretation of results are presented in Chapter 10.

7.2 Indicator *Escherichia coli*

Indicator *E. coli* isolates were obtained from 95% of caecal samples from broiler flocks (130/137), 97% of samples from pigs (173/179), and 96% of samples from cattle (177/184).

7.2.1 Indicator *Escherichia coli* from broilers, cattle and pigs

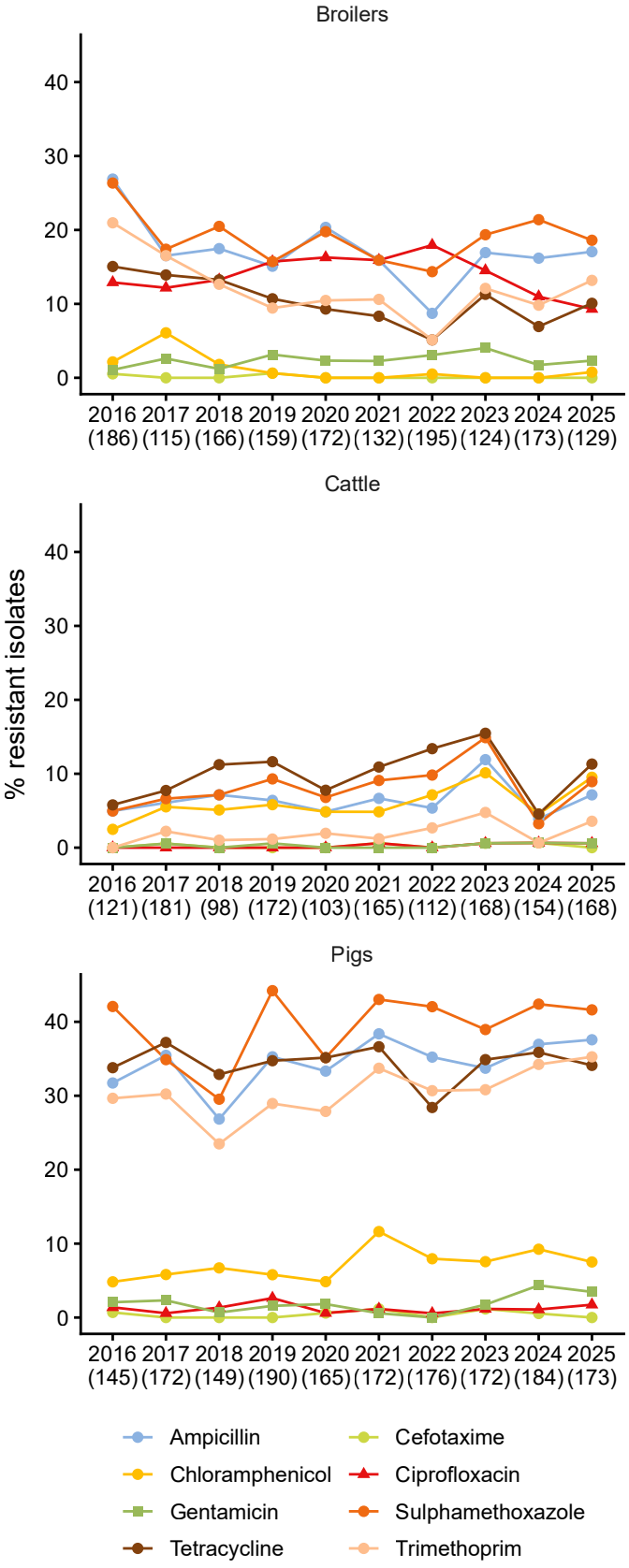
As in 2024, the percentage of broiler isolates susceptible to all antimicrobials in the test panel continued to increase in 2025 (66%, 2 percent points higher than in the previous year). After an observed increase to 93% of full-susceptibility in isolates from cattle in the previous year, in 2025 the level decreased to 88%. Among isolates from pigs, the occurrence of full-susceptibility remained similar to what was observed in 2024 (41%), with a one percent point oscillation (Table 7.1, Figure 7.2).

Table 7.1 Resistance (%) in *Escherichia coli* isolates from broilers, cattle and pigs, Denmark, 2025 DANMAP 2025

	Broilers	Cattle	Pigs
	Danish	Danish	Danish
	%	%	%
Amikacin	<1	0	2
Ampicillin	17	7	38
Azithromycin	0	0	6
Cefotaxime	0	0	0
Ceftazidime	0	0	0
Chloramphenicol	<1	10	8
Ciprofloxacin	9	<1	2
Colistin	0	0	0
Gentamicin	2	<1	3
Meropenem	0	0	0
Nalidixic acid	9	0	2
Sulphamethoxazole	19	9	42
Tetracycline	10	11	34
Tigecycline	0	0	<1
Trimethoprim	13	4	35
Fully susceptible (%)	66	88	41
Number of isolates	129	168	173

An isolate is considered fully susceptible if sensitive to all antimicrobial agents included in the test panel (Chapter 10, Table 10.2).

Figure 7.1 Resistance (%) among *Escherichia coli* isolates from broilers, cattle and pigs, Denmark, 2016-2025 DANMAP 2025



The number of isolates included each year is shown in the parentheses.

For *E. coli* isolates from broilers and pigs, the fluctuations in the occurrence of resistance to most antimicrobials in the test panel were minor between 2024 and 2025 (1-3% points). Resistance to some antimicrobials among isolates from cattle increased more markedly in 2025, after the decrease observed in 2024. Specifically, there was 3% points increase for ampicillin and trimethoprim resistance, 5% points for chloramphenicol resistance and 6% points for sulphametoxazole and tetracycline resistance; these resistance levels are similar to those observed in the period of 2021-2022 (Figure 7.1).

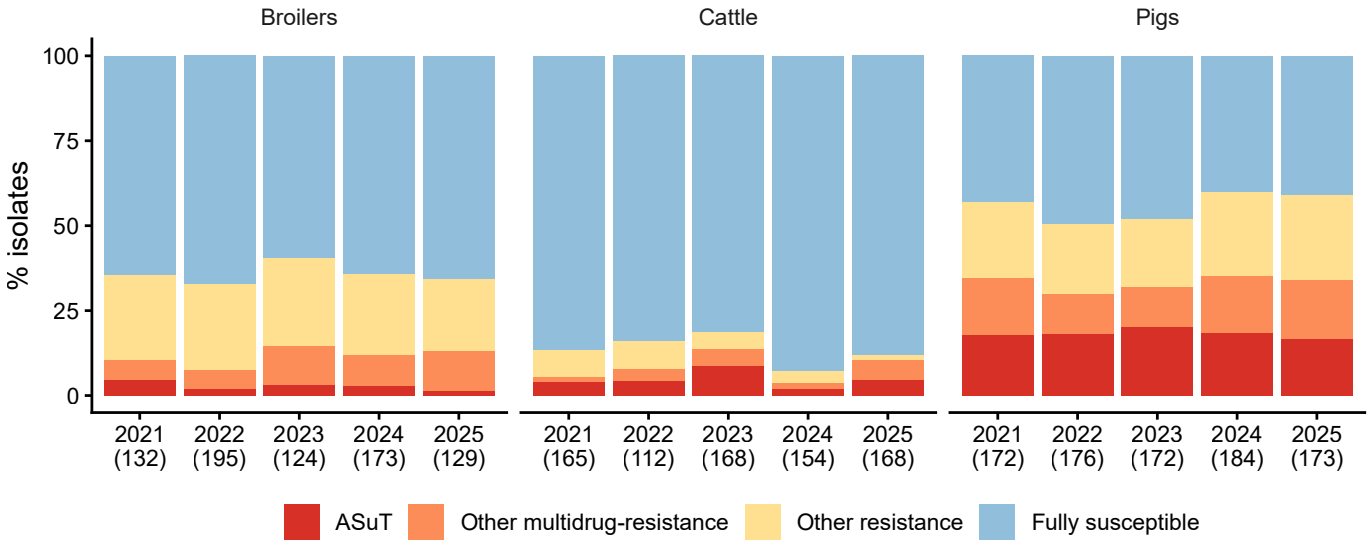
Remarkably, the occurrence of resistance to ciprofloxacin in *E. coli* from broilers continued decreasing in 2025, after the decrease already observed in the two previous years, with fluoroquinolone resistance reaching the level of 9%. These findings reinforce the hypothesis of an ongoing decreasing trend.

Notably, in pig isolates (although by a limited magnitude), the increase in resistance to macrolides already observed in 2024 continued in 2025 (azithromycin: from 4% to 6%), while the occurrence of resistance to aminoglycosides remained somewhat stable (amikacin: 2%; gentamicin: 3%).

As in previous years, no isolates resistant to colistin or meropenem were detected in 2025. Similarly, resistance to third generation cephalosporins was not detected in indicator *E. coli* using non-selective methods. Resistance to fluoroquinolones continues to be very low (up to 2%) in isolates from cattle and pigs, and higher (9%) among broiler isolates. Among pig isolates, one was resistant to tigecycline, three were resistant to amikacin and eleven were resistant to azithromycin. A single isolate from broilers was resistant to amikacin (Table 7.1).

In 2025, the occurrence of multidrug-resistance (MDR) in *E. coli* from broilers, including combined resistance to ampicillin, sulfamethoxazole and tetracycline (ASuT) and other MDR profiles, was 13%, like that observed in 2024. In pigs, occurrence of MDR and other resistance profiles also appeared relatively stable in comparison with the previous year (34%), and ASuT resistance was as frequent as the joint occurrence of other MDR profiles. Notably, in cattle, following the marked decrease observed in 2024, the occurrence of MDR *E. coli* returned to 11% (5% ASuT and 6% other MDR profiles) in 2025 (Figure 7.2).

Figure 7.2 Relative distributions (%) of fully susceptible, resistant and multidrug-resistant *Escherichia coli* isolates from broilers, cattle and pigs, Denmark, 2021-2025 DANMAP 2025



The number of isolates included each year is shown in parentheses. An isolate is considered fully susceptible if sensitive to all antimicrobial agents included in the test panel, and multidrug-resistant if resistant to 3 or more of the 12 antimicrobial classes included in the test panel (Chapter 10, Table 10.3). ASuT are the multidrug-resistant isolates resistant to ampicillin, sulphamethoxazole and tetracycline.

7.3 ESBL/AmpC- and carbapenemase-producing *E. coli*

In 2025, caecal samples collected from pigs and cattle at slaughter, and from packages of fresh, chilled pork and beef collected from Danish wholesale and retail outlets were subject to the specific monitoring of ESBL/AmpC- and CP-producing *E. coli* and the corresponding results are reported in this chapter. Furthermore, samples from consignments of imported pork and beef were sampled at Danish border control posts (BCP) in agreement with the EU harmonized AMR monitoring [Decision 2020/1729/EU]. None of the samples collected at BCPs tested positive for ESBL/AmpC- or CP-producing *E. coli*, and due to the low sample size the results of the BCP monitoring are not included in the chapter.

Among the samples randomly collected at retail, 26% (83 out of 323) of pork samples and 51% (149 out of 293) of beef samples were imported products. The distribution of the country of origin of the sampled imported pork meat did not change considerably compared to 2023, with the same two EU countries representing 84% of all samples in 2025 (previously 92%). The distribution of the country of origin of the sampled imported beef changed somewhat compared to the previous reporting year. In 2023, the collected samples originated predominantly (57%) from one of three EU countries. In 2025, only two of those countries remained as a predominant origin of beef samples (43%), with other two countries, one EU (15%) and one non-EU (19%), also being highly represented. Still, the predominant country representing most samples of imported pork and beef did not change between 2023 and 2025.

As in previous years, the selective procedures for detection of CP-producing *E. coli* (including oxacillinase-producing OXA-48-like enzymes), recovered no isolates from retail meat.

7.3.1 Prevalence of ESBL/AmpC-producing *E. coli* in animals and meat

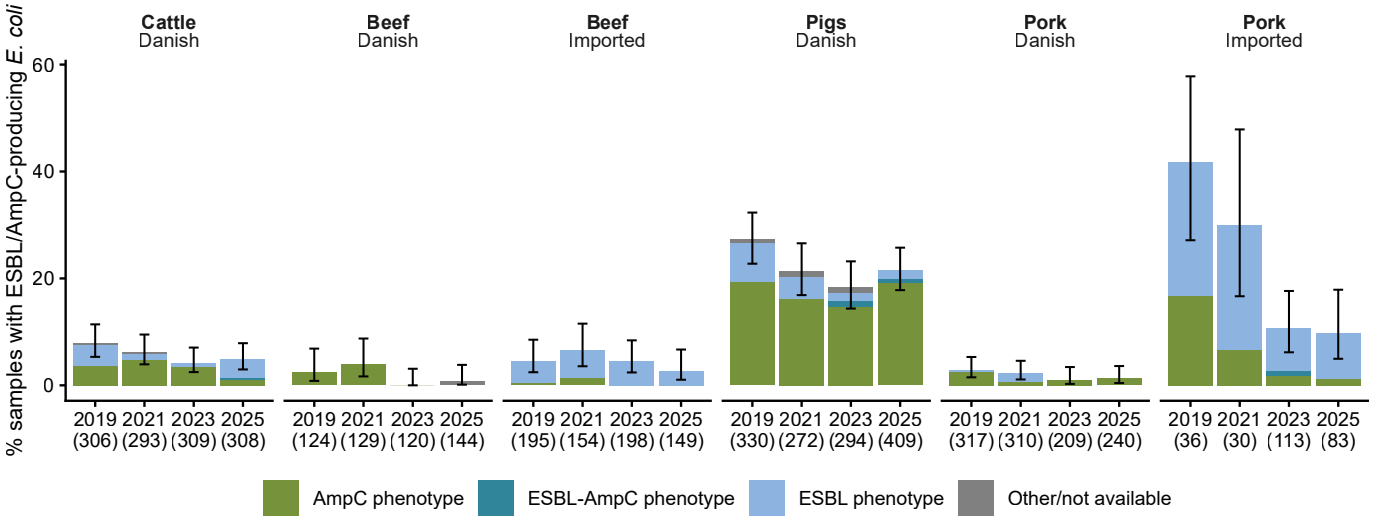
Following selective enrichment, ESBL/AmpC-producing isolates, i.e. *E. coli* resistant to third generation cephalosporins (cefotaxime and/or ceftazidime), here abbreviated as ESBL/AmpC *E. coli*, were obtained from 88/409 samples from pigs (22%; CI 95%: 18-26%), 3/240 samples from Danish pork (1%; CI 95%: 0.4-4%), 8/83 samples from imported pork (10%; CI 95%: 5-18%), 15/308 samples from cattle (5%; CI 95%: 3-8%), 1/144 samples from Danish beef (1%; CI 95%: 0.1-4%), and 4/149 samples from imported beef (3%; CI 95%: 1-7%) (Figure 7.3, Table 7.2).

In 2025, in comparison to 2023, the prevalence of ESBL/AmpC *E. coli* has increased in Danish pigs by 4% points (from 18% to 22%) and fluctuated in Danish and imported pork by 1-2% points. As previously, ESBL/ AmpC *E. coli* continued to show higher occurrence in imported pork compared to Danish pork.

Similarly, in 2025 compared to 2023, the prevalence of ESBL/AmpC *E. coli* in Danish calves and domestic and imported beef oscillated only by 1-2% points, and as seen previously the discrepancy in occurrence between domestic and imported meat is not as marked as that observed in pork (Figure 7.3, Table 7.2).

Figure 7.3 Occurrence (%) of samples with phenotypic ESBL- or AmpC-producing *E. coli* from animals and meat recovered by selective enrichment, Denmark 2019-2025

DANMAP 2025



Number of samples tested per year is presented in the parentheses. Confidence intervals for total proportion of samples positive for phenotypic ESBL and/or AmpC producing *E. coli* - calculated as 95% binomial proportion Wilson intervals. Classification of ESBL and AmpC phenotypes according to the scheme provided by EFSA (Chapter 10, Section 10.7.2).

7.3.2 Phenotypic resistance in ESBL/AmpC-producing *E. coli*

The distribution of phenotypes seems relatively stable across the samples tested for specific monitoring of ESBL/AmpC-producing *E. coli*, apart from a shift to a higher proportion of ESBL phenotypes and a lower proportion of AmpC phenotypes among isolates from cattle in 2025 (Figure 7.3). Due to the overall low number of isolates recovered from cattle and retail meat, it is important to carefully interpret any increasing or decreasing trends in the occurrence of resistance in these samples.

As in previous years, all the recovered ESBL/AmpC *E. coli* isolates were resistant to both third generation cephalosporins (cefotaxime and ceftazidime) and ampicillin. In 2025, 87% of the cattle isolates, all isolates from imported beef, 33% of the pig isolates and 88% of isolates from imported pork were also resistant to fourth generation cephalosporins (cefepime). Among isolates from pigs, cefepime resistance occurrence has increased from 24% (of a total of 54 isolates) in 2023 to 33% (of a total of 88 isolates) in 2025 (Table 7.2).

From 2023 to 2025, the observed resistance to fluoroquinolones (ciprofloxacin) has also increased in ESBL/AmpC *E. coli* from Danish pigs (from 6% in 2023 to 12% in 2025).

Unlike the previous monitoring year, in 2025 ertapenem resistance was not observed in any ESBL/AmpC *E. coli* isolates (previously 11% in isolates from imported pork). Resistance against meropenem was also not observed, and a single isolate from pigs showed resistance to imipenem, a decrease compared to the 6% occurrence observed in 2023.

As previously, there was no occurrence of colistin or tigecycline resistance among the recovered ESBL/AmpC *E. coli*, and temocillin resistance was detected in 3% of the isolates from pigs.

Opposed to 2023, in 2025, azithromycin resistance was not observed in cattle or beef isolates, and it was detected in pig and pork isolates (16% in pigs, a single isolate from Danish pork and two isolates from imported pork). Notably, among cattle isolates, the occurrence of gentamicin resistance increased from 8% in 2023 (from a total of 13 isolates) to 27% in 2025 (from a total of 15 isolates), while it decreased among pig isolates, from 11% in 2023 to 7% in 2025.

Table 7.2 Resistance (%) and resistance phenotypes in specific monitoring of ESBL/AmpC-producing *Escherichia coli* from animals and meat recovered by selective enrichment, Denmark, 2025 DANMAP 2025

	Cattle	Beef		Pigs	Pork	
Antimicrobial agent	Danish %	Danish %	Import %	Danish %	Danish %	Import %
Amikacin	7	0	0	1	0	0
Ampicillin	100	100	100	100	100	100
Azithromycin	0	0	0	16	33	25
Cefepime	87	0	100	33	0	88
Cefotaxime	100	100	100	100	100	100
Cefotaxime/clavulanic acid	20	100	0	90	100	12
Cefoxitin	27	0	0	92	100	12
Ceftazidime	100	100	100	99	100	100
Ceftazidime/clavulanic acid	20	100	0	90	100	12
Chloramphenicol	40	0	25	10	0	50
Ciprofloxacin	67	0	50	12	0	50
Colistin	0	0	0	0	0	0
Ertapenem	0	0	0	0	0	0
Gentamicin	27	0	0	7	0	12
Imipenem	0	0	0	1	0	0
Meropenem	0	0	0	0	0	0
Nalidixic acid	13	0	25	7	0	25
Sulphamethoxazole	53	0	50	58	67	38
Temocillin	0	0	0	3	0	0
Tetracycline	27	0	75	65	100	62
Tigecycline	0	0	0	0	0	0
Trimethoprim	20	0	0	67	67	75
Number of AmpC phenotypes	3	0	0	78	3	1
Number of ESBL phenotypes	11	0	4	7	0	7
Number of ESBL+AmpC phenotypes	1	0	0	3	0	0
Other phenotypes	0	1	0	0	0	0
Number of isolates (%)	15 (5%)	1 (1%)	4 (3%)	88 (22%)	3 (1%)	8 (10%)
Number of samples	308	144	149	409	240	83

Classification of ESBL-, AmpC- and AmpC+ESBL phenotypes is based on the MIC results (Chapter 10, Section 10.7.2). AmpC, ESBL and AmpC+ESBL phenotypes indicate the number of isolates expressing each specific phenotype.

7.3.3 Genotypic resistance in ESBL/AmpC-producing *E. coli*

The genetic basis for ESBL and AmpC enzymes was detected in most ESBL/AmpC-producing isolates, with the detected enzymes mainly corresponding to the phenotypes derived from susceptibility testing. A single isolate from Danish beef did not show an AmpC-producing phenotype, while whole genome sequencing revealed an upregulated AmpC promotor C-42T mutation. Another isolate from cattle showed an ESBL and AmpC-producing phenotype, even though the genomic analysis only revealed an ESBL genotype. Finally, two isolates from pigs showed an AmpC phenotype but an ESBL genotype (Tables 7.2 and 7.3).

Among the AmpC-producing isolates recovered in 2025, resistance was, as observed in previous years, mainly conferred by upregulated AmpC promotor C-42T mutations (three isolates from cattle, one from Danish beef, 76 from pigs, three from Danish pork and one from imported pork). However, among isolates from pigs, the plasmid-mediated AmpC beta-lactamase encoding genes blaCMY-2 (one isolate) and blaDHA-1 (six isolates) were also observed (Table 7.3).

Among all ESBL-producing isolates, nine different ESBL genes were detected. Overall, the most observed ESBL encoding genes across all categories of animals and meat sampled in 2025 were blaCTX-M-15 (9 isolates), blaCTX-M-14 (7 isolates), blaCTX-M-1 and blaCTX-M-55 (6 isolates). While the CTX-M-1 and CTX-M-14 enzymes were most common among pig isolates, CTX-M-15 and CTX-M-55 were most abundant among isolates from cattle. The ESBL genes blaCTX-M-8, blaTEM-106 and blaTEM-126 were only detected in single isolates from pigs. Among the two pig isolates that harbored both ESBL and AmpC genotypes, upregulated AmpC promotor C-42T mutation was detected, together with the ESBL genes blaTEM-106 and blaTEM-126 (one isolate) and blaTEM-207 (one isolate).

In total, 32 MLSTs were observed among all ESBL/AmpC-producing *E. coli* isolates. The most common MLST was ST88, followed by ST156. These frequencies were mostly due to the overrepresentation of pig isolates. Among cattle isolates, ST58 was most commonly observed, while only two ST88 were detected and ST156 was absent.

Table 7.3 Number of ESBL and AmpC enzymes detected in beta-lactamase-producing *E. coli* isolates from animals and meat recovered by selective enrichment, Denmark, 2025 DANMAP 2025

	Cattle	Beef		Pigs	Pork	
Enzymes	Danish	Danish	Import	Danish	Danish	Import
CTX-M-1	1		1	3		1
CTX-M-14			1	4		2
CTX-M-15	6		2			1
CTX-M-27	1					1
CTX-M-55	4			1		1
CTX-M-8				1		
TEM-106				1		
TEM-126				1		
TEM-207				2		2
CMY-2				1		
DHA-1				6		
Chromossomal AmpC (C-42T)	3	1		71	3	1
Number of AmpC genotypes	3	1		76	3	1
Number of ESBL genotypes (two or more enzymes)	12		4	9 (2)		6 (2)
Number of AmpC+ESBL genotypes				2		
Number (%) positive samples	15 (5%)	1 (1%)	4 (3%)	88 (22%) [a]	3 (1%)	8 (10%) [b]
Number of tested samples	308	144	149	409	240	83

Number (%) positive samples are isolates recovered by selective enrichment methods for monitoring of beta-lactamase-producing *E. coli* ESBL/AmpC enzymes were determined by whole genome sequencing of the recovered isolates (Chapter 10, Section 10.6). [a] WGS was only available for 87 of the 88 isolates; [b] WGS was only available for 7 of the 8 isolates.

7.4 Indicator *Enterococci*

Enterococci were obtained from 204 (42%) out of 490 faecal samples taken from pigs at slaughter, and antimicrobial susceptibility testing was subsequently performed on 122 *E. faecalis* isolates and on 80 *E. faecium* isolates.

7.4.1 *E. faecalis* and *E. faecium* from pigs

Overall, 18% of the *E. faecalis* isolates and 10% of the *E. faecium* isolates were susceptible to all antimicrobials in the test panel (Table 7.4).

As in 2023, the previous year of *E. faecalis* monitoring in pigs, no *E. faecalis* isolates showed resistance to ampicillin, ciprofloxacin, or vancomycin. However, in 2025, resistance to chloramphenicol, daptomycin, and erythromycin have increased by 14%, 10% and 10% points, respectively. Furthermore, resistance to linezolid (2%) and to tigecycline (3%) were detected among *E. faecalis* isolates. Resistance to erythromycin and tetracycline, followed by chloramphenicol, continued to be the most common (Table 7.4). The increase in resistance to erythromycin and chloramphenicol observed among *E. faecalis* isolates in 2025, follows a previous increase already observed in 2023 compared to 2021 (Figure 7.4).

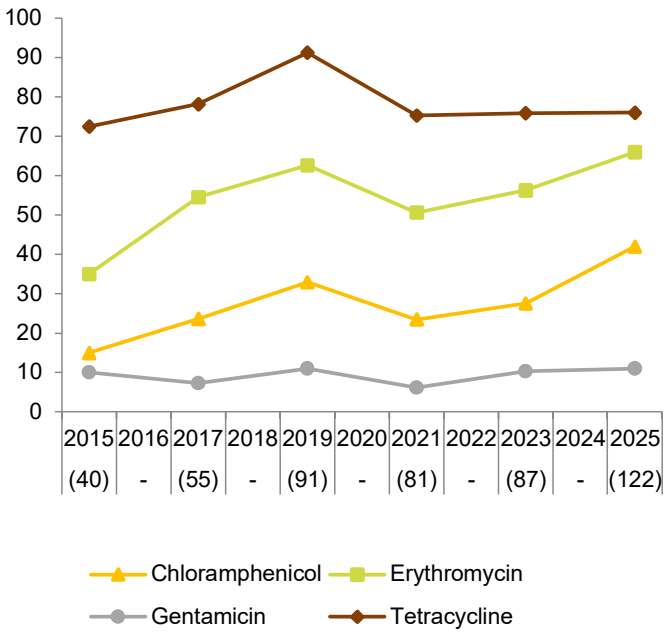
Compared to 2019, the last year of *E. faecium* monitoring in pigs, in 2025 there was an overall increase in the resistance levels to most tested antibiotics. Most notably, there was a marked increase in resistance to ampicillin (from 12% to 28%), ciprofloxacin (from 5% to 12%) and quinupristin/dalfopristin (when interpreted with ECOFF, from 71% to 85%). It should be noted that the interpretation of the cutoff values for quinupristin/dalfopristin has changed. 2019 data has been re-analysed with the new cutoff and the value here reported differs therefore from previously reported values. Furthermore, linezolid resistance was detected in 1% of the isolates in 2025 (Table 7.4).

Table 7.4 Resistance (%) in Enterococci isolates from pigs, Denmark, 2025 DANMAP 2025

	Enterococcus faecalis	*Enterococcus faecium*
Antimicrobial agent	%	%
Ampicillin	0	28
Chloramphenicol	42	2
Ciprofloxacin	0	12
Daptomycin	12	0
Erythromycin	66	24
Gentamicin	11	0
Linezolid	2	1
Quinupristin/dalfopristin	100	85
Teicoplanin	0	0
Tetracycline	76	58
Tigecycline	3	0
Vancomycin	0	0
Fully susceptible (%)	18	10
Number of isolates	122	80

E. faecalis are assumed inherently resistant to streptogramins (Quinupristin/Dalfopristin).
An isolate is considered fully susceptible if sensitive to all antimicrobial agents included in the test panel (Chapter 10, Table 10.3).

Figure 7.4 Resistance (%) among *E. faecalis* isolates from pigs, Denmark, 2015-2025 DANMAP 2025



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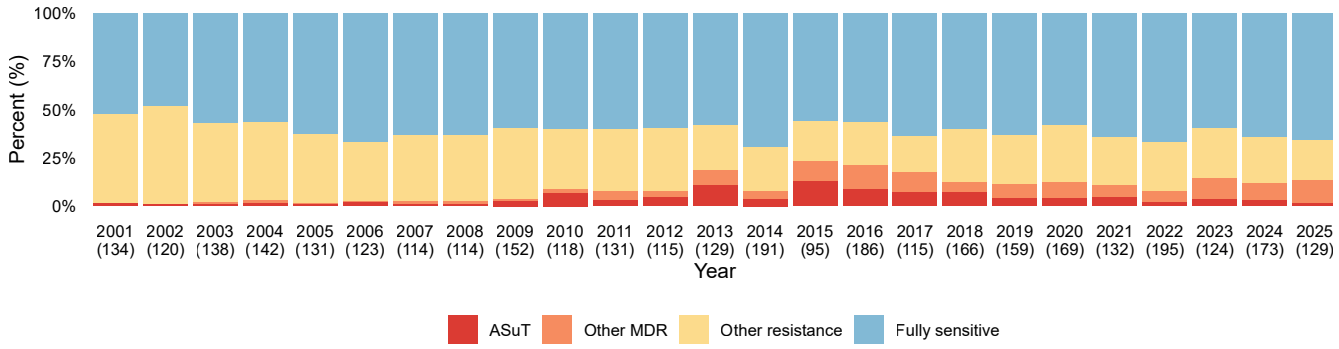
Textbox 7.1

30 years of *Escherichia coli* surveillance in Danish broilers

Denmark has had a nationwide surveillance of antimicrobial resistance in indicator *Escherichia coli* recovered from healthy food-producing animals since 1995. A retrospective comparison of resistance patterns in *E. coli* over the past 25 years of the DANMAP programme[1] was performed.

A total of 3,495 *E. coli* isolates from broilers were collected and reported in DANMAP between 2001 and 2025. The sampling strategy has changed over time, with a more standardized approach being implemented after 2014, following the introduction of the harmonized antimicrobial resistance monitoring in the European Union [Commission Implementing Decision (EU) 2020/1729].

Figure 1 Relative distributions (%) of AMR profiles among *E. coli* from broilers by year, Denmark, 2001-2025 DANMAP 2025



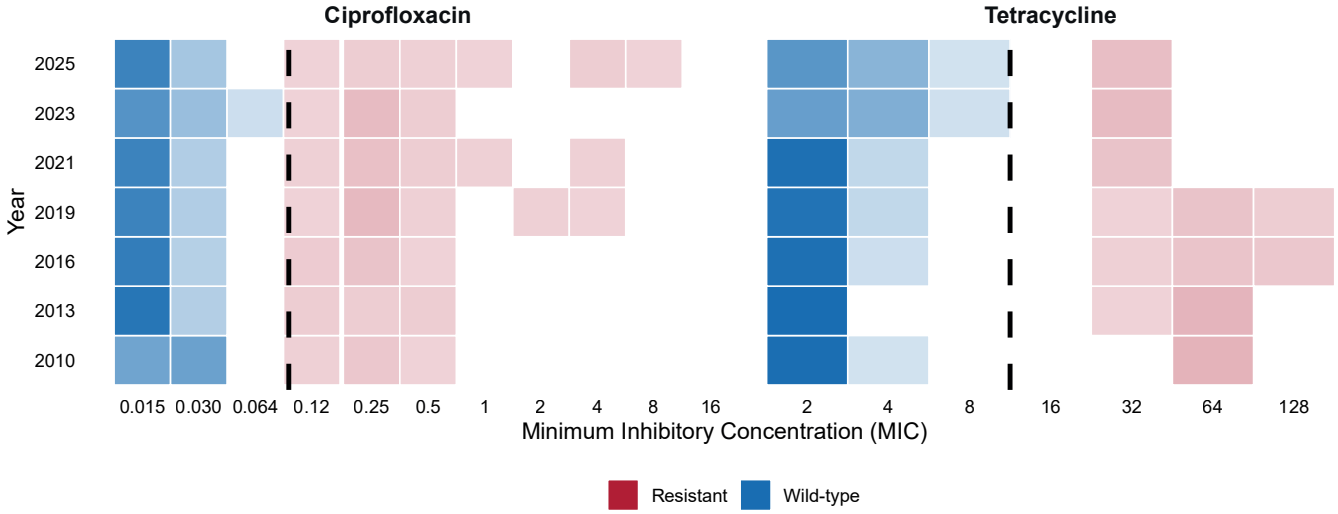
The bars show the percentage of isolates classified as ASuT (resistant to at least ampicillin, sulfamethoxazole and tetracycline), other MDR (other multidrug resistance profiles than ASuT), other resistance (resistance to one or two antimicrobial classes), or fully sensitive (sensitivity to all antimicrobial substances tested). The number of isolates included for each year is given in parentheses below each bar.

The relative distribution of antimicrobial resistance profiles varied between years (Figure 1). Fully sensitive *E. coli* isolates were dominant across all years, ranging from 52% to 70%, except in 2002, when 48% of the isolates were fully sensitive and 51% had other resistance. The proportion of ASuT and other MDR was generally low and increased from 2009, reaching a maximum of 23% in 2015 before decreasing and plateauing from 2019 onwards.

MIC distributions for ciprofloxacin and tetracycline were examined for selected years to assess changes in the distribution of MIC values over time (Figure 2). Statistical comparisons were performed separately for wild-type and resistant isolates for each antimicrobial using the Kruskal-Wallis test followed by Dunn's post hoc test with Bonferroni correction, to assess whether the MIC distributions changed across the years considered.

[1] Although *E. coli* surveillance in DANMAP was established in 1995, MIC results are included from 2001 onwards as data from 1995-2000 was digitally unavailable at the time of writing.

Figure 2 Distribution of MIC values from *E. coli* from broilers by antimicrobial substance and year DANMAP 2025



Blue indicates wild-type isolates while red indicates resistant isolates. The intensity of the colour shading represents the percentage of isolates with the respective MIC value within each year, with darker shading indicating higher percentages. The dashed line represents the ECOFF value applied for interpretation.

Among wild-type isolates, the MIC distribution for ciprofloxacin shifted towards lower MIC values after 2010 and remained similar in 2013, 2016, 2019 and 2021. In 2023, the distribution shifted towards higher MIC values, closer to the ECOFF, and was significantly different from 2013 and 2016. In 2025, a significant shift towards lower MIC values was observed compared with 2023. For tetracycline, the distribution in 2023 and 2025 differed significantly from the previous years, shifting towards higher MIC values and closer to the ECOFF. Among resistant isolates, no significant differences were observed in the distribution of MIC values across years for ciprofloxacin except in 2025. In recent years, higher MIC values have been observed, although not at a level significantly different from previous years. For tetracycline, the MIC distribution among resistant isolates was significantly different in 2025, 2023 and 2021 compared to previous years.

Overall, changes in resistance profiles and MIC distributions were observed over time for *E. coli* in broilers, with a tendency towards higher MIC values in recent years while the overall distribution of resistance profiles remained similar.

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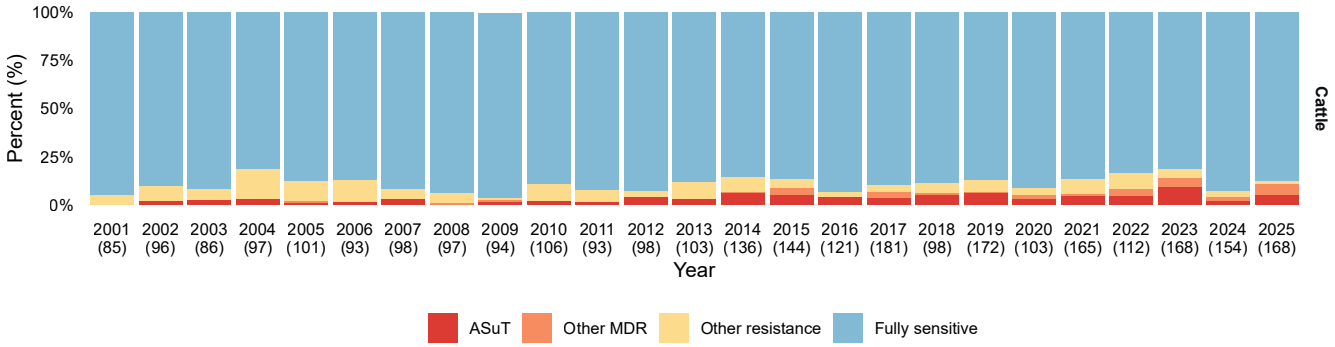
Textbox 7.2

30 years of *Escherichia coli* surveillance in Danish cattle

Denmark has had a nationwide surveillance of antimicrobial resistance in indicator *Escherichia coli* recovered from healthy food-producing animals since 1995. A retrospective comparison of resistance patterns in *E. coli* over the past 25 years of the DANMAP programme[1] was performed.

A total of 2,969 *E. coli* isolates from cattle were collected and reported in DANMAP between 2001 and 2025. The sampling strategy has changed over time, with a more standardized approach being implemented after 2014, following the introduction of the harmonized antimicrobial resistance monitoring in the European Union [Commission Implementing Decision (EU) 2020/1729].

Figure 1 Relative distributions (%) of AMR profiles among *E. coli* from cattle by year, Denmark, 2001-2025 DANMAP 2025



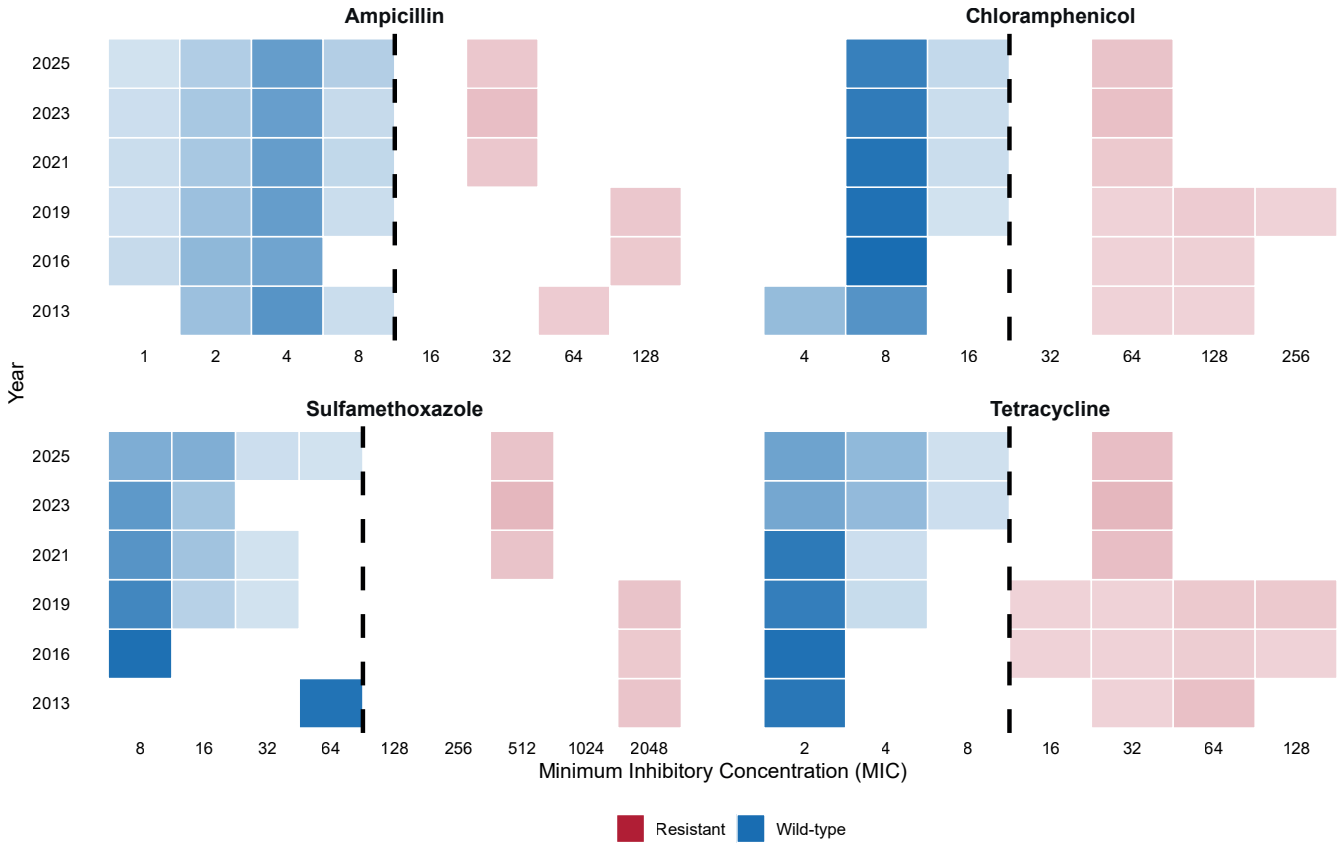
The bars show the percentage of isolates classified as ASuT (resistant to at least ampicillin, sulfamethoxazole and tetracycline), other MDR (other multidrug resistance profiles than ASuT), other resistance (resistance to one or two antimicrobial classes), or fully sensitive (sensitivity to all antimicrobial substances tested). The number of isolates included for each year is given in parentheses below each bar.

The relative distribution of antimicrobial resistance profiles varied between years (Figure 1). Fully sensitive *E. coli* isolates were dominant across all years, ranging from 81% to 97%. ASuT was the predominant resistance profile throughout the study period, although other MDR accounted for a larger proportion of isolates in 2025. Although the proportion of ASuT isolates was generally low from 2001 to 2013, it subsequently fluctuated without a significant trend, reaching a maximum of 9% in 2023.

MIC distributions for ampicillin, chloramphenicol, sulfamethoxazole and tetracycline were examined for selected years to assess changes in the distribution of MIC values over time (Figure 2). Statistical comparisons were performed separately for wild-type and resistant isolates for each antimicrobial using the Kruskal-Wallis test followed by Dunn's post hoc test with Bonferroni correction, to assess whether the MIC distributions changed across the years considered.

[1] Although *E. coli* surveillance in DANMAP was established in 1995, MIC results are included from 2001 onwards as data from 1995-2000 was digitally unavailable at the time of writing.

Figure 2 Distribution of MIC values from *E. coli* from cattle by antimicrobial substance and year DANMAP 2025



Blue indicates wild-type isolates while red indicates resistant isolates. The intensity of the colour shading represents the percentage of isolates with the respective MIC value within each year, with darker shading indicating higher percentages. The dashed line represents the ECOFF value applied for interpretation.

Among wild-type isolates, the MIC distribution for tetracycline remained similar in the earlier years, followed by a significant shift towards the ECOFF in 2023 and 2025. For chloramphenicol, a significant shift towards higher MIC values was observed after 2013. For sulfamethoxazole, the MIC distribution showed more pronounced differences between years. The distribution in 2013 differed significantly from those observed in all subsequent years, while the distributions in 2019, 2021 and 2023 were similar. In 2025, a significant shift towards higher MIC values and closer to the ECOFF was observed compared with all previous years. For ampicillin, the MIC distribution remained relatively stable across years, although significant differences were observed between 2016 and 2021, 2023 and 2025. The distribution in 2025 also differed significantly from 2019.

Among resistant isolates, a shift in the MIC distributions was observed from 2019 onwards. For sulfamethoxazole and ampicillin, this was characterised by a significant shift towards lower MIC values in the later years. For tetracycline and chloramphenicol, the MIC distributions observed in 2019 differed significantly from those observed in 2021, 2023 and 2025.

Overall, the MIC distributions appear to be moving towards the ECOFF, with wild-type isolates shifting towards higher MIC values, and resistant isolates shifting towards lower MIC values.

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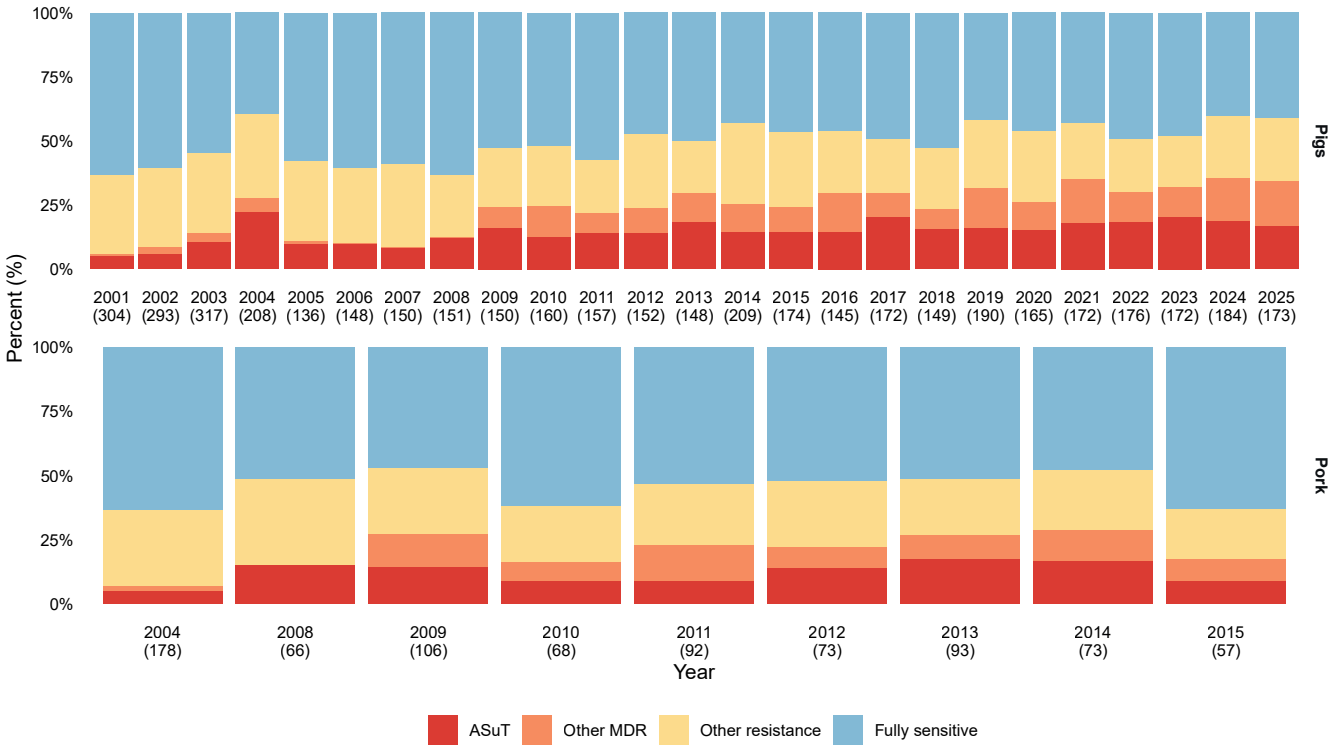
Textbox 7.3

30 years of *Escherichia coli* surveillance in Danish pigs and pork

Denmark has had a nationwide surveillance of antimicrobial resistance in indicator *Escherichia coli* recovered from healthy food-producing animals since 1995. A retrospective comparison of resistance patterns in *E. coli* over the past 25 years of the DANMAP programme[1] was performed.

A total of 4,546 *E. coli* isolates from pigs and 806 *E. coli* isolates from pork have been collected and reported in DANMAP from 2001 to 2025. Isolates from pigs were collected consistently throughout the 25-year period, whereas isolates from pork were only collected in 2004 and from 2008 to 2015. The sampling strategy has changed over time, with a more standardized approach being implemented after 2014, following the introduction of the harmonized antimicrobial resistance monitoring in the European Union [Commission Implementing Decision (EU) 2020/1729].

Figure 1 Relative distributions (%) of AMR profiles among *E. coli* from pigs and pork by year, Denmark, 2001-2025 DANMAP 2025

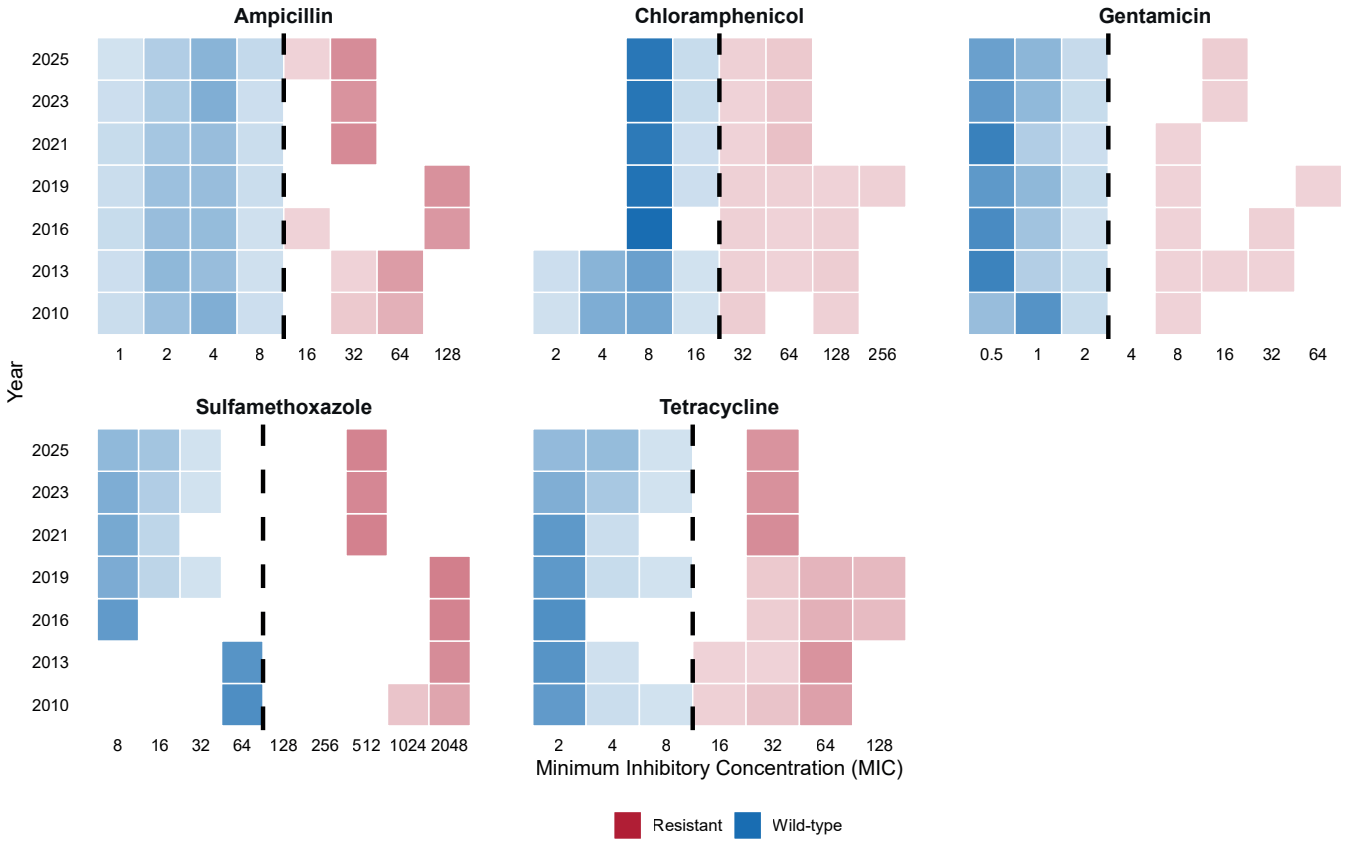


The bars show the percentage of isolates classified as ASuT (resistant to at least ampicillin, sulfamethoxazole and tetracycline), other MDR (other multidrug resistance profiles than ASuT), other resistance (resistance to one or two antimicrobial classes), or fully sensitive (sensitivity to all antimicrobial substances tested). The number of isolates included for each year is given in parentheses below each bar.

The relative distribution of antimicrobial resistance profiles varies between sample origin and year (Figure 1). Fully sensitive *E. coli* isolates were dominant in both pigs and pork across all years, ranging from 40% to 64% among pigs and from 47% to 64% among pork. Among resistant isolates from pigs, ASuT was the predominant resistance profile for most of the surveillance period. In pig isolates, the proportion of ASuT increased from 5% in 2001 to approximately 12% in 2009 and remained at a statistically similar level thereafter. However, in 2016 and 2025, other MDR accounted for a larger proportion of isolates than ASuT. A similar pattern was observed in pork, with the prevalence of ASuT increasing from 2004 to 2008 and then stabilizing (note that no data were available for the years 2005-2007, so this observation must be interpreted with caution).

[1] Although *E. coli* surveillance in DANMAP was established in 1995, MIC results are included from 2001 onwards as data from 1995-2000 was digitally unavailable at the time of writing.

Figure 2 Distribution of MIC values from *E. coli* from pigs and pork by antimicrobial substance and year DANMAP 2025



Blue indicates wild-type isolates while red indicates resistant isolates. The intensity of the colour shading represents the percentage of isolates with the respective MIC value within each year, with darker shading indicating higher percentages. The dashed line represents the ECOFF value applied for interpretation.

Among isolates from pigs, MIC distributions for ampicillin, sulfamethoxazole, tetracycline, gentamicin and chloramphenicol were examined for given years to assess changes in the distribution of MIC values over time (Figure 2). Statistical comparisons were performed separately for wild-type and resistant isolates for each antimicrobial using the Kruskal-Wallis test followed by Dunn's post hoc test with Bonferroni correction, to assess whether the MIC distributions changed across the years considered.

Among wild-type isolates, for ampicillin, the MIC distribution remained stable from 2010 to 2023, with no pairwise differences. Differences in the MIC distribution were observed in 2025 compared with 2013, 2016, 2019 and 2021 (with a slight shift towards the ECOFF). For sulfamethoxazole, the MIC distribution differed significantly between the early years (2010 and 2013) and the later part of the surveillance period. Furthermore, the MIC distribution in 2025 differed significantly from the distribution in 2016. For tetracycline, the MIC distribution remained stable from 2010 to 2021, followed by a shift towards the ECOFF in 2023 and 2025. For chloramphenicol, the MIC distribution shifted significantly towards the ECOFF from 2016 onwards compared with 2010 and 2013, after which the distribution remained stable through 2025. For gentamicin the distribution fluctuated over time, shifting away from the ECOFF in 2013 compared with 2010, followed by a shift back towards the ECOFF in 2019. The distribution then shifted away from the ECOFF again in 2021 before moving towards the ECOFF in 2023, where it remained stable through 2025.

Among resistant isolates, for ampicillin, the MIC distribution above the ECOFF had three phases, with similar distributions in 2010-2013, 2016-2019, and 2021-2025. For tetracycline, a similar pattern was observed, although the 2013 MIC distribution did not differ significantly from the distributions observed in 2010, 2016, or 2019. For sulfamethoxazole, the MIC distribution above the ECOFF shifted significantly towards the ECOFF in 2021 compared with 2010-2019 and remained stable through 2025.

continued ... Textbox 7.3

No significant differences were observed for the MIC distributions above the ECOFF for gentamicin and chloramphenicol, although the distribution appeared to shift away from the ECOFF for gentamicin and towards the ECOFF for chloramphenicol in the most recent years.

Overall, the relative occurrence of ASuT profiles in indicator *E. coli* from pigs has remained similar with minor non-significant fluctuations from 2010 to 2025, while the MIC distributions showed changes. For all five antimicrobials, the MIC distribution among wild-type isolates appeared to fluctuate over time, with distributions in the most recent years tending to be closer to the ECOFF. This shift may be indicative of future changes in the proportion of isolates classified as resistant, and hence an early signal of a possible increase in ASuT resistance in the near future. However, in 2023 and 2025 the occurrence of other MDR profiles also seems to have increased (Figure 1).

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