

# Surveillance of AMR in *Escherichia coli* on Raw Fresh Chicken and Turkey Meat in Retail Sale in Northern Ireland in 2024

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## FSA Research and Evidence

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- Antimicrobial resistance (AMR) is defined as the ability of a microorganism to multiply or persist in the presence of an increased level of an antimicrobial agent relative to the susceptible counterpart of the same species.
- It should be noted that epidemiological cut-off values (ECOFFs) have been used in this survey to determine 'resistance', but ECOFFs do not necessarily indicate clinical resistance ([ACMSE, 2024](#)).
- Mandatory anonymised reporting (without product details) under [EU regulation 2020/1729](#) for the monitoring and reporting of AMR in zoonotic and commensal bacteria has been submitted to the EU for antimicrobial resistant *Escherichia coli* (*E. coli*) isolated from fresh chicken and turkey purchased for retail sale in Northern Ireland (NI) from January to December 2024.
- In this survey, 300 chicken and 300 turkey fresh retail meat samples were tested for Extended Spectrum Beta-Lactamases (ESBL), AmpC Beta-Lactamases (AmpC) and Carbapenemases (CP) enzyme producing *E. coli* according to [EU regulation 2020/1729](#).
- The overall prevalence of ESBL and AmpC producing *E. coli* was 12% (73/600) from fresh raw chicken and turkey samples, correlating with 2022 UK levels. The prevalence of ESBL

and AmpC producing *E. coli* was 9% from chicken (27/300) and 15% from turkey (46/300).

- No isolates were resistant to last line antibiotics, including colistin and carbapenems.
- The risk of acquiring AMR related infections through the handling and consumption of retail contaminated meats is very low with proper food handling and adequate cooking practices.
- A summary can be found in our infographic available [here](#).

## Introduction

It should be noted that epidemiological cut-off values (ECOFFs) have been used in this survey to determine 'resistance', but ECOFFs do not necessarily indicate clinical resistance ([ACMSE, 2024](#)).

Antimicrobial resistance (AMR) is defined as the ability of a microorganism to multiply or persist in the presence of an increased level of an antimicrobial agent relative to the susceptible counterpart of the same species ([ACMSE, 2024](#)). AMR microorganisms are increasingly being recognised as a global problem, making infections harder to treat. Whilst it is a natural process, the extensive use of antimicrobials in humans and animals has been a significant driving force in its development. Antimicrobials are used in the livestock industry to prevent and control bacterial disease. The use of subtherapeutic levels of antibiotics in animal feed as growth promoters since the 1950s has contributed to the expansion of antibiotic-resistant bacteria (AMR). This practice was banned in the EU and UK in 2006, following concerns about the development of AMR ([WHO, 2023](#)).

*E. coli* is a normal inhabitant of the mammalian gut (termed a commensal) and most isolates do not cause observable clinical disease in healthy animals or humans ([WHO, 2018](#)). However, commensal bacteria can be AMR gene reservoirs. Horizontal gene transfer among bacteria allows them to exchange their genetic material, including antibiotic resistance genes. *E. coli* isolates are therefore useful 'indicators' of AMR. They are ubiquitous in animals and allow us to monitor the presence of AMR typically circulating in food producing animals. If bacteria possess a resistance to three or more different classes of antibiotics, they are called multidrug resistant (MDR). MDR bacteria pose a health risk because fewer therapeutic agents are active against them. This is of particular concern if the MDR includes

resistance to certain classes of “last line” antibiotics (such as carbapenems), which are used to treat severe bacterial infections when other treatment options are ineffective ([WHO, 2017](#)).

One of the main objectives within the [FSA's Strategy for 2022-2027](#) is to ensure that ‘food is safe’. This survey will provide continued monitoring for *E. coli* from retail meats. The continued surveillance of AMR bacteria in humans, environments and food producing animals is crucial to monitor and understand if these meats pose a risk to animal public health, in relation to AMR and will allow future monitoring of trends over time. The FSA is responsible for the monitoring and reporting to the European Union (EU) of AMR from fresh meats at retail sale in Northern Ireland (NI) under [\(EU\) 2020/1729](#) and [Article 9\(1\) of Directive 2003/99/EC](#). Addressing the public health threat posed by AMR is a national strategic priority for the UK and led to the Government publishing both a [20-year vision of AMR](#) and a [5-year \(2024-2029\) AMR National Action Plan \(NAP\)](#). This research also contributes to the [Northern Ireland AMR Action Plan](#), which aims to promote multidisciplinary AMR research and to ensure that policy and practice are informed by this.

The aim of this study was to gather data on the prevalence of Extended Spectrum Beta-Lactamases (ESBLs), AmpC Beta-Lactamases (AmpC) or Carbapenemases (CP) producing *E. coli*. This ongoing mandatory surveillance will allow trends in the prevalence and levels of AMR in retail meats over time in NI and to assess the risk to public health.

## Material and methods

The FSA in NI commissioned an [AMR survey in beef and pork in 2023, 2025 and 2027 and chicken and turkey meats in 2024 and 2026 collected at retail sale in NI](#) under [\(EU\) 2020/1729](#). All sampling methodology and analytical methods were performed in accordance with [Decision 2020/1729/EU](#).

This survey collected 300 chicken and 300 turkey fresh meat samples on retail sale in NI from January to December 2024. The sampling design was based on a randomised monthly sampling schedule, with sampling spread as evenly as possible on nominated days by trained staff from HallMark Veterinary & Compliance. Sampling randomisation methods were in accordance with EU technical guidelines ([EFSA, 2020](#)). Briefly, retailers were selected based on market share proportions, ensuring proportional representation of both major supermarket chains and smaller butchers. The selection of sampling regions was based across UK International Territorial Levels (ITL3) regions to ensure geographic representation, covering at least 80% of the total population over a 12-month sampling period. Basted, cook in the bag or meats that contained any other ingredients (such as breaded or herbs etc) were not sampled, and neither were minced, frozen or cooked meat.

Product categories were defined using the same categories from previous FSA UK wide AMR in retail meat studies, including whole birds, breasts, legs, portions and wings (for chicken only) for consistency.

600 fresh broiler (chicken) and turkey meat samples available for NI retail sale were tested for Extended-spectrum Beta-lactamases (ESBLs), AmpC Beta-lactamases, and carbapenemases (CP) enzyme producing *Escherichia coli* (*E. coli*). The testing, using selective agars, for carbapenemase-producing *E. coli* and OXA-carbapenemase producing *E. coli*, was also performed. Analysis involved the initial isolation and enrichment of *E. coli* from all meat samples, prior to testing for the production of ESBLs, AmpC and CP enzymes using [ISO/IEC 17025:2017](#) accredited protocols. Selective agars and biochemical testing were used to confirm the identity of all bacterial isolates as *E. coli*. The AMR phenotype was determined using a standard microbroth dilution method with European Committee on [Antimicrobial Susceptibility Testing \(EUCAST\) thresholds](#) for resistance and concentration ranges for (up to 25) antimicrobial substances according to [Decision 2020/1729/EU](#). Antimicrobial broth microdilution Minimal Inhibitory Concentration (MIC) determination was performed in accordance with [Decision 2020/1729/EU](#) using Sensititre™ Panels by the Sensititre AutoInoculator /AIM ® using [ISO/IEC 17025:2017](#) accredited protocols.

The following antimicrobials were tested as specified from Table 2 of [Decision 2020/1729/EU](#) (the ECOFF applied is stated in brackets was at mg/L): amikacin (>8) ampicillin (>8), azithromycin (>16), cefotaxime (>0.25), ceftazidime (>1), chloramphenicol (>16), ciprofloxacin (>0.06), colistin (>2), gentamicin (>2), meropenem (>0.06), nalidixic acid (>8), sulfamethoxazole (>64), tetracycline (>8), tigecycline (>0.5), trimethoprim (>2). Further testing of the supplementary panel of antimicrobials (in accordance with Table 5 (the ECOFF applied is stated in brackets was at mg/L) from [Decision 2020/1729/EU](#)) was then performed on isolates resistant to cefotaxime, ceftazidime or meropenem using cefepime (>0.125), cefotaxime (>0.25), cefotaxime + clavulanate (>0.25), cefoxitin (>8), ceftazidime (>1), ceftazidime plus clavulanate (>1), ertapenem (0.03), imipenem (>0.5), meropenem (>0.06) and temocillin (>16).

All 73 confirmed ESBL or AmpC *E. coli* isolates had Whole Genome Sequencing (WGS) performed on them, including In-silicon Multi-locus sequence typing (MLST) and AMR analyses using draft genome assemblies according to [Decision 2020/1729/EU](#) guidelines. Bacterial isolation, DNA preparation and DNA quality and quantity assessment, library preparation, library quality and quantity assessment and sequencing, and bioinformatics analysis were all performed in accordance with [European Union Reference Laboratories \(EURL\) WGS-AMR protocols](#) and (where appropriate) Illumina website guidelines. DNA Library preparation used

Illumina DNA Prep Library Prep Reference Guide ([1000000025416](#)) with an Illumina MiSeq. Sequencing was performed using a paired-end approach with a read length of 2 x 250 bp. AMR gene and point mutation prediction was performed in accordance ([EURL](#)) [WGS-AMR protocols](#) recommendations using ResFinder tool v4.2. with pointfinderversion 4.0.1. All genes and plasmids of AMR and virulence interest had at least 95% confirmed identity. All DNA sequences were uploaded to the European Nucleotide Archive (ENA) browser: [PRJEB87324](#).

## Results

- The overall prevalence of ESBL and AmpC *E. coli* was 12% (73/600) from raw fresh chicken and turkey samples. The prevalence of ESBL and AmpC *E. coli* was 9% (27/300) from chicken and 15% (46/300) from turkey samples.
- From the 300 chicken samples; 13 chicken samples were positive for ESBL *E. coli* (4.3%, 95% confidence interval CI [2.6-7.3%]) and 14 chicken samples were positive for AmpC *E. coli* (4.7%, 95% confidence interval CI [2.8-7.7%]).
- From the 300 turkey samples; 35 turkey samples were positive for ESBL *E. coli* (11.7%, 95% confidence interval CI [8.5-15.8%]) and 9 turkey samples were positive for AmpC *E. coli* (3%, 95% confidence interval CI [1.6- 5.6%]). There were also 2 turkey samples that were positive for "Other phenotype" *E. coli* (0.7%, 95% confidence interval CI [0.2-2.4%]).
- No carbapenem-resistant *E. coli* were isolated from carbapenem-selective agar plates from chicken or turkey after enrichment.
- No isolates from either chicken or turkey meat were resistant to last line antibiotics, including colistin and carbapenems (see [Table 1](#) & [Table 2](#)).
- [Table 1](#) and [Table 2](#) below summarise the phenotypic AMR profiles of all 73 ESBL and AmpC *E. coli* isolates from 600 fresh retail chicken and turkey samples.
- Overall, 48 isolates had confirmed ESBL resistance, 23 isolates had confirmed AmpC resistance, and two isolates from turkey meat had "Other Phenotype "resistance. All of these isolates had resistance to ampicillin and cefotaxime (see [Table 1](#) & [Table 2](#)). The two "Other Phenotypes" from turkey meat were 1 dilution away from being classified as

AmpC regarding the Minimal Inhibitory Concentration (MIC) (see [Table 2](#)). The WGS results suggested an AmpC phenotype for both of these isolates from turkey.

- Resistance to ampicillin, cefotaxime, cefotaxime & clavulanic acid, ceftazidime and ceftazidime was most common (4.6%) from ESBL and AmpC *E. coli* isolates from 300 retail chicken meat samples (see [Table 1](#)).
- Resistance to ampicillin (11.6%), cefotaxime (11.6%), ceftazidime (11.3%), cefepime (11.3%) and tetracycline (8.3%) was most common from ESBL and AmpC *E. coli* isolates from 300 turkey meat samples (see [Table 2](#)).

Table 1. An antimicrobial resistance summary of 27 Extended Spectrum Beta Lactamases (ESBLs) and AmpC  $\beta$ -Lactamases (AmpC) enzyme producing isolates from 300 fresh chicken retail meats purchased in Northern Ireland in 2024.

| Antimicrobial                 | Number resistant* isolates and % prevalence from 300 samples tested |           | Other Phenotype |
|-------------------------------|---------------------------------------------------------------------|-----------|-----------------|
|                               | ESBL                                                                | AmpC      |                 |
| Amikacin                      | 0                                                                   | 0         | 0               |
| Ampicillin                    | 13 (4.3%)                                                           | 14 (4.7%) | 0               |
| Azithromycin                  | 0                                                                   | 0         | 0               |
| Chloramphenicol               | 4 (1.3%)                                                            | 0         | 0               |
| Ciprofloxacin                 | 9 (3%)                                                              | 12 (4%)   | 0               |
| Colistin                      | 0                                                                   | 0         | 0               |
| Gentamicin                    | 0                                                                   | 0         | 0               |
| Meropenem                     | 0                                                                   | 0         | 0               |
| Ertapenem                     | 0                                                                   | 0         | 0               |
| Imipenem                      | 0                                                                   | 0         | 0               |
| Nalidixic acid                | 4 (1.3%)                                                            | 9 (3%)    | 0               |
| Sulfamethoxazole              | 9 (3%)                                                              | 4 (1.3%)  | 0               |
| Tetracycline                  | 7 (2.3%)                                                            | 13 (4.3%) | 0               |
| Tigecycline                   | 0                                                                   | 0         | 0               |
| Trimethoprim                  | 8 (2.6%)                                                            | 3 (1%)    | 0               |
| Temocillin                    | 0                                                                   | 0         | 0               |
| Cefepime                      | 13 (4.3%)                                                           | 1 (0.3%)  | 0               |
| Cefotaxime                    | 13 (4.3%)                                                           | 14 (4.6%) | 0               |
| Cefotaxime & clavulanic acid  | 0                                                                   | 14 (4.6%) | 0               |
| Ceftazidime                   | 11 (3.6%)                                                           | 14 (4.6%) | 0               |
| Ceftazidime & clavulanic acid | 0                                                                   | 13 (4.3%) | 0               |

\* – Microbiologically resistant using European Committee on Antimicrobial Susceptibility Testing (EUCAST) thresholds for resistance and concentration ranges from [Decision 2020/1729/EU](#).

13 ESBL *E. coli* (4.3%, 95% confidence interval CI [2.6-7.3%]) and 14 AmpC *E. coli* (4.7%, 95% confidence interval

CI [2.8-7.7%]

No isolates were resistant to last line antibiotics, including colistin and carbapenems.

0 = all isolates sensitive to antimicrobial

Table 2. An antimicrobial resistance summary 46 isolates of Extended Spectrum Beta Lactamases (ESBLs) and AmpC  $\beta$ -Lactamases (AmpC) enzyme producing isolates from 300 fresh turkey retail meats purchased in Northern Ireland in 2024.

| Antimicrobial                 | Number resistant* isolates and % prevalence from 300 samples tested |          | Other Phenotype |
|-------------------------------|---------------------------------------------------------------------|----------|-----------------|
|                               | ESBL                                                                | AmpC     |                 |
| Amikacin                      | 0                                                                   | 0        | 0               |
| Ampicillin                    | 35 (11.6%)                                                          | 9 (3%)   | 2 (0.6%)        |
| Azithromycin                  | 0                                                                   | 3 (1%)   | 0               |
| Chloramphenicol               | 7 (2.3%)                                                            | 0        | 1 (0.3%)        |
| Ciprofloxacin                 | 23 (7.6%)                                                           | 4 (1.3%) | 1 (0.3%)        |
| Colistin                      | 0                                                                   | 0        | 0               |
| Gentamicin                    | 0                                                                   | 0        | 0               |
| Meropenem                     | 0                                                                   | 0        | 0               |
| Ertapenem                     | 0                                                                   | 0        | 0               |
| Imipenem                      | 0                                                                   | 0        | 0               |
| Nalidixic acid                | 6 (2%)                                                              | 2 (0.6%) | 1 (0.3%)        |
| Sulfamethoxazole              | 23 (7.6%)                                                           | 1 (0.3%) | 0               |
| Tetracycline                  | 25 (8.3%)                                                           | 5 (1.6%) | 1 (0.3%)        |
| Tigecycline                   | 0                                                                   | 0        | 0               |
| Trimethoprim                  | 2 (0.6%)                                                            | 4 (1.3%) | 1 (0.3%)        |
| Temocillin                    | 0                                                                   | 0        | 0               |
| Cefepime                      | 34 (11.3%)                                                          | 1 (0.3%) | 0               |
| Cefotaxime                    | 35 (11.6%)                                                          | 9 (3%)   | 2 (0.6%)        |
| Cefotaxime & clavulanic acid  | 0                                                                   | 9 (3%)   | 2 (0.6%)        |
| Cefoxitin                     | 0                                                                   | 9 (3%)   | 0               |
| Ceftazidime                   | 34 (11.3%)                                                          | 9 (3%)   | 2 (0.6%)        |
| Ceftazidime & clavulanic acid | 0                                                                   | 8 (2.6%) | 2 (0.6%)        |

\* – Microbiologically resistant using European Committee on Antimicrobial Susceptibility Testing (EUCAST) thresholds for resistance and concentration ranges from [Decision 2020/1729/EU](#).

35 ESBL *E. coli* (11.7%, 95% confidence interval CI [8.5-15.8%]) and 9 AmpC *E. coli* (3%, 95% confidence interval CI [1.6- 5.6%]). There were also 2 “Other phenotype” *E. coli* (0.7%, 95% confidence interval CI [0.2-2.4%]).

No isolates were resistant to last line antibiotics, including colistin and carbapenems.

0 = all isolates sensitive to antimicrobial

## Discussion

Our study indicated a 12% prevalence of ESBL/AmpC resistance from 300 chicken and 300 turkey fresh meat samples on retail sale in NI from January to December 2024. This correlates with previous ESBL/AmpC UK levels from chicken and turkey in 2022 ([FSA, 2023](#)). ESBL/AmpC levels in NI (12%) also compared with the low ESBL/AmpC prevalence from 2016-2022 in the UK ([FSA, 2023](#)) and still remains lower than in most EU countries ([EFSA,](#)

2024). CP-producing *E. coli* were not detected in any chicken or turkey NI retail samples tested. This mandatory EU surveillance work contributes to the food safety commitments from the [5-year \(2024-2029\) AMR National Action Plan \(NAP\)](#) and [Northern Ireland AMR Action Plan](#). The data is aligned to the current EU harmonised monitoring specification and ensures that the key antimicrobials of concern to public health are monitored for efficacy. The evidence presented will help to inform the risk assessment for AMR in chicken and turkey meat, which are both regularly consumed in the UK. The FSA will continue the surveillance of AMR in retail meats in NI to allow for future monitoring of AMR trends over time and the assessment of potential risks to animal and public health, contributing to the [Northern Ireland AMR Action Plan](#). The risk of acquiring AMR related infections through the handling and consumption of retail contaminated meats is very low with proper food handling and cooking practices ([FSA, 2024](#)).

## Acknowledgements

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# Appendix A: An Infographic of the Surveillance of AMR in *Escherichia coli* from raw fresh chicken and turkey meat on retail sale in Northern Ireland in 2024

## Introduction to Antimicrobial Resistance (AMR)

AMR is when microbes no longer respond to antimicrobial medicines/drugs in humans and animals, making infections harder to treat.



AMR is increasingly a global problem due to drug resistance, especially to “last line” antibiotics used to treat severe bacterial infections when other treatment options are ineffective.



## Methods and Results



- 600 retail meat samples: 300 chicken & 300 turkey were sampled & tested from Northern Ireland (NI) in 2024.
- NI AMR levels\* (12%) were similar to 2022 UK levels and remain lower than most of the EU.
- No isolates were resistant to last line antibiotics, including colistin and carbapenems.

## Conclusions



Low risk of acquiring AMR related infections, provided that good hygiene and cooking practices are followed.



The FSA is continuing NI AMR retail meats surveillance to enable monitoring of AMR trends.

\*: NI AMR levels: Refers to Extended-spectrum Beta-lactamases (ESBLs) and AmpC Beta-lactamases (AmpC) enzyme producing *E. coli*.

## Supplementary Materials

Appendix A: An Infographic of the Surveillance of AMR in *Escherichia coli* from raw fresh chicken and turkey meat on retail sale in Northern Ireland in 2024

Download: [https://science.food.gov.uk/article/141772-surveillance-of-amr-in-\\_escherichia-8203-coli\\_-on-raw-fresh-chicken-and-turkey-meat-in-retail-sale-in-northern-ireland-in-2024/attachment/296237.pptx](https://science.food.gov.uk/article/141772-surveillance-of-amr-in-_escherichia-8203-coli_-on-raw-fresh-chicken-and-turkey-meat-in-retail-sale-in-northern-ireland-in-2024/attachment/296237.pptx)

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