Public Services Delivery
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NHS SCOTLAND

Scottish One Health Antimicrobial Use and Antimicrobial Resistance in 2025



Antimicrobial Resistance and Healthcare Associated Infection
An NHS Scotland Assure Service

Public Health Scotland

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Alternative formats

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About the 2025 SONAAR Report

Antimicrobial resistance (AMR) is one of the most significant global public health threats of our time. It puts at risk the effectiveness of routine treatments and life-saving healthcare interventions, increases the risk of severe infection and death, and places growing pressure on health and care systems, economies and societies worldwide. Addressing AMR requires sustained and coordinated action across human, animal and environmental sectors.

The Scottish One Health Antimicrobial Use and Antimicrobial Resistance (SONAAR) Report demonstrates Scotland's continued commitment to tackling AMR through a coordinated, evidence based One Health approach. By bringing together surveillance data and intelligence from across human, animal and environmental systems, the report provides a comprehensive picture of antimicrobial use (AMU), AMR and infection trends in Scotland. This intelligence helps support informed decision-making, helps identify emerging threats and priorities, and enables targeted action to protect the effectiveness of antimicrobials for future generations.

SONAAR is a key component of Scotland's response to AMR and contributes to the wider UK surveillance landscape. The report supports delivery of the ambitions set out in the UK National Action Plan to contain, control and mitigate antimicrobial resistance by 2040. By providing policymakers, healthcare professionals, researchers and stakeholders with robust evidence and insights, SONAAR helps monitor progress, inform policy and practice and strengthen antimicrobial stewardship across sectors.



This report is jointly delivered by ARHAI Scotland and Public Health Scotland (PHS). ARHAI Scotland leads on human health AMU and AMR surveillance, while PHS leads on animal health surveillance and reporting, including contributions from Scotland's Rural College (SRUC) and the Small Animal Veterinary Surveillance Network (SAVSNET). This report is further strengthened by contributions from the Scottish Environment Protection Agency (SEPA) and Food Standards Scotland, ensuring a truly integrated One Health perspective that reflects the interconnected nature of AMR across people, animals and the environment.

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sepa

Healthcare Improvement Scotland

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Scotland’s One Health approach to antimicrobial use and antimicrobial resistance

AMR: an ongoing challenge

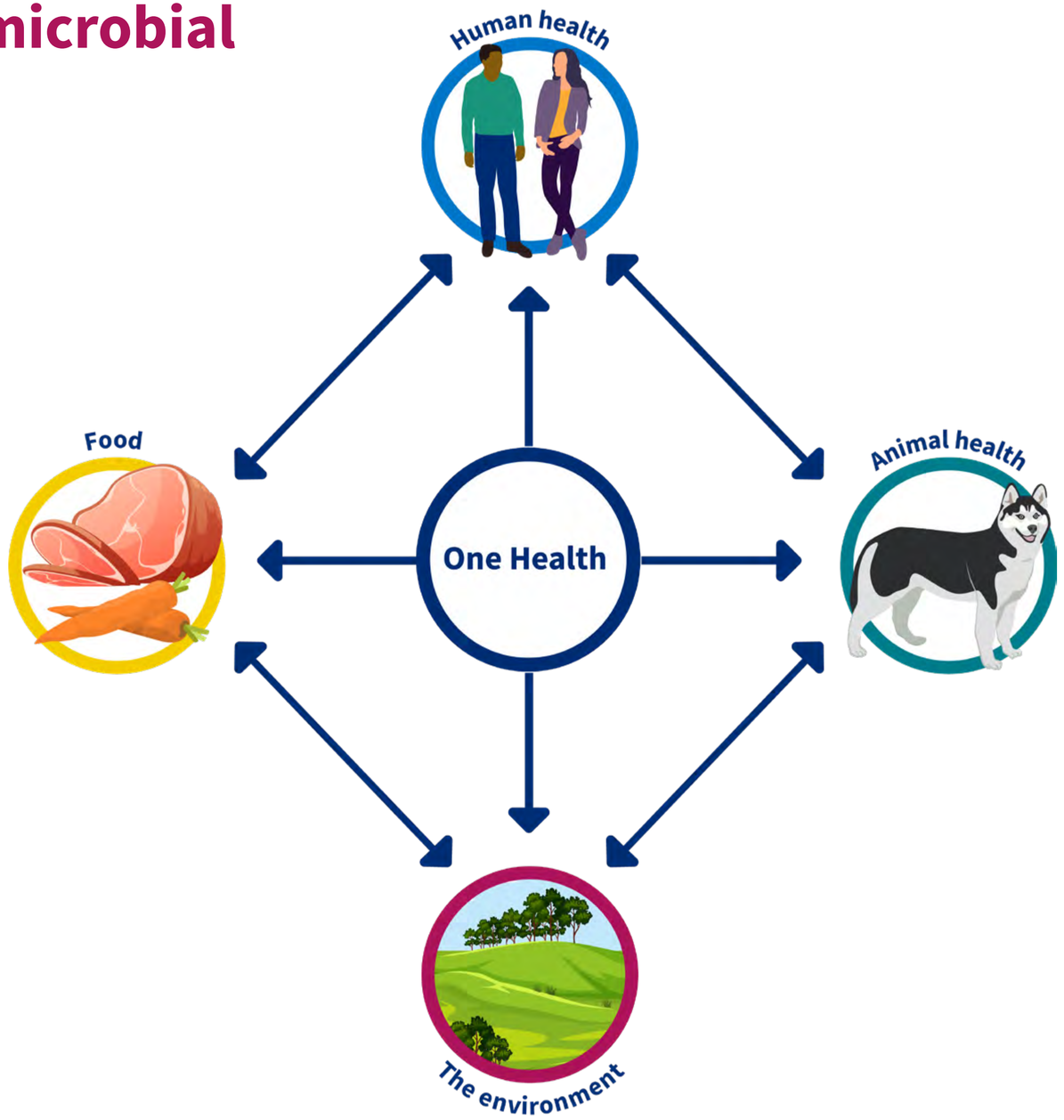
AMR is a well-established global health threat that occurs when microorganisms such as bacteria, fungi, viruses, and parasites develop resistance to antimicrobials. AMR threatens the success of modern medicine, such as outcomes of surgery, chemotherapy, organ transplantation, and animal health.

The One Health approach

The One Health approach recognises that the health of humans, animals, plants and the wider environment are closely interconnected.

Resistant microorganisms can emerge and spread across these sectors. Therefore, coordinated action is essential to monitor and respond to AMR and to support the responsible use of antimicrobial agents.

The One Health approach offers an optimal framework for coordinating and addressing these shared challenges.



Scotland's One Health approach to AMU and AMR Surveillance

Scotland's One Health approach to AMU and AMR surveillance aims to:

- Embed One Health principles within national policy and surveillance frameworks
- Strengthen surveillance infrastructure to ensure consistent, high-quality data collection and collaboration across sectors
- Support efforts to reduce the burden of antimicrobial resistant infections through collaboration across human, animal, and environmental sectors
- Translate surveillance intelligence into evidence-based policy and targeted interventions
- Promote sustainable antimicrobial stewardship in collaboration with agencies such as the Scottish Antimicrobial Prescribing Group (SAPG)
- Strengthen clinical and laboratory collaboration through national networks, including the Scottish Microbiology and Virology Forum (SMVF).

Supporting action through surveillance intelligence

The SONAAR report brings together surveillance intelligence from a range of activities that support Scotland's One Health approach to AMU and AMR surveillance. Activities include:

- Real-time monitoring of antimicrobial use for antibiotics commonly prescribed for respiratory infections
- Provision of prescribing intelligence to NHS Boards and GP practices
- Surveillance of unusual AMR phenotypes through the AMR Early Warning System
- Dissemination of surveillance information to national stakeholders to guide clinical practice, stewardship initiatives, and policy development
- Together, these support timely clinical decision-making, antimicrobial stewardship, and public health action.



UK AMR National Action Plan (NAP) Confronting Antimicrobial Resistance 2024 to 2029

Through collaborative One Health activities, organisations across Scotland continue to contribute to the delivery of the UK AMR NAP 2024 to 2029. The themes presented below demonstrate how the surveillance, stewardship, policy and partnership activities highlighted in the SONAAR report support progress towards key NAP outcomes and ambitions.

UK AMR NAP 2024 to 2029

Theme 1. Reducing the need for, and unintentional exposure to, antimicrobials

- Infection prevention and management (Outcome 1)
  - Commitment 1.1 informed interventions
  - Commitment 1.2 The built environment
  - Human health target 1a
  - Human health target 1b
- Strengthened surveillance (Outcome 3)
  - Commitment 3.1 Optimising surveillances of infections and outbreaks, and response
    - Gram-negative bacteraemia
    - Carbapenemase-producing organisms
    - Gram-positive bacteraemia

Theme 2. Optimising the use of antimicrobials

- Antimicrobial stewardship and disposal (Outcome 4)
  - Human health target 4a
  - Human health target 4b
- Scottish national indicators for antibiotic use targets
  - Primary care (targets 1, 2 and 3)
  - Secondary care (targets 4 and 5)
  - Dental prescribing (targets 6 and 7)

Theme 3. Investing in innovation, supply and access

- Health disparities and health inequalities (Outcome 8)
  - Commitment 8.1 Data on health inequalities
    - Primary care (excluding dental) prescribing
    - Antimicrobial resistant bacteraemia
    - Gram-negative bacteraemia
    - Carbapenemase-producing organisms

Theme 4. Being a good global partner

- AMR diplomacy (Outcome 9)
  - Commitment 9.1 Prevention and preparedness
  - Building sustainable partnerships

sepa SRUC Food Standards Scotland

  - Commitment 9.3 Antimicrobial use in farming
    - Antimicrobial resistance in animals

Antimicrobial use in humans

Antimicrobials include antibiotics, antivirals, antifungals and antiparasitic medicines. Currently the SONAAR report focuses on antibiotics, with future ambitions to include other antimicrobial groups.

Antibiotic use is a key driver of AMR in bacteria, as antibiotic exposure selects for resistant organisms within microbial populations. Inappropriate antibiotic use occurs when antibiotics are used unnecessarily or incorrectly, including when they are prescribed for infections or conditions that do not require antibiotic treatment or when the choice, dose or duration of treatment is not optimal. Effective stewardship ensures antibiotics are used only when indicated, with appropriate choice, dose and treatment duration which supports safe and effective patient care.

ARHAI Scotland monitor AMU in humans to support national antimicrobial stewardship. As antibiotic prescribing expands across a wider range of healthcare settings and professional groups, surveillance systems must continue to evolve to accurately capture prescribing activity and support stewardship interventions across all prescribers.

Surveillance intelligence is routinely shared with the Scottish Antimicrobial Prescribing Group (SAPG), the Association of Scottish Antimicrobial Pharmacists (ASAP), and the Scottish Antimicrobial Nurses Group (SANG) to inform strategic decision making and strengthen antimicrobial stewardship across Scotland.

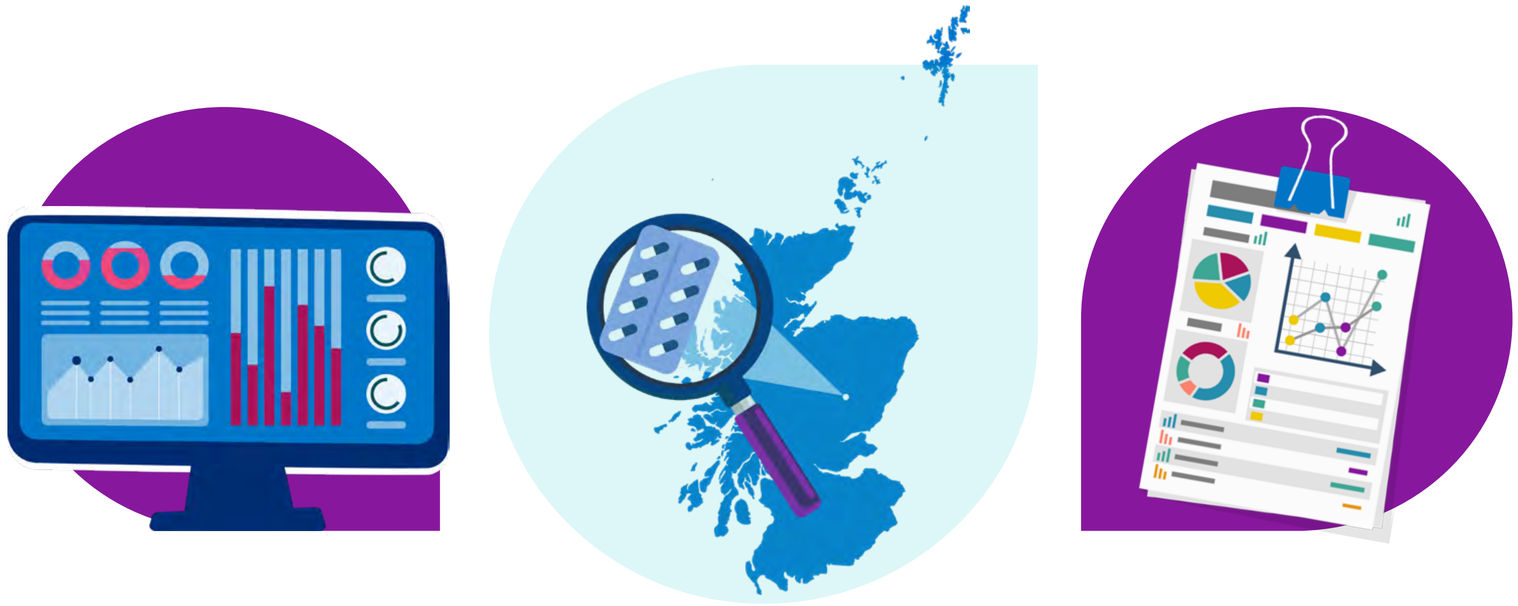


Scottish national indicators for antibiotic use

The UK AMR National Action Plan (NAP) 2024 to 2029 sets out measures of success to ensure progress, including targets on antimicrobial use, targets 4a and 4b.

To support the delivery of the UK AMR NAP 2024-2029, the Scottish Government published agreed Scottish national indicators for antibiotic use in December 2025, replacing previous antibiotic indicators issued in February 2023. The indicators were developed by the SAPG in collaboration with stakeholders across Scotland, with support from ARHAI Scotland. The indicators include targets to be reached by 2029 across Primary Care (targets 1, 2, and 3), Secondary Care (targets 4 and 5) and Dental prescribing (targets 6 and 7). The Scottish national indicators for antibiotic use are reviewed regularly to ensure they continue to support NHS boards in achieving optimal antimicrobial prescribing practices and contribute to the delivery of the UK AMR NAP 2024 to 2029.

ARHAI Scotland continues to develop dashboards and reports to ensure alignment with Scottish national antibiotic indicators across primary care, secondary care, and dental settings. These outputs support NHS Boards in monitoring progress against Scottish targets and support delivery of the UK AMR NAP 2024 to 2029.



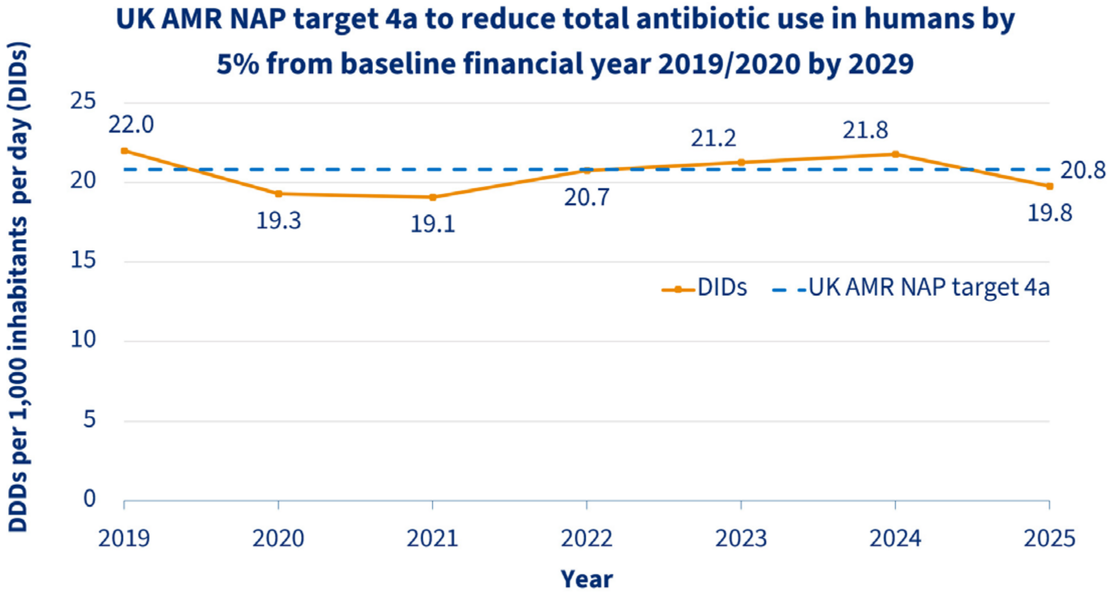
Total antibiotic use in humans in Scotland

In **2025**, **19.8 defined daily doses per 1,000 inhabitants per day (DIDs)** of **antibiotics** were used in **Scotland**.

There was a **decrease of 9.2%** in the **rate of DIDs** in **2025** compared with **2024**.

UK AMR NAP target 4a: By 2029, we aim to reduce total antibiotic use in human populations by 5% from the financial year 2019/20 baseline.

In 2025, the rate was below the target (20.8 DIDs) based on 5% reduction from the Scottish financial year 2019/20 baseline.



In **2025**, **81.7%** of **antibiotic defined daily doses (DDDs)** were in **primary care**, while **18.3%** were in **secondary care**.

81.7%



Primary care

18.3%



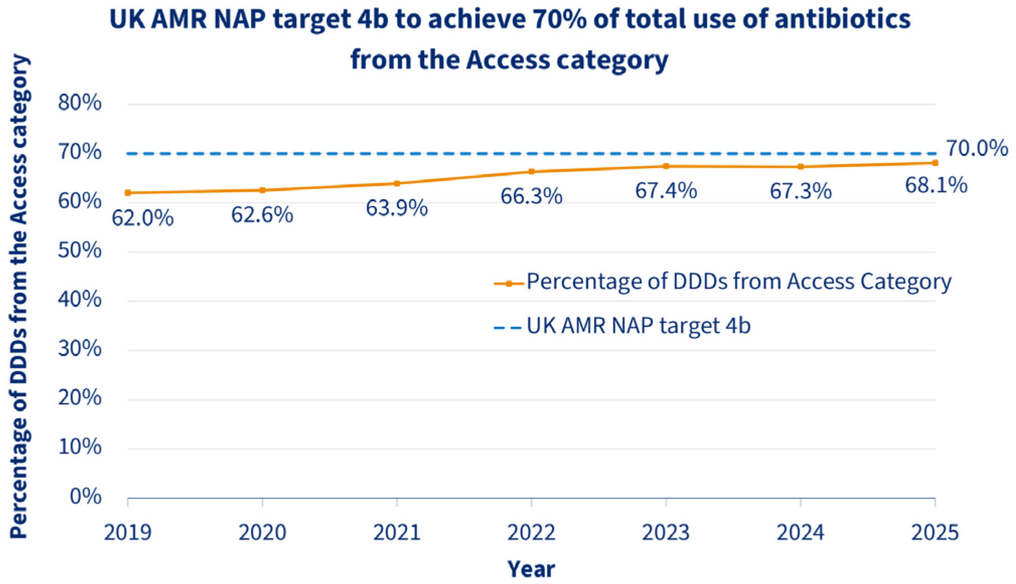
Secondary care

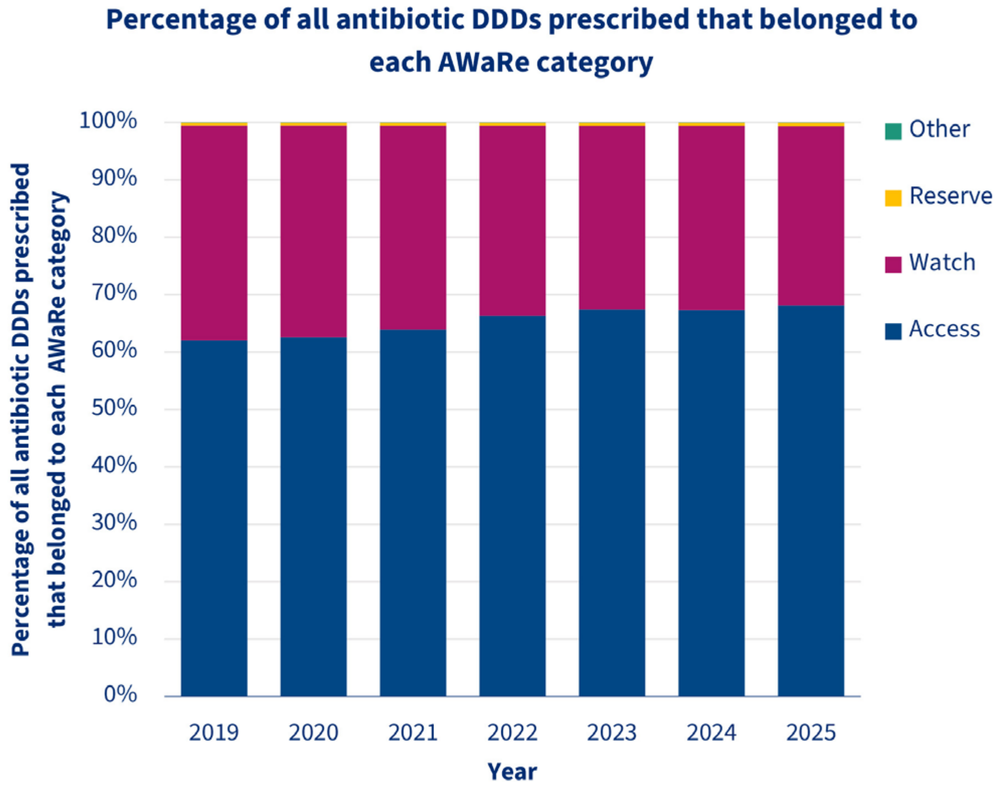
Percentage of total antibiotic use in Scotland that belonged to the Access group

To reduce unnecessary use of broad-spectrum antibiotics, the 2024 UK-adapted version of the World Health Organization (WHO) **Access**, **Watch**, **Reserve (AWaRe)** classification of antibiotics is used to monitor antibiotic use in Scotland. Access antibiotics are recommended as **first line treatment** for most common infections.

In **2025**, **Access antibiotics** accounted for **68.1%** of **total antibiotic use**[1] in **Scotland**.

This is an **increase** from **67.3%** in **2024**.





UK AMR NAP target 4b: By 2029, we aim to achieve 70% of total use of antibiotics from the Access category (new UK category) across the human healthcare system.
In 2025, the proportion of total antibiotic use from Access category was only 1.9% away from the 70% target.

[1]Methenamine has been excluded from all AMU metrics in the SONAAR report in line with its exclusion from the UK AMR NAP 2024 to 2029 targets so previously reported figures will differ from this report. Please see the Methenamine usage section and Appendix 2 for more information.

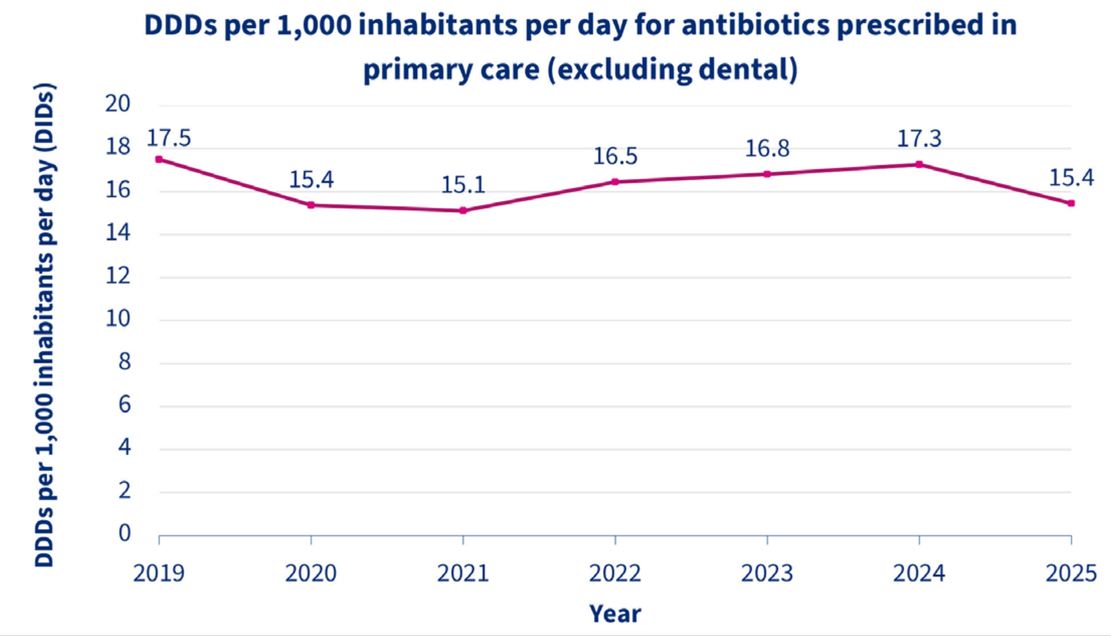
Antibiotic use in primary care (excluding dental) in Scotland

Primary care prescribing continues to account for the majority of antibiotic use in Scotland. Robust community level surveillance systems are essential to monitor prescribing patterns and support safe and effective use of antibiotics.

Reducing unnecessary prescribing for self-limiting conditions, such as coughs, colds, sore throats, and earache, in otherwise healthy individuals, is a key component of optimising antibiotic use in primary care.

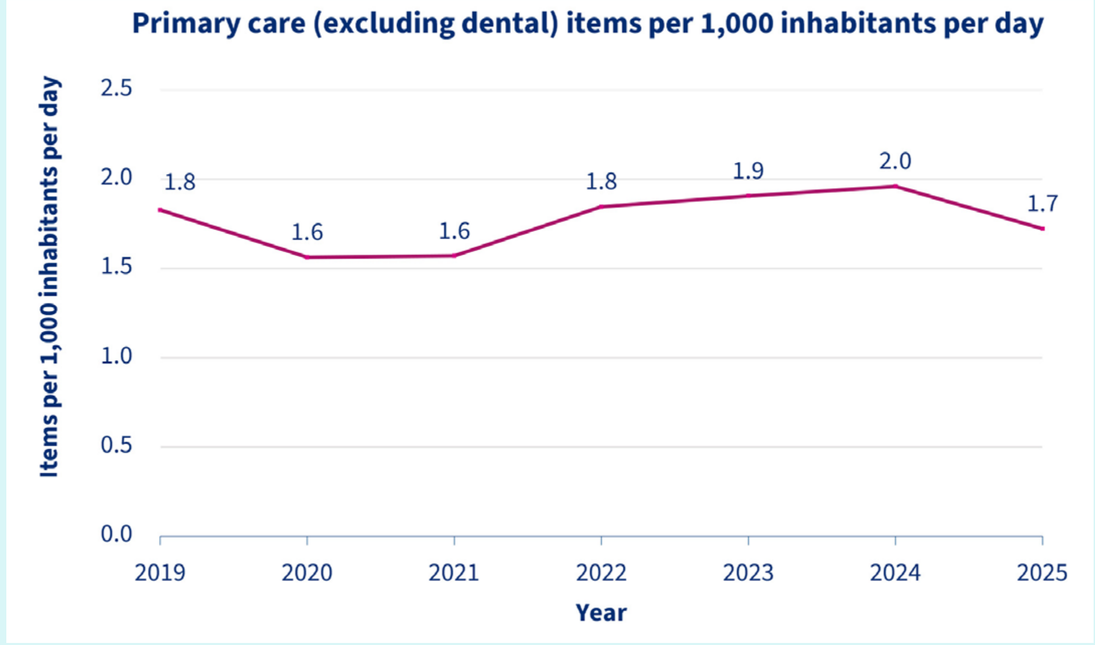
Primary care (excluding dental) AMU by defined daily doses per 1,000 inhabitants per day (DIDs)

In **2025**, **15.4 DIDs** were used, a **10.5% decrease** in the rate between **2024** and **2025**.



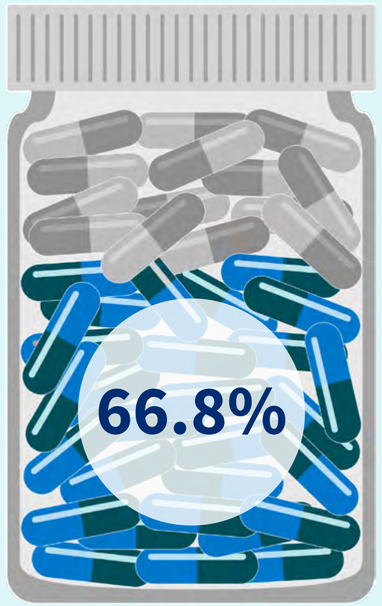
Primary care (excluding dental) AMU by number of items

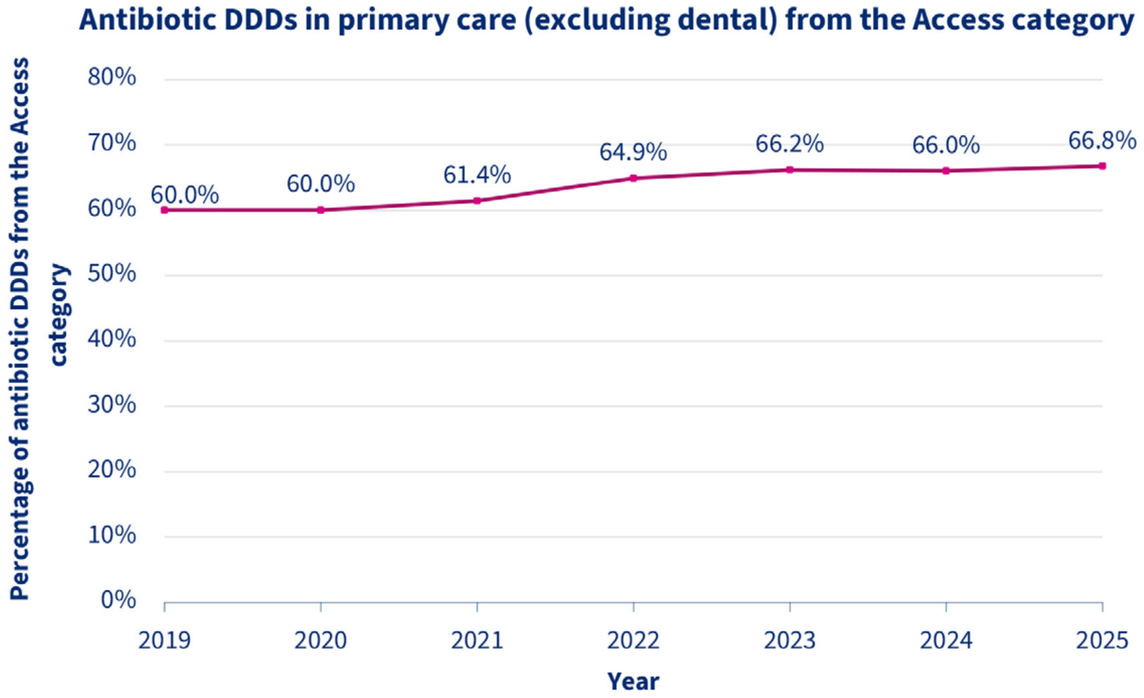
In **2025**, **1.7 items per 1,000 inhabitants per day** were prescribed, a **12.1% decrease** from **2024**.



AWaRe Access antibiotic use in primary care (excluding dental)

In **2025**, **66.8%** of **antibiotic DDDs** in primary care (excluding dental) were from the **Access category**, compared to **66.0%** in **2024**.





Improving adherence to evidence based prescribing guidance is key to promoting the appropriate use of Access antimicrobial agents and reducing the inappropriate use of Watch and Reserve antimicrobial agents.

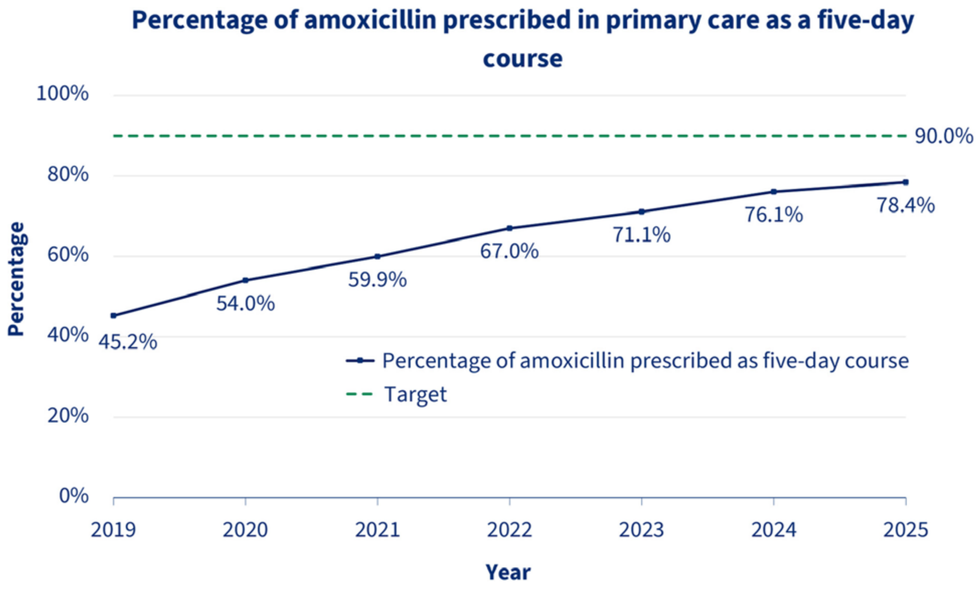


Scottish national indicators for antibiotics use: Primary care targets

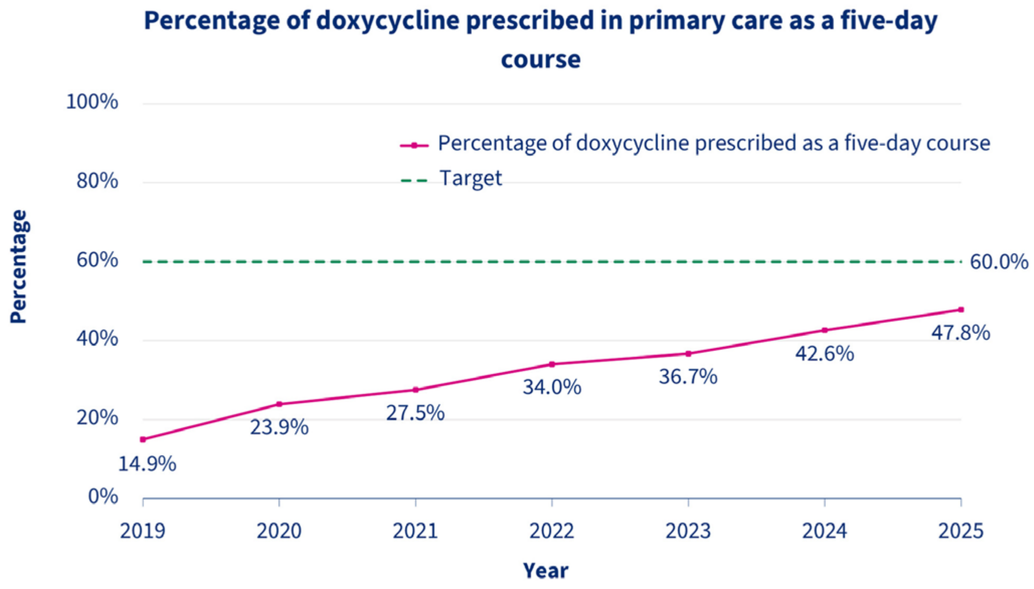
Target 1

To reduce unnecessary exposure to antibiotics and minimise AMR, clinical guidelines recommend that where antibiotics are required for respiratory tract infections, treatment should generally be limited to five days. Target 1 of the Scottish national indicators for antibiotic use aims to increase adherence to these guidelines for amoxicillin and doxycycline prescribing.

In **2025**, the **percentage** of **amoxicillin** courses prescribed for five days was **78.4%**, a **3.0% increase** from **2024**.



In **2025**, the **percentage** of **doxycycline** courses prescribed for five days was **47.8%**, a **12.2% increase** from **2024**.



Scottish national indicators of antibiotic use target 1: By 2029, 90% of prescriptions of amoxicillin and 60% for doxycycline in primary care will be for a five-day course

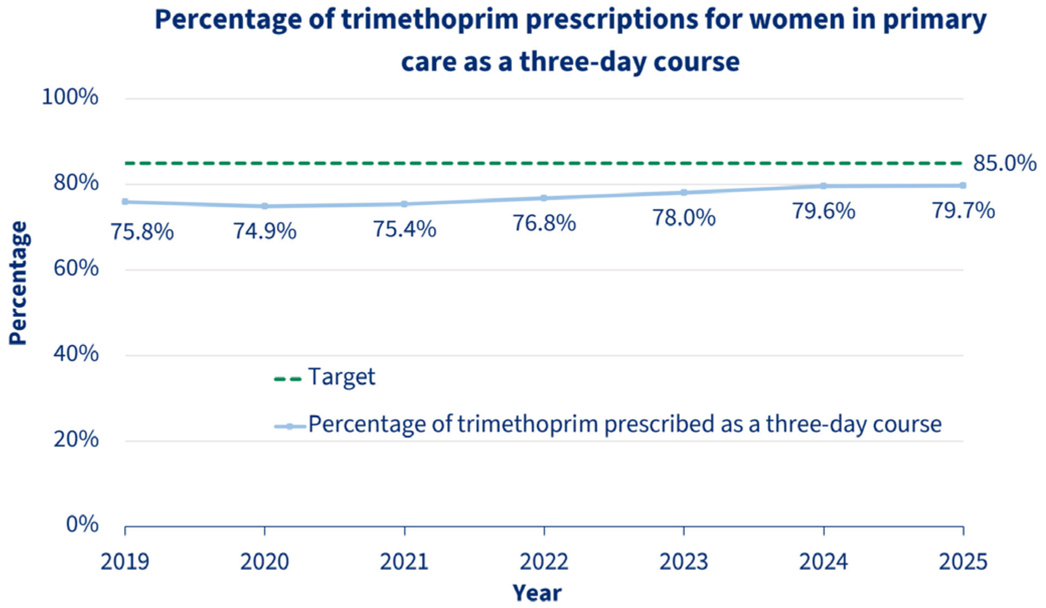
In 2025,

- Prescriptions of **amoxicillin** as a five-day course **increased** but remained below the 90% target,
- Prescriptions of **doxycycline** as a five-day course **increased** but remained below the 60% target.

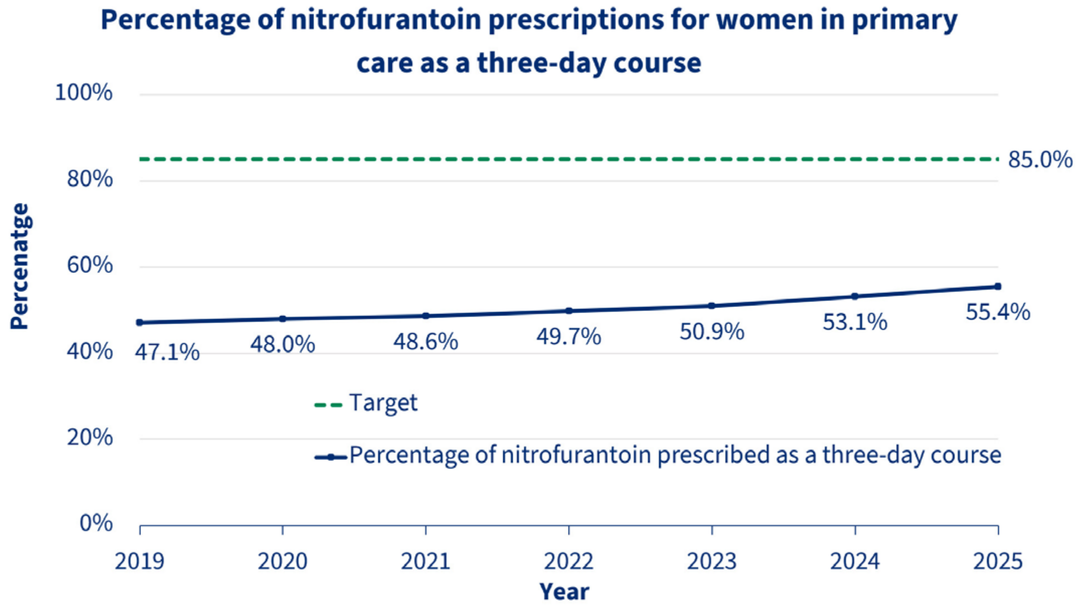
Target 2

Clinical guidelines recommend that for uncomplicated UTI, treatment should be limited to three days. Target 2 of the Scottish national indicators for antibiotic use aims to increase the percentage of prescriptions of trimethoprim and nitrofurantoin in women aged 16 years and over which meet the three-day course guidelines.

In **2025**, the **percentage** of **trimethoprim** courses prescribed for three days in **women** was **79.7%**. There has been **no change** between **2024** and **2025**.



In **2025**, the **percentage** of **nitrofurantoin** courses prescribed for three days in **women** was **55.4%**, a **4.3% increase** from **2024**.



Scottish national indicators of antibiotic use target 2: By 2029, 85% of prescriptions of trimethoprim and nitrofurantoin for women in primary care will be for three days

In 2025,

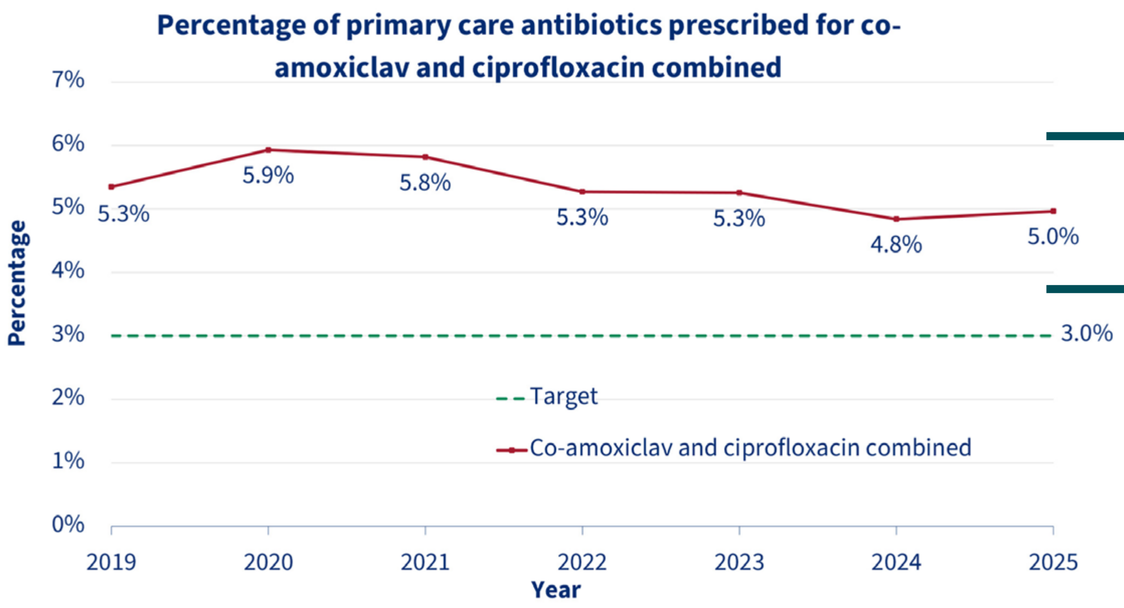
- Prescriptions of **trimethoprim** for three days **remained unchanged** and remained below the 85% target,
- Prescriptions of **nitrofurantoin** for three days **increased** but remained below the 85% target.

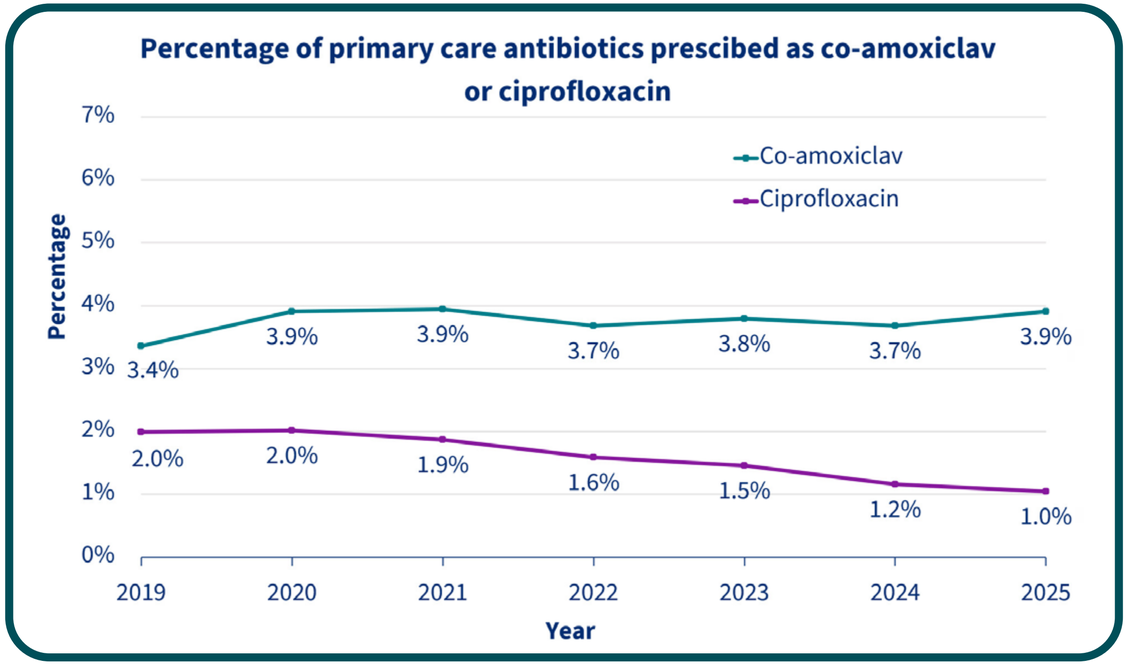
Target 3

Antimicrobial stewardship also promotes the use of narrow-spectrum antibiotics where appropriate. Reducing the use of broad-spectrum agents helps limit the selection pressure that drives the emergence and spread of antimicrobial resistance. Target 3 of the Scottish national indicators for antibiotic use aims to ensure less than 3% of all antibiotics in primary care will be for co-amoxiclav and ciprofloxacin combined.

In **2025**, the **combined percentage** of **co-amoxiclav** and **ciprofloxacin** courses prescribed was **5.0%**, a **2.5% increase** from **2024**, and remains **above** the **3% target**.

In **2025**, the **percentage** of **co-amoxiclav** courses prescribed was **3.9%**, a **6.2% increase** from **2024**. The **percentage** of **ciprofloxacin** courses prescribed was **1.0%**, a **9.2% decrease** from **2024**.





Scottish national indicators of antibiotic use target 3: By 2029, less than 3% of all antibiotics in primary care will be for co-amoxiclav and ciprofloxacin combined

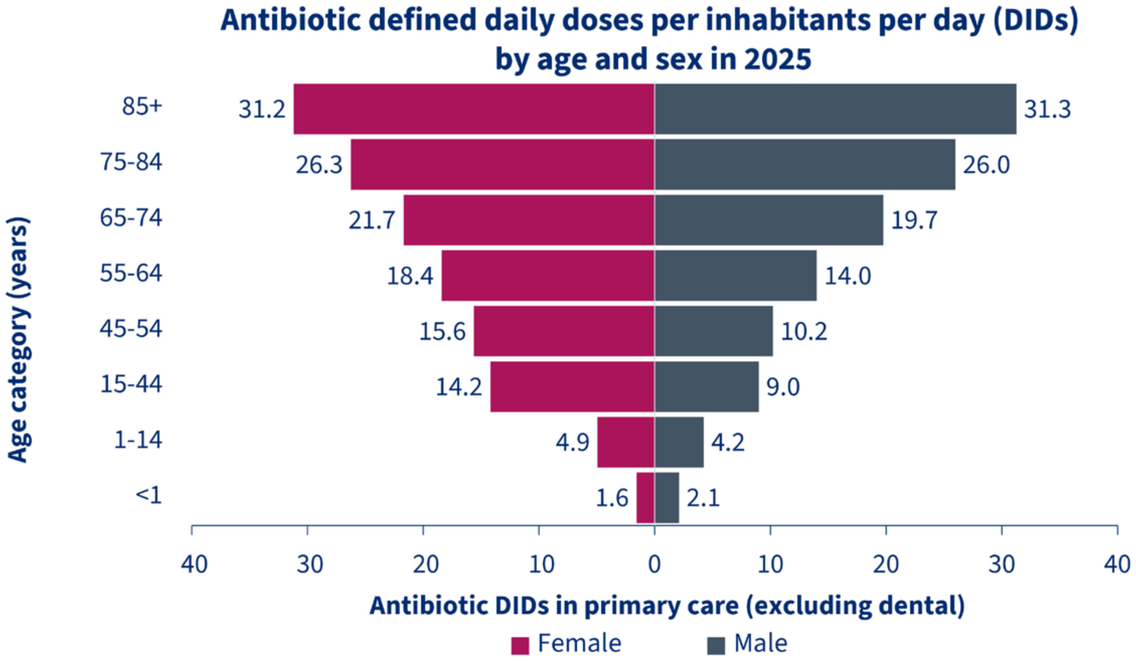
- In 2025, the combined percentage of **co-amoxiclav and ciprofloxacin** prescriptions **increased** and remained above the 3% target.

Health inequalities in primary care antibiotic prescribing (excluding dental)

Understanding health inequalities in antibiotic prescribing can provide evidence-based support for policy development, clinical decision making, and antimicrobial stewardship interventions. Examining prescribing patterns across population groups, including deprivation, age and sex, helps identify unwarranted variation and supports the UK AMR NAP 2024 to 2029 ambitions to reduce antibiotic use and optimise treatment choices.

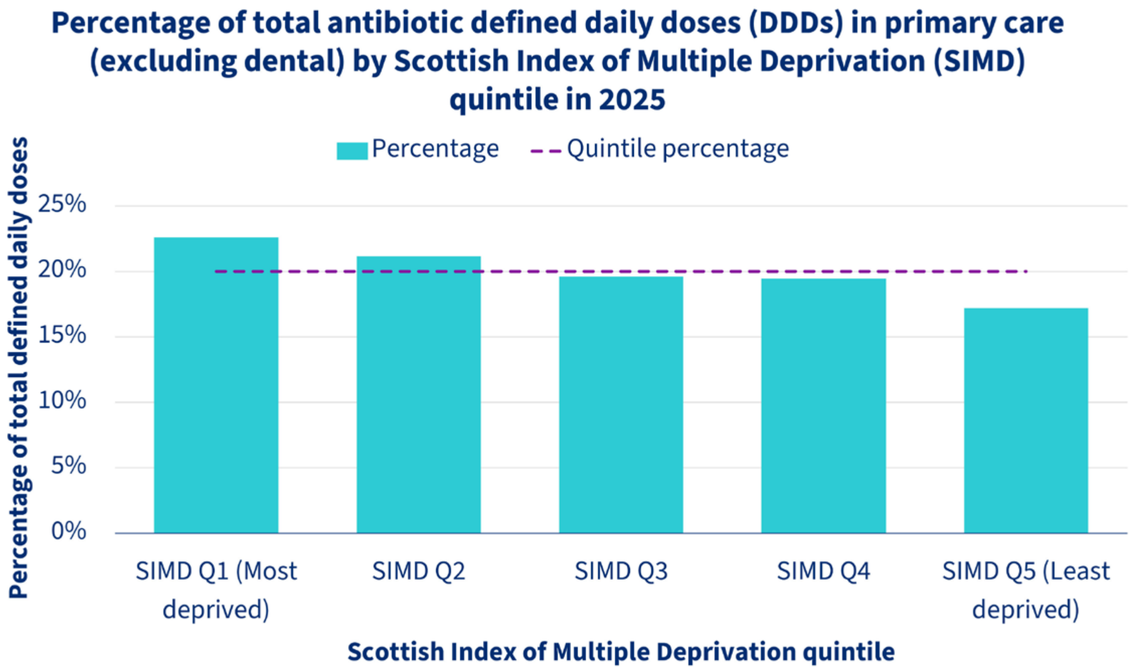
Age and sex

In **2025**, in those **aged 65 and over**, the **rate of antibiotic defined daily doses per inhabitants per day (DIDs)** was **23.8**, compared to **11.3** in those **aged 64 and under**. In **females**, the **rate of DIDs** was **15.9** compared to **11.8** in **males**.[1]



Deprivation

In **2025**, **43.7%** of **antibiotic defined daily doses (DDDs)** were prescribed to people living in the **40% most deprived areas** of Scotland.[1] This indicates a slightly higher concentration of antibiotic use in more deprived communities, although differences in health need, age profile and multimorbidity should be considered when interpreting these findings.



[1]Data for age, sex, and SIMD were not available for 12.1% of patients, therefore percentages include only data which were available.

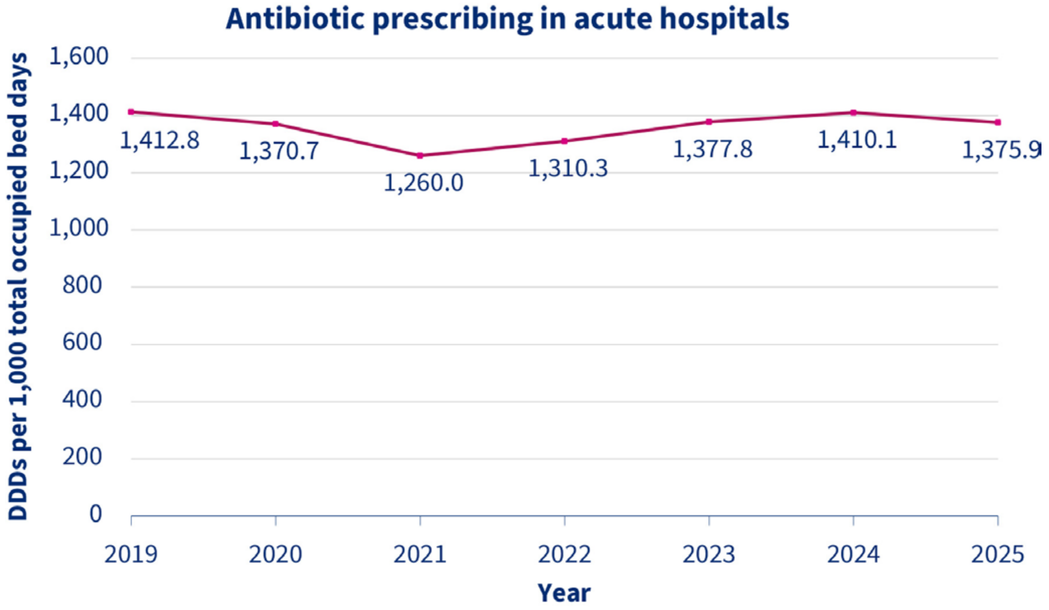
Antibiotic use in acute hospitals in Scotland

Optimising antibiotic use in acute hospital settings is a complex process that begins with accurate diagnosis to determine clinical need. When antibiotics are indicated, empiric prescribing should be guided by evidence-based local protocols that prioritise narrow-spectrum agents where appropriate, ensure appropriate route and duration of therapy, and support timely review, de-escalation and step down based on clinical progress and microbiological findings. This structured, multidisciplinary approach remains central to reducing antimicrobial resistance and improving patient outcomes.

Antibiotic use in acute hospitals

In **2025**, antibiotic use was **1,375.9 DDDs per 1,000 total occupied bed days**. There has been a **2.4% decrease** in the rate between **2024** and **2025**.[1]

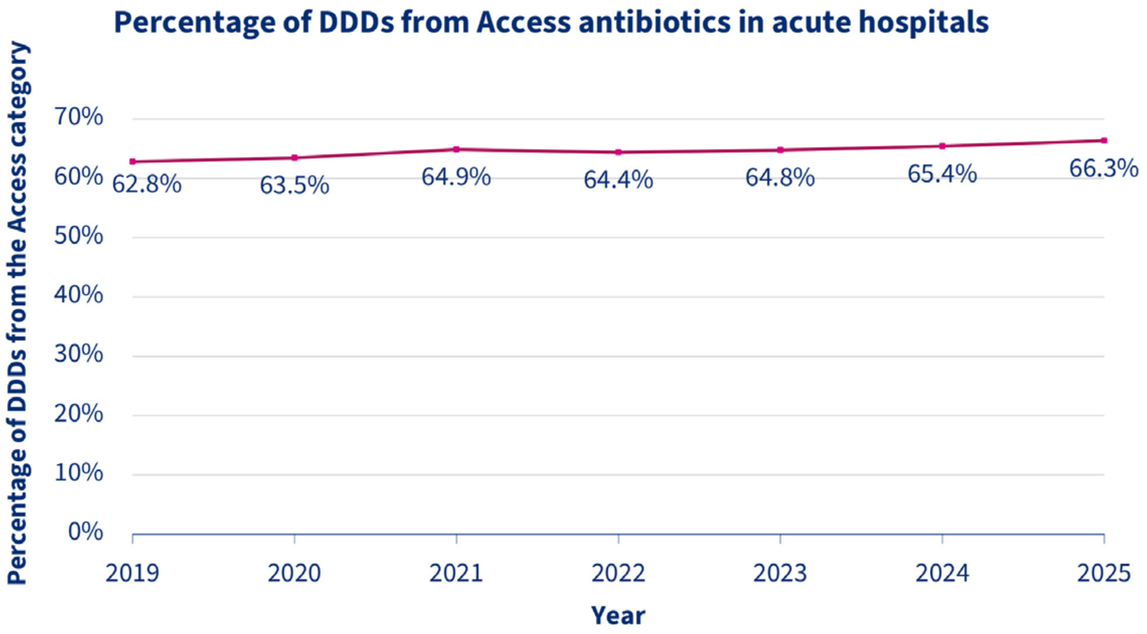




[1]Values for years 2019 to 2024 have been retrospectively amended from those reported in 2024 SONAAR report following review of acute hospital inclusion criteria. More information can be found in Appendix 2.

AWaRe Access antibiotic use in acute hospitals

Access antibiotics accounted for **66.3%** of **total antibiotic DDDs** in **2025**, compared to **65.4%** in **2024**.



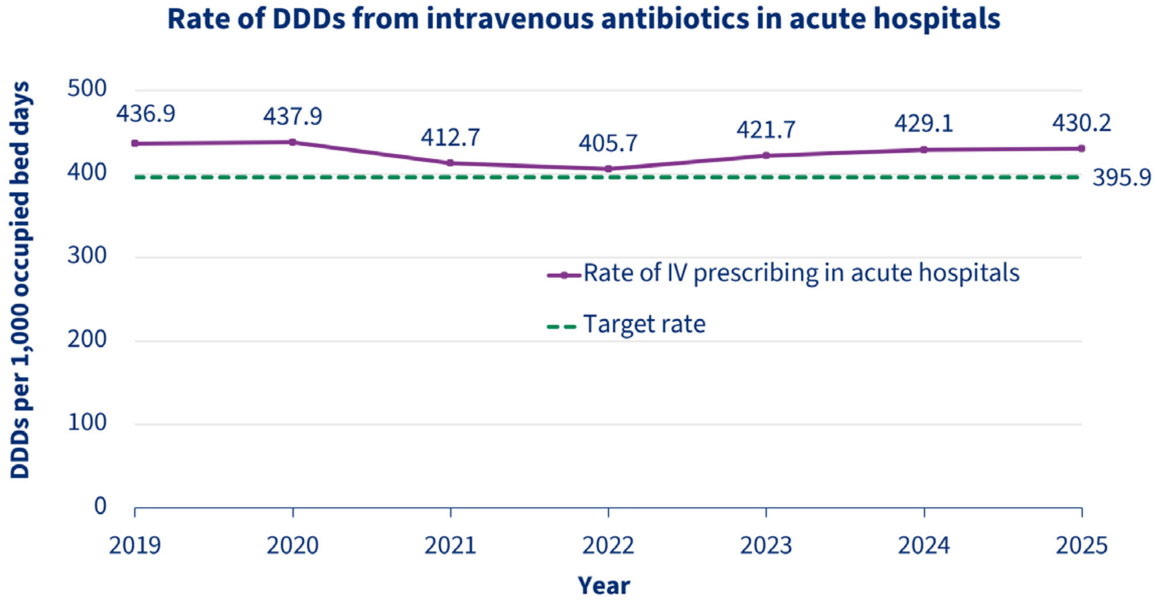


Scottish national indicators for antibiotic use: Secondary care targets

Targets 4 and 5

Selecting the most appropriate route of administration is essential to ensure infections are treated effectively while minimising risks associated with unnecessary use of intravenous (IV) therapy. Regular clinical review of hospital patients receiving IV antibiotics supports timely IV to oral switch and discontinuation of treatment where appropriate. This remains an important element of antimicrobial stewardship in acute hospitals in Scotland. Target 4 of the Scottish national indicators of antibiotic use aims to lower IV antibiotic prescribing by 10% from the financial year (FY) 2019/2020 baseline and target 5 to ensure that 95% of antimicrobial prescriptions have an indication recorded in secondary care.

Target 4: In **2025**, **430.2 DDDs of IV antibiotics** were used **per 1,000 occupied bed days in acute hospitals**, a **0.3% increase** from **2024**, and remaining **above** the **target** of **395.9**.



Scottish national indicators of antibiotic use target 4: By 2029, IV antibiotic prescribing (DDDs per 1,000 acute occupied beds) will be 10% lower than the FY 2019/2020 baseline

- In 2025, **IV antibiotic prescribing** (DDDs per 1,000 acute occupied beds) **has increased** and remains above the FY 2019/2020 baseline.

Scottish national indicators of antibiotic use target 5: By 2029, 95% of antimicrobial prescriptions will have an indication recorded in secondary care

- Currently unable to be quantified.

Target 5: National patient-level data on Secondary care AMU is currently being developed in Scotland. This includes improving the availability of indication data for national reporting. These targets will be kept under review to ensure that they are supporting boards to improve antimicrobial prescribing and delivery of the UK AMR NAP 2024 to 2029.

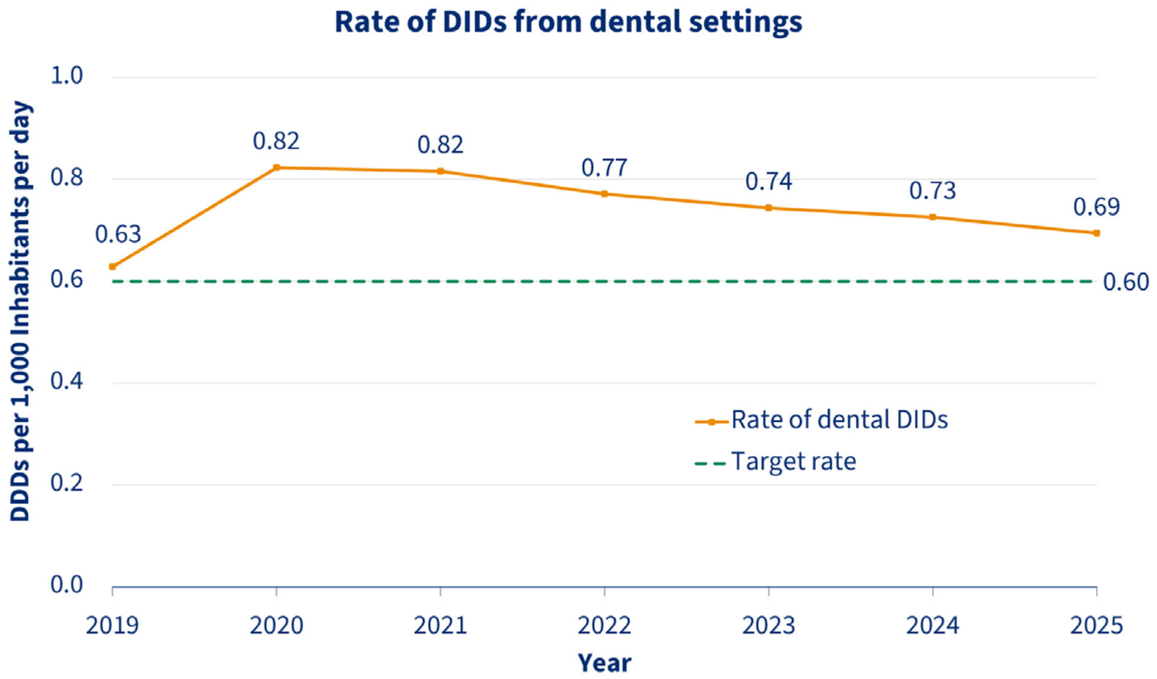
Antibiotic use in dental care in Scotland

Scottish national indicators for antibiotic use: Dental care targets

Dentistry accounts for approximately 10% of total antibiotic prescribing and is therefore an important focus for antimicrobial stewardship. The Scottish national indicators for antibiotic use in dental settings focus on reducing overall antibiotic use and promote the appropriate use of narrow-spectrum agents, helping to minimise the development of antimicrobial resistance (AMR). Target 6 focuses on reducing antibiotic prescribing in dental practice, while target 7 aims to increase the use of phenoxymethylpenicillin. Progress is measured by the proportion of dental antibiotic prescribing accounted for by phenoxymethylpenicillin, with a target of 60% by 2029. Achieving this target would mean phenoxymethylpenicillin is prescribed more frequently than amoxicillin.

Target 6

In **2025**, **antibiotic use** in **dental prescribing** was **0.69 defined daily doses per 1,000 Inhabitants per day (DIDs)**, a **4.3% decrease** from **2024**, but remains **above** the **target** of **0.60 DIDs**.



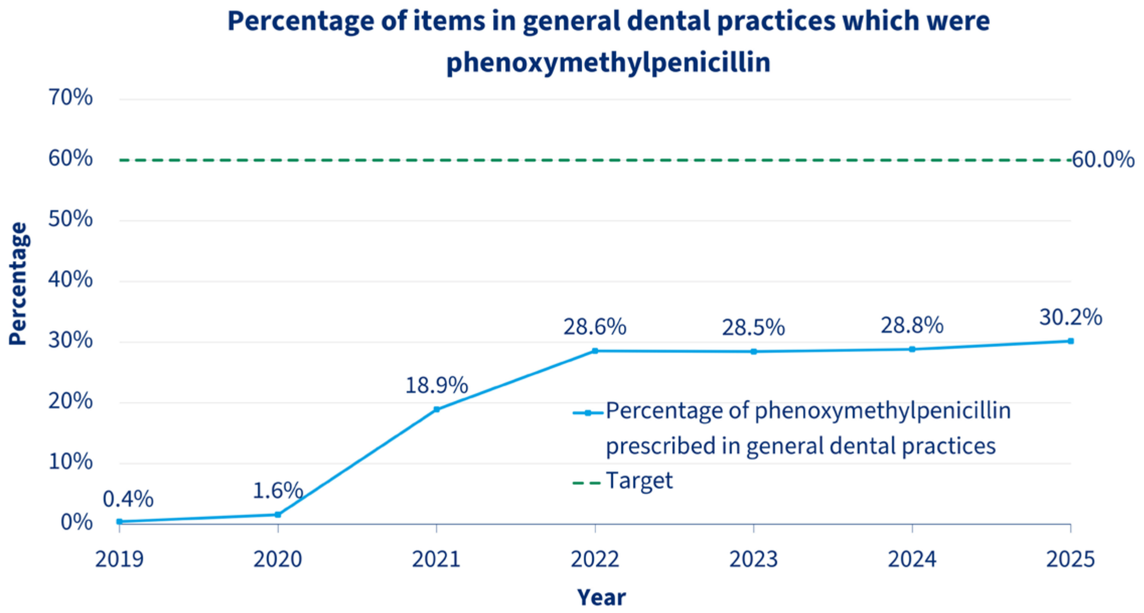
Scottish national indicators of antibiotic use target 6: By 2029, total antibiotic use in dental prescribing will be 5% lower than the FY 2019/2020 baseline

- In 2025, **total antibiotic use in dental prescribing has decreased** but remains above the FY 2019/2020 baseline of 0.60 DIDs.



Target 7

In **2025**, **phenoxymethylpenicillin** prescribing made up **30.2%** of **total antibiotic prescribing** in dental practice, a **4.7% increase** from **2024**, but remains **below** the **60% target**.



Scottish national indicators of antibiotic use target 7: By 2029, phenoxymethylpenicillin will be prescribed more frequently than amoxicillin in general dental practice and will account for at least 60% of total antibiotic prescribing

- In 2025, **phenoxymethylpenicillin prescribing in general dental practice increased** and remains below the 60% target of total antibiotic prescribing.

Methenamine usage

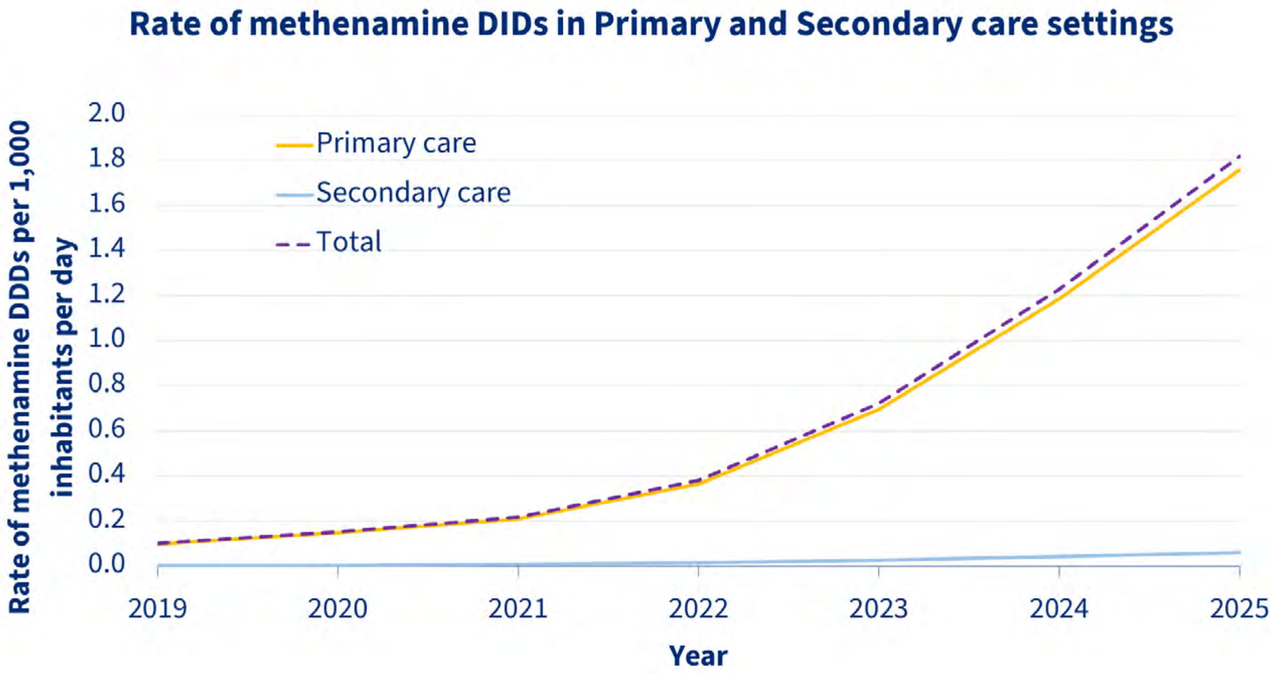
Following agreement across the four UK nations, methenamine has been excluded from NAP calculations and total antimicrobial use metrics and is reported separately. Monitoring methenamine use remains important as it is a non-antibiotic option for the prevention of recurrent urinary tract infections and may help support efforts to reduce antibiotic use.

In **2025**, **methenamine use** in **Scotland** was **1.8 defined daily doses per 1,000 inhabitants per day (DIDs)**.

This was a **47.9% increase** from **2024**.

The sustained increase reflects growing use of methenamine as a non-antibiotic option for the prevention of recurrent urinary tract infections, potentially driven by early adoption of NICE guidance published in December 2024. Prescribing remains predominantly in primary care, while use in secondary care remains low.





Antimicrobial use in companion animals

Data on AMU in companion animals were obtained from veterinary practice premises in Scotland contributing voluntarily to the Small Animal Veterinary Surveillance Network (SAVSNET), providing data from 87,527 consultations for 38,627 individual animals across 27 premises in 2025, and 51,850 consultations for 29,268 individual animals across 38 premises in 2024. The majority (97.2%) of consultations in companion animals were for dogs and cats.



Prescribing rates of antimicrobials in companion animals

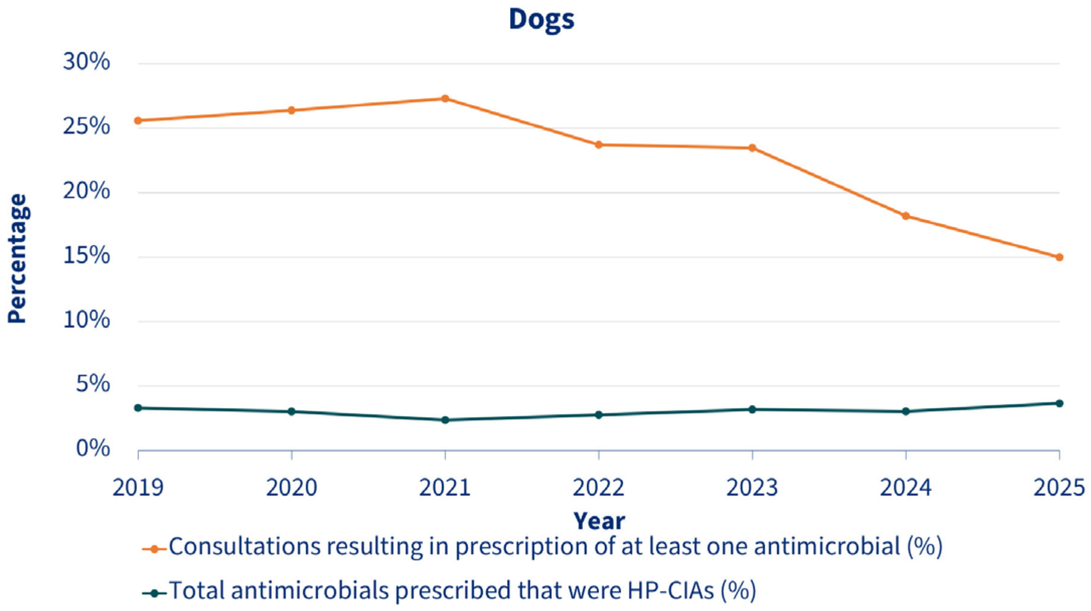
Prescribing rates of antimicrobials have **decreased** in recent years in both **dogs** and **cats**.

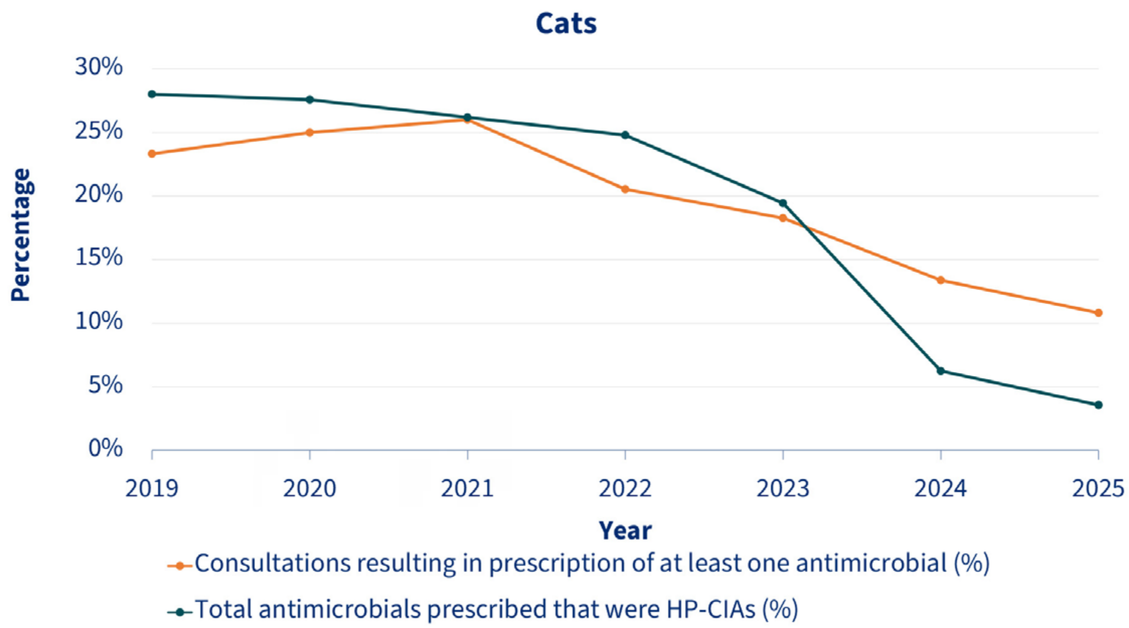
- In **2025**, **15.0%** of **consultations for dogs** resulted in the prescribing of at least one antimicrobial (9,258 of 61,761 consultations), which was a **decrease** from the **prescribing rate** of **18.2%** observed in **2024** (6,688 of 39,750 consultations).
- Antimicrobial **prescribing rates** in **cats** also **decreased** (**10.8%**, 2,523 of 23,336 consultations in **2025**; **13.4%**, 1,810 of 13,536 consultations in **2024**) and are now **lower** than in **dogs**.
- For **cats**, the proportion of **antimicrobial prescriptions*** that were **high priority critically important antimicrobials (HP-CIA)** have **decreased** considerably in recent years from **28.0%** (618 of 2,206 antimicrobial prescriptions) in **2019** to **6.2%** (128 of 2,049 antimicrobial prescriptions) in **2024**, with a **further reduction** in **2025** (**3.6%**, 99 of 2,775 antimicrobial prescriptions) to become **equivalent** with that of **dogs**.
- For **dogs**, the proportion of **antimicrobial prescriptions** that were **HP-CIA remained steady** (**3.0%**, 235 of 7,742 antimicrobial prescriptions in **2024**; **3.7%**, 391 of 10,679 antimicrobial prescriptions in **2025**).



* Where topical veterinary prescription products contain more than one antimicrobial, the constituent antimicrobials within them have been counted separately.

Trends in prescribing of antimicrobials (including HP-CIAs) for dogs and cats, in veterinary practices in Scotland contributing to SAVSNET, 2019 to 2025



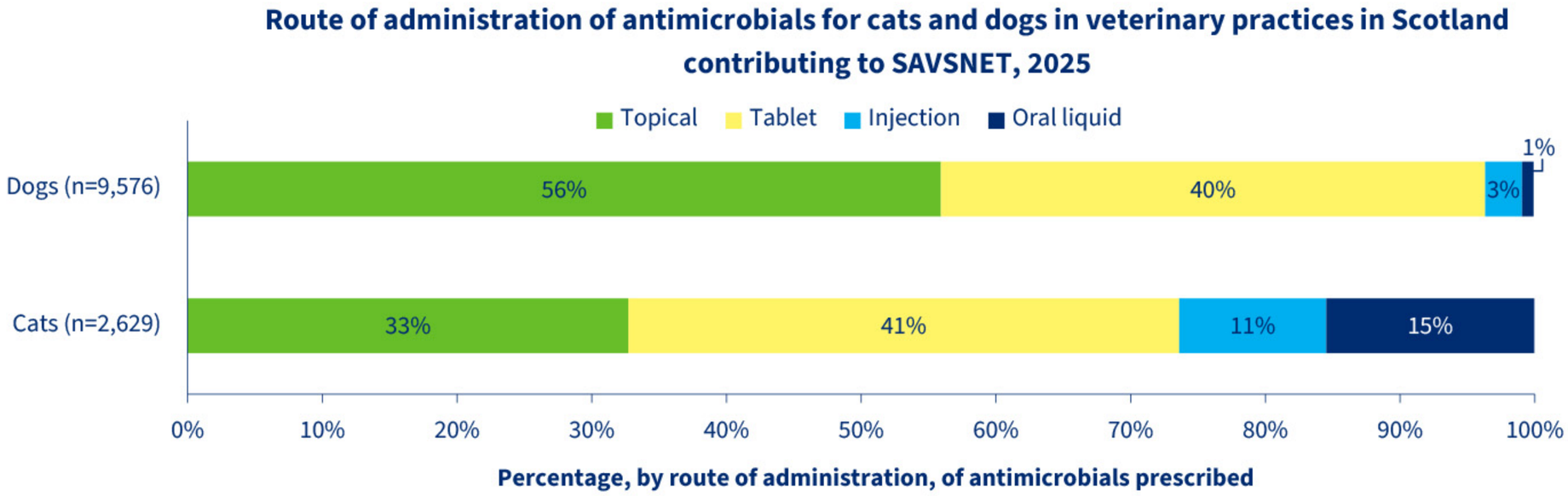


Contributing practices are low in number and cannot be assumed to be representative of all companion animal practices in Scotland. Total antimicrobials prescribed are greater than the number of preparations which are also greater than the number of consultations with antibiotics as more than one antimicrobial product may be prescribed in a consultation and some products may contain more than one antimicrobial.

Route of administration in companion animals

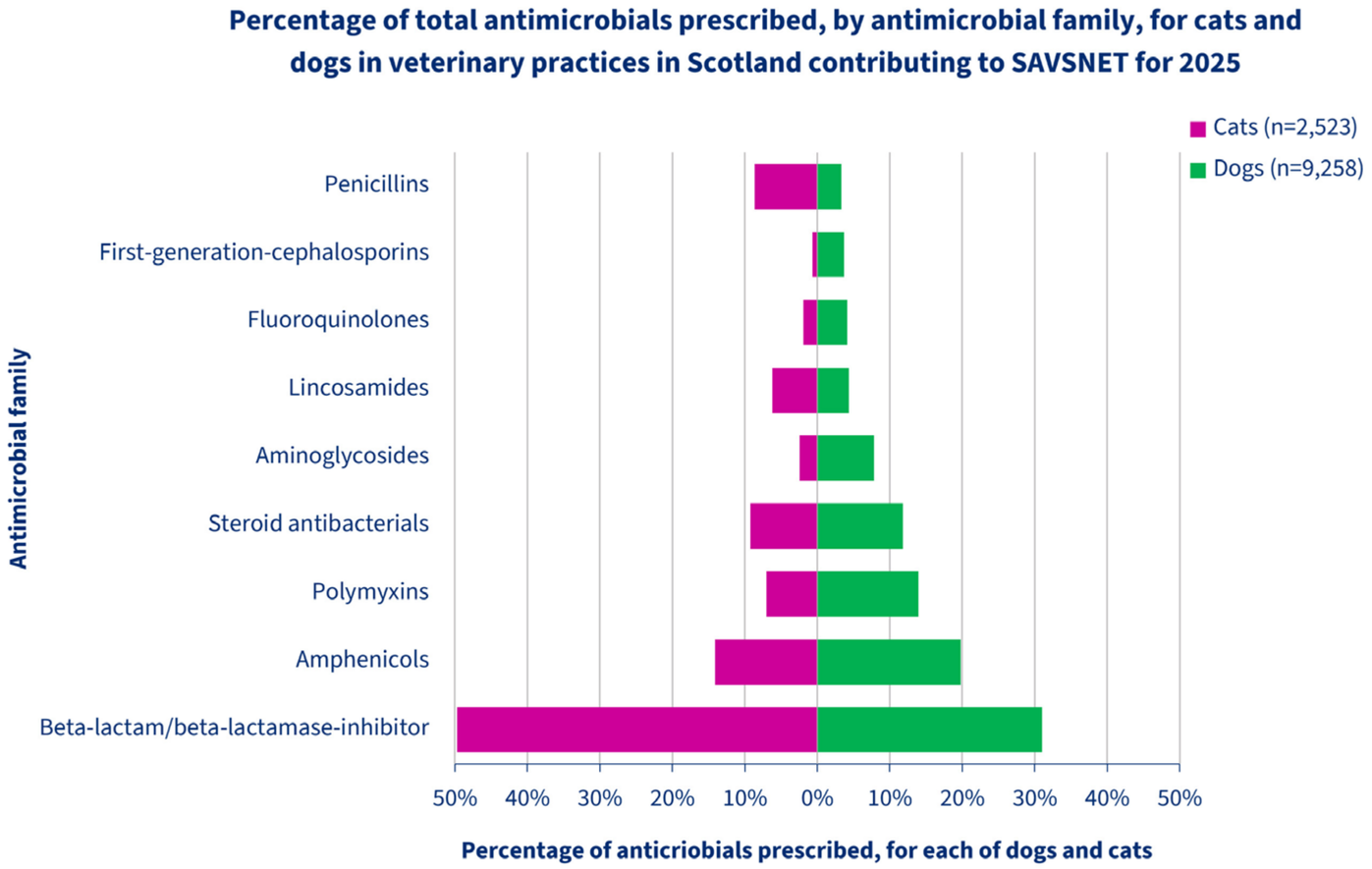
Of **antimicrobial preparations** prescribed for **dogs** (n=9,576) and **cats** (n=2,629) in **2025**:

- **Topical preparations** were the **most commonly prescribed** products in **dogs** (**55.9%**), followed by **tablets** (**40.4%**), whereas in **cats**, **tablets** (**40.9%**) were **more commonly prescribed** than **topical preparations** (**32.7%**).
- Antimicrobial preparations administrated by **injection** or by **oral liquid** routes were **more commonly prescribed** in **cats** than dogs (**oral liquid**: **15.4% cats**, **0.9% dogs**; **injection**: **10.9% cats**, **2.7% dogs**).
- A small proportion of preparations (**10.0%** in **dogs**; **4.5%** in **cats**) consisted of more than one antimicrobial; these were mostly topical products.



Antimicrobials prescribed in companion animals

- **Beta-lactam/beta-lactamase-inhibitors** were the **most commonly prescribed antimicrobials** in **dogs** (**31.0%** of 9,258) and **cats** (**49.7%** of 2,523), followed by **amphenicols** (**19.8% dogs**, **14.1% cats**).
- In comparison, **aminoglycosides**, **lincosamides**, **fluoroquinolones**, **first generation cephalosporins** and **penicillins** were less commonly prescribed.

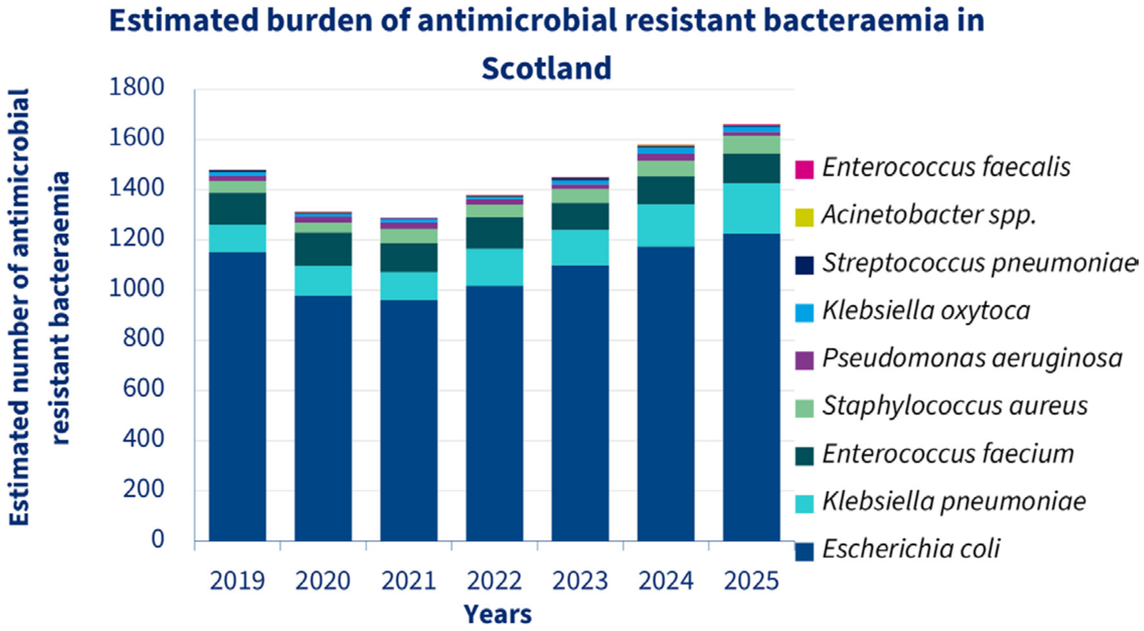


For more information on AMU in companion animals see Supplementary Data.

Antimicrobial resistance in humans

Antimicrobial resistant infections remain one of the most significant threats to global health, complicating treatment, prolonging hospital stays, increasing healthcare costs, and lead to poorer patient outcomes. Containing AMR is essential to preserve the effectiveness of existing antimicrobials. Surveillance is essential to understand the epidemiology, identify emerging threats, and inform national policy, antimicrobial stewardship, and infection prevention and control activities.

Antimicrobial resistance burden



In **2025**, **18.4%** of bacteraemias in select priority organisms of public health importance **were resistant to** at least one key antibiotic, **an estimated 1,662** resistant bacteraemias (Appendix Table 12).

Of those, **88.1% were caused by antimicrobial resistant Gram-negative bacteria**. The most common organism causing antimicrobial resistant bacteraemia was *Escherichia coli (E. coli),* followed by *Klebsiella pneumoniae (K. pneumoniae)* and *Enterococcus faecium (E. faecium).*

26.7% of ***E. coli*** **bacteraemia** in Scotland were **resistant to at least one key antibiotic**.

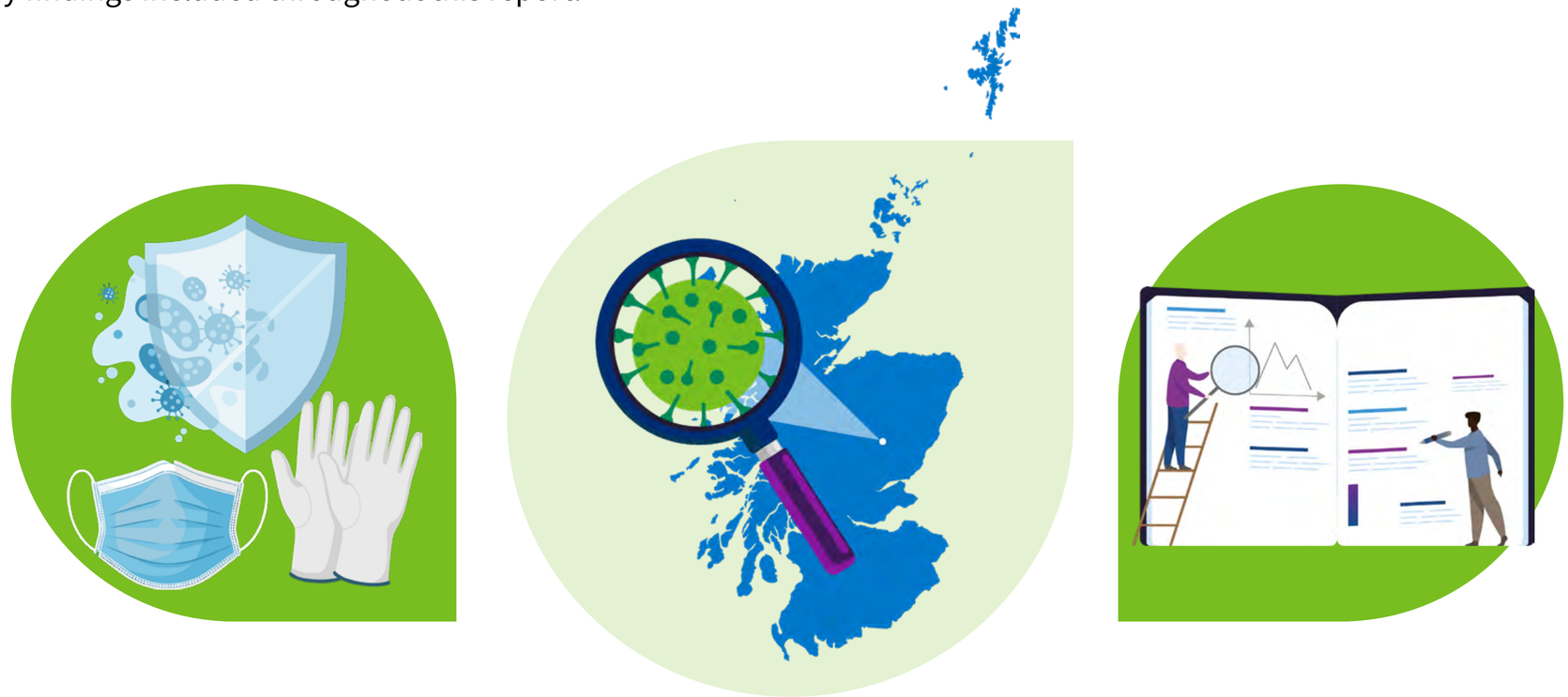
For more detailed information on priority organisms and AMR burden see Appendix 2 and Supplementary Data.

AMR and infections - the UK AMR National Action Plan 2024 to 2029

The UK AMR National Action Plan (NAP) 2024 to 2029 includes targets to prevent increases in drug resistant infections and Gram-negative bloodstream infections (GN-BSIs) in humans (targets 1a and 1b).

To support the delivery of the UK AMR NAP 2024 to 2029, Scotland continues to strengthen IPC, AMR surveillance, antimicrobial stewardship, and HCAI surveillance programmes. These efforts are supported by the Scottish Government's HCAI Strategy 2023 to 2025 and the recently published Infection Prevention and Control Strategy for Scotland, which recognises the close relationship between IPC and AMR to support reducing the burden of infection across health and social care settings. This includes the development and monitoring of data for action to reduce unnecessary harm from infection.

In line with the UK AMR NAP 2024 to 2029 Commitment 8.1, reporting of health inequality metrics to describe human AMR and infections in Scotland has been developed with some key findings included throughout this report.

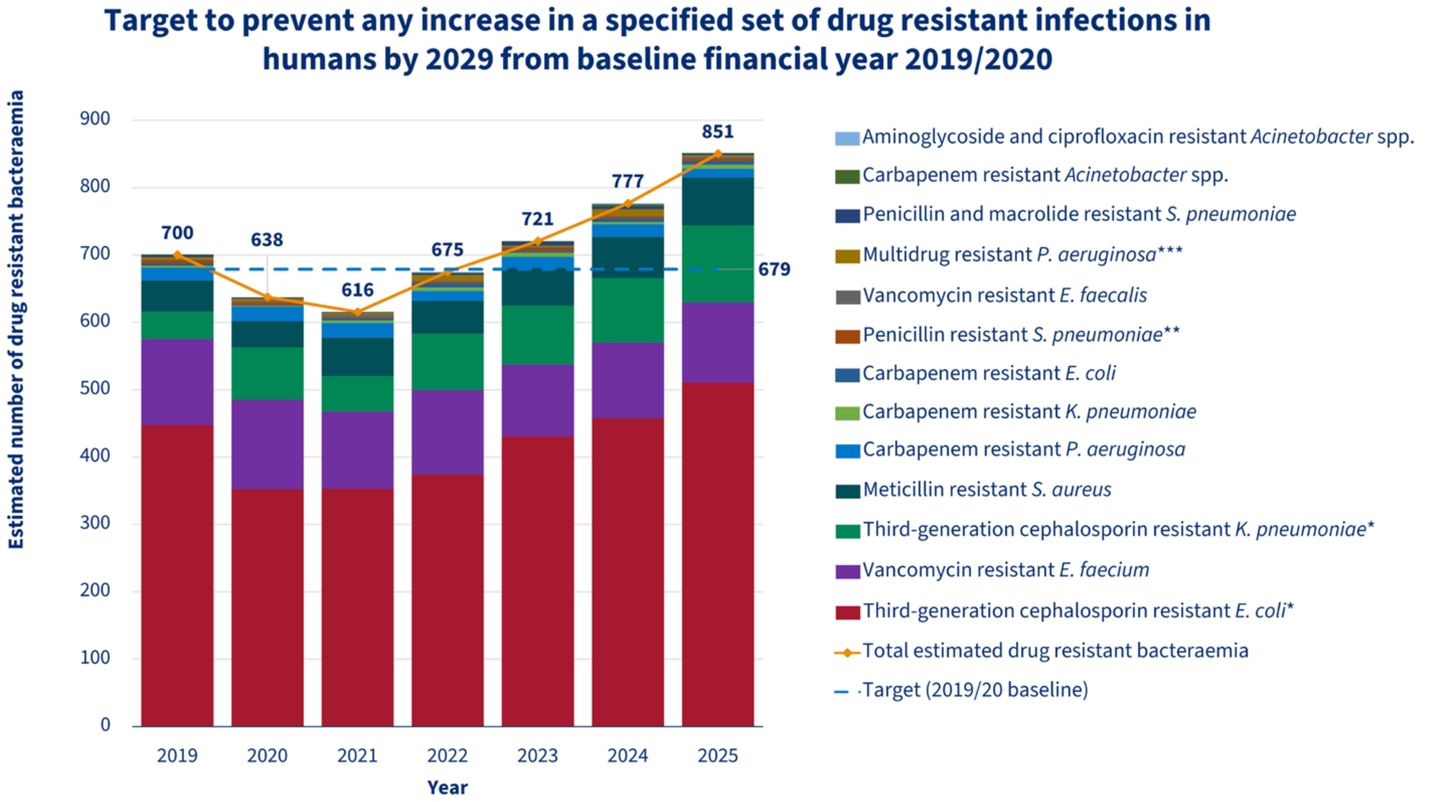


The UK AMR National Action Plan 2024 to 2029 and AMR target 1a

Of the **specified set of drug resistant infections in the UK AMR NAP 2024 to 2029**, there were an estimated **851 drug resistant bacteraemia** in **2025** in Scotland, which exceeded the **baseline financial year 2019/2020 (n=679)** by **25.3%**.

These drug resistant infections are a subset of the AMR bacteraemia burden estimates in select priority organisms (Appendix 2 Table 13).
Higher estimated burden of drug resistant bacteraemia in **2025** compared to **2019/2020** was driven by **increases** in **third generation cephalosporin resistant *E. coli*** and ***K. pneumoniae*** **bacteraemia** and by **MRSA bacteraemia**.

Achieving this ambitious target will require a significant reduction in drug resistant bacteraemia. While the reasons for these trends are not fully understood, they are likely influenced by multiple factors and will require a whole systems approach with coordinated action across infection prevention and control, antimicrobial stewardship, and surveillance.



*but not resistant to carbapenems
**but not resistant to macrolides
***resistant to three or more antimicrobial groups (aminoglycosides (amikacin, gentamicin); piperacillin-tazobactam (Tazocin); ciprofloxacin; ceftazidime), but not resistant to carbapenems.

Target 1a: By 2029, we aim to prevent any increase in a specified set of drug resistant infections in humans from the 2019 to 2020 financial year baseline.
The year-ending 2025 count exceeded the baseline target.

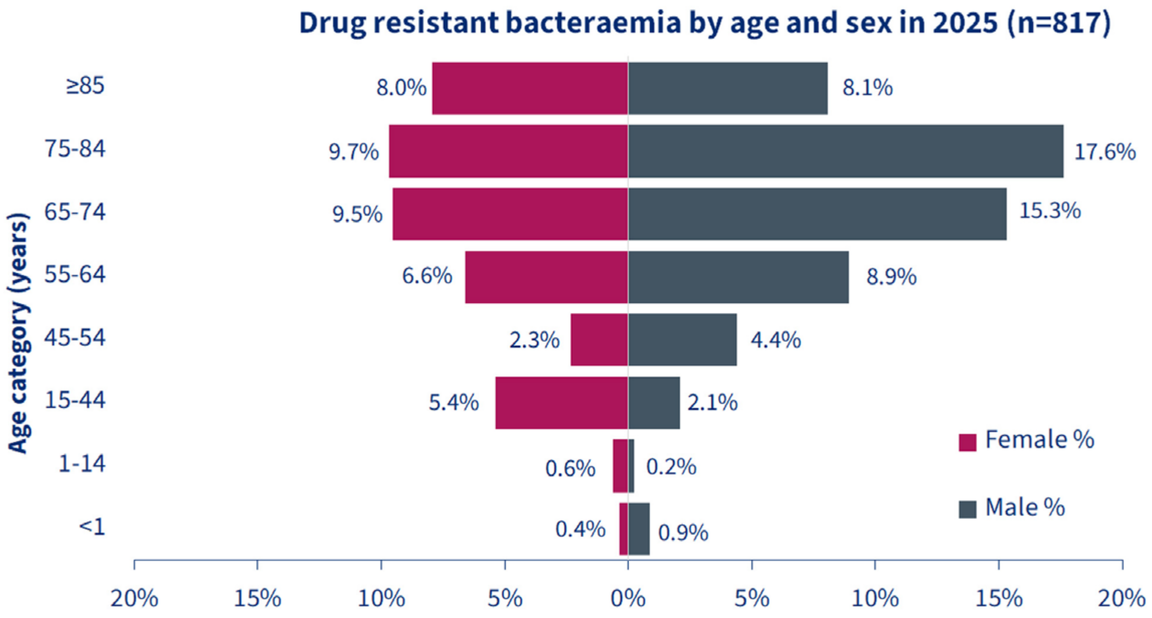
For more information on the UK AMR NAP 2024 to 2029 see Appendix 2 and Supplementary Data.

Antimicrobial resistance - health inequalities

Understanding how AMR varies by socioeconomic deprivation and geographic accessibility, can help to inform policy development and target interventions to reduce health inequalities and improve population health outcomes.

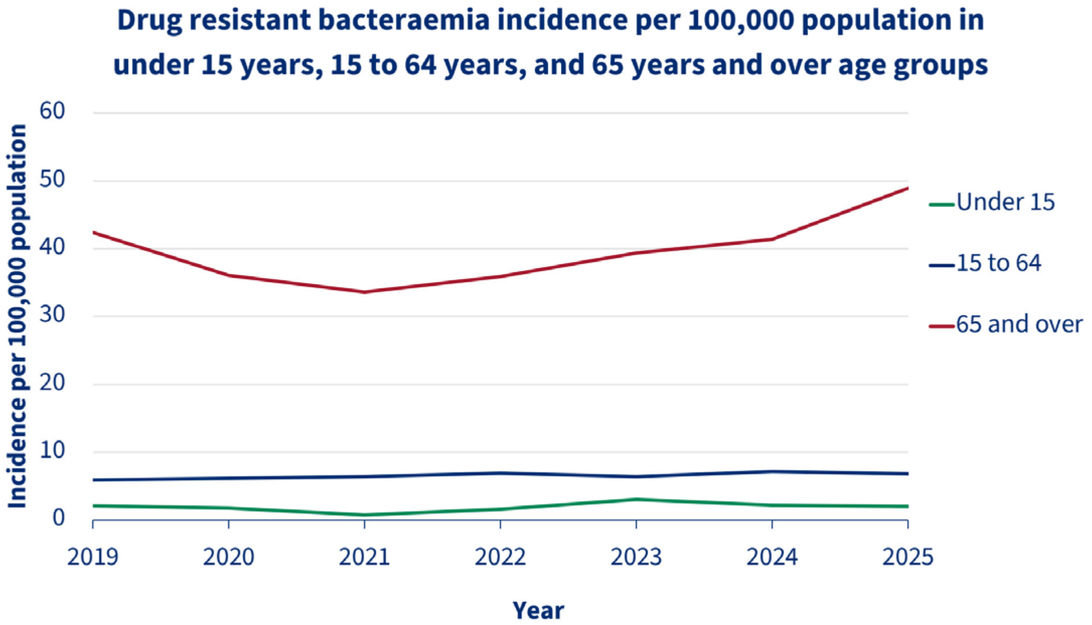
Age and sex

In **2025**, **57.5%** of **the drug resistant bacteraemia** cases **specified in the UK AMR NAP 2024 to 2029**[1] occurred in **males**, and **68.2%** of cases were **aged 65 and over**.



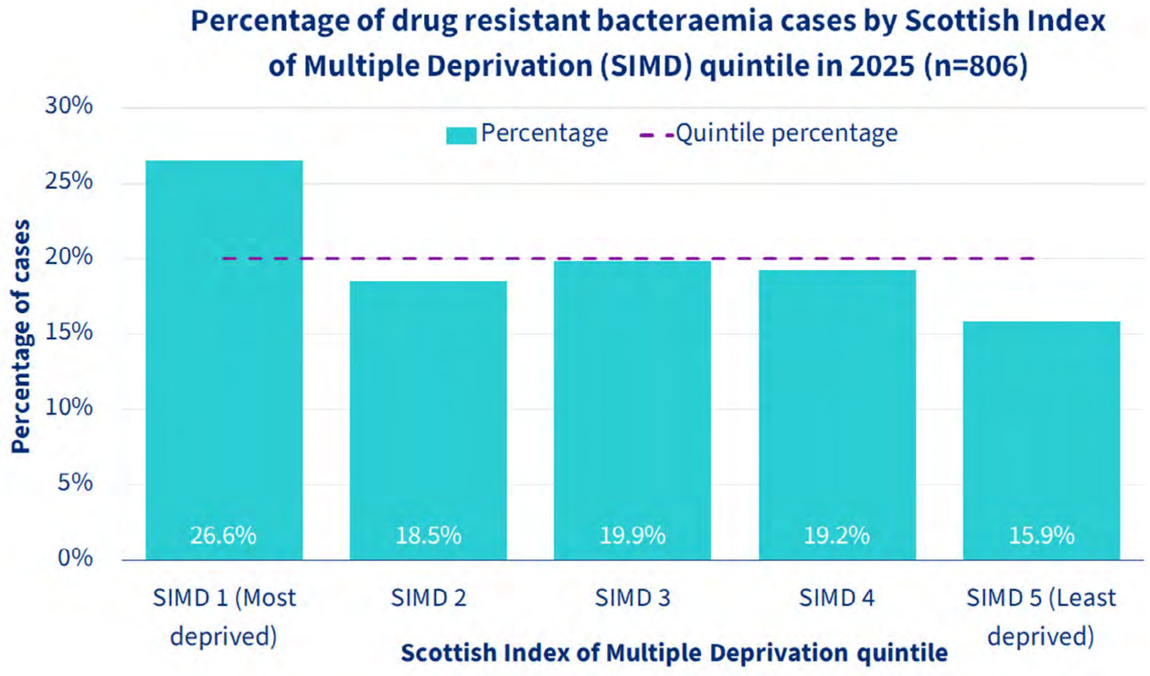
[1]Only bacteraemia cases with complete antimicrobial susceptibility testing (AST) results (96.0% bacteraemia) are included.

The **annual incidence rate** of **drug resistant bacteraemia** cases in patients **aged 65 and over** was **48.9** per 100,000 population in **2025**. This was **higher** than the **annual incidence rate** in those **aged 15 to 64** (**6.8** per 100,000 population) and those **aged under 15** (**2.0** per 100,000 population) in **2025**. This mirrors patterns seen in Gram-negative bacteraemia more broadly, with the highest burden in older adults and males.

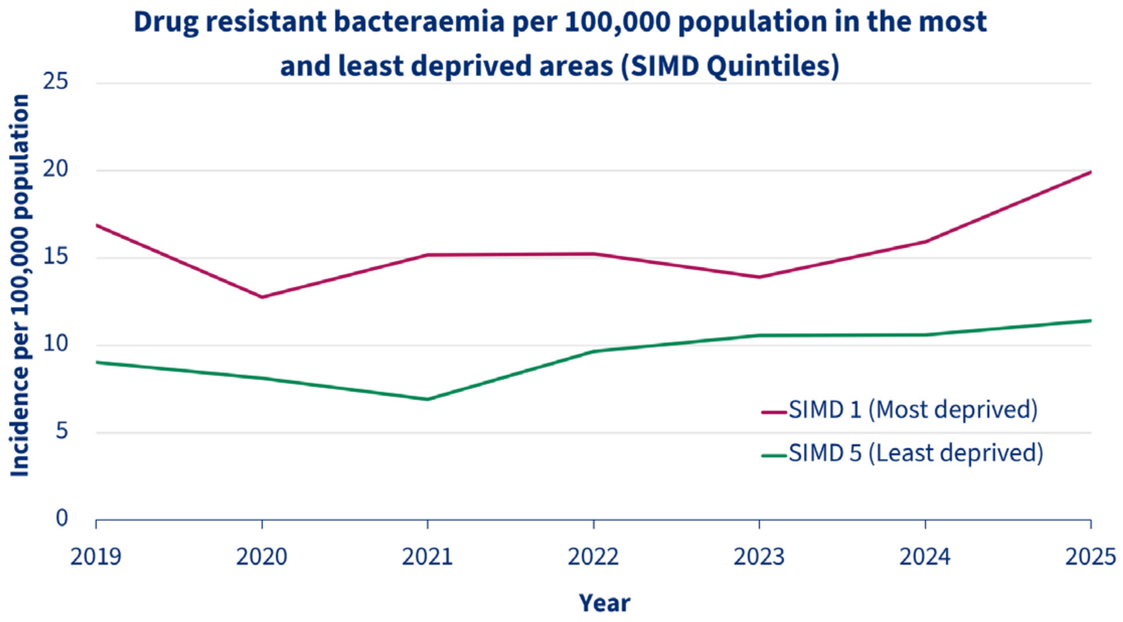


Antimicrobial resistance and health inequalities: Deprivation

In **2025**, **45.0%** of the **drug resistant bacteraemia** cases,[1,2] occurred among people living in the **40% most deprived areas** of Scotland.



The **annual incidence rate** of **drug resistant bacteraemia** in **2025** was **higher** in the **most deprived areas** (**19.9** per 100,000 population) than in the **least deprived areas** (**11.4** per 100,000 population).



[1] Only bacteraemia cases with complete antimicrobial susceptibility testing (AST) results (96.0% bacteraemia) are included.

[2]Data for SIMD quintiles were not available for 1.3% of drug resistant bacteraemia cases with complete AST in 2025, therefore percentages include only patients for whom these data were available.

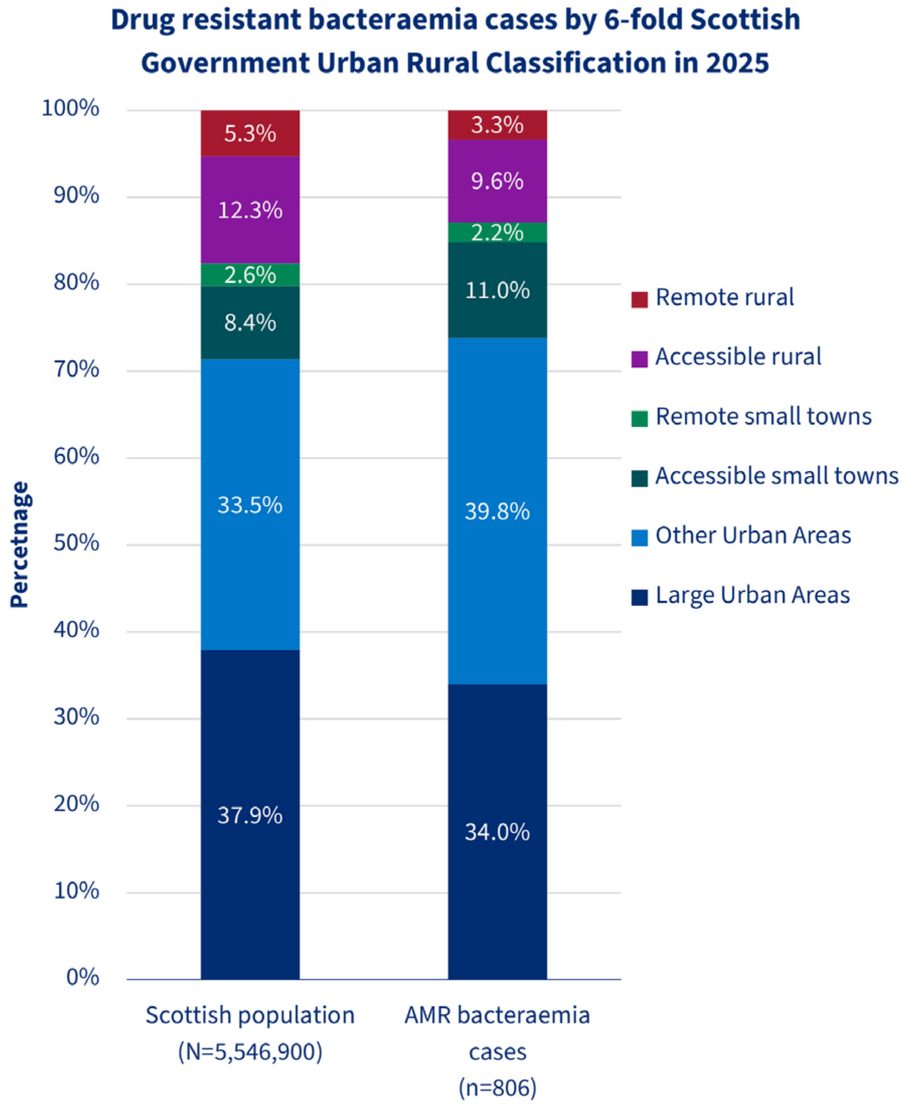
Antimicrobial resistance and health inequalities: Urban, rural, and remote areas

In **2025**, the **majority** of **drug resistant bacteraemia cases** were in people who live in **large urban and other urban areas** in Scotland (**73.8%**). People living in **remote** and **rural areas** accounted for **5.6%** and **12.9%** of **drug resistant bacteraemia cases**[1,2] respectively compared to **7.9%** and **17.6%** of the **Scottish population**.



[1]Only bacteraemia cases with complete antimicrobial susceptibility testing (AST) results (96.0% bacteraemia) are included.

[2]Data for Urban/Rural classification were not available for 1.3% of drug resistant bacteraemia cases with complete AST in 2025, therefore percentages include only cases for whom these data were available.

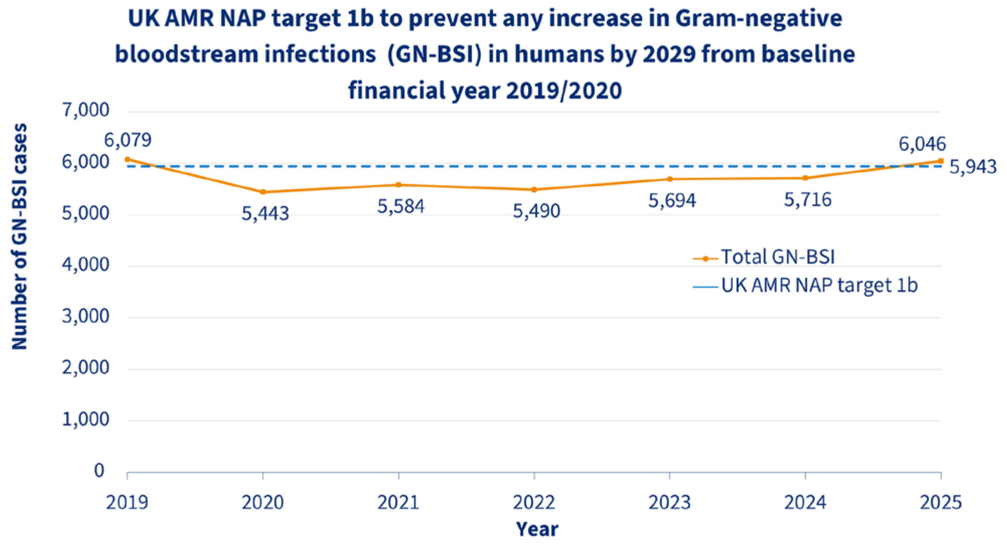


For more information see Appendix 2 and Supplementary Data.

Gram-negative bacteraemia

The UK AMR National Action Plan 2024 to 2029 and Gram-negative bacteraemia target 1b

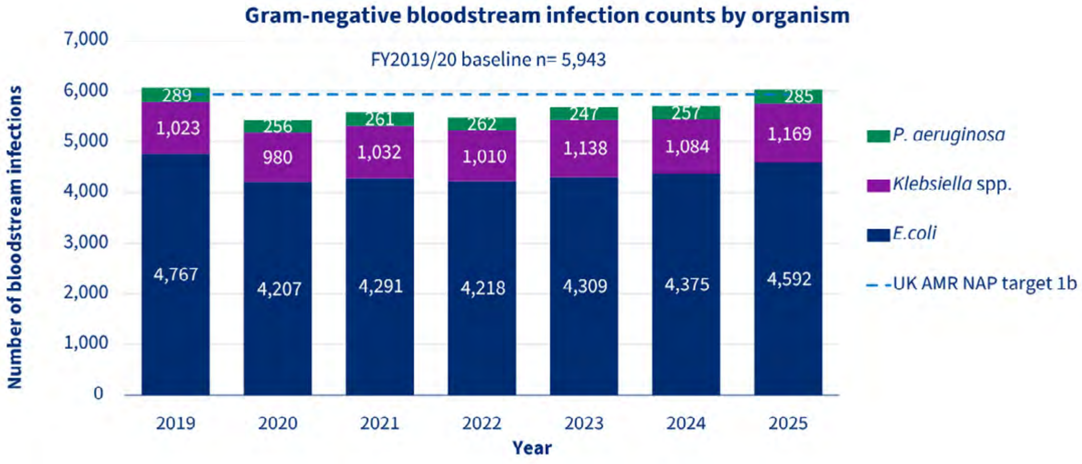
UK AMR NAP target 1b: By 2029, we aim to prevent any increase in Gram-negative bloodstream infections (GN-BSI) in humans from the 2019 to 2020 financial year baseline.
The year-ending 2025 count currently exceeds the baseline target.



Of the specified GN-BSI set in the UK AMR NAP 2024 to 2029 (***E. coli*, *Klebsiella* spp.** and ***P. aeruginosa***) there were **6,046** cases in **2025** in Scotland, which exceeds the **baseline financial year 2019/2020** (n=5,943) by **1.7%**.

These infections are predominantly ***E. coli* bacteraemia** cases (**n=4,592** in **2025**), however there has also been a **rise** in ***Klebsiella* spp.** numbers (**n=1,169** in **2025**), specifically ***K. pneumoniae***. More information can be found in Incidence of Gram-negative bacteraemia section.

The increasing incidence of Gram-negative bacteraemia continues to contribute to the growing burden of antimicrobial resistant infections in Scotland and highlights the ongoing challenge posed by invasive bacterial infections. National efforts to strengthen surveillance, address health inequalities, optimise antimicrobial prescribing, support delivery of antimicrobial use targets, and enhance infection prevention and control activities continue to support reducing the impact of AMR on patients and healthcare services.



Scottish supplementary HCAI ECB targets

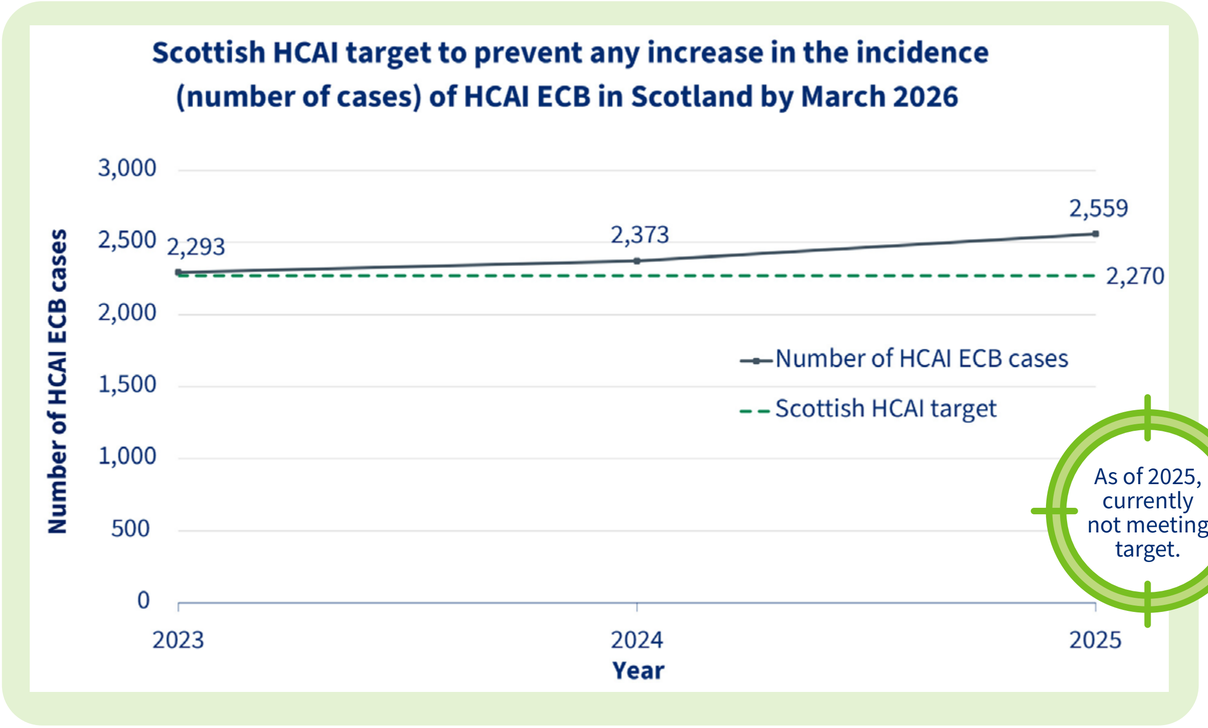
To support progress towards the UK NAP GNBSI target and support HCAI reduction strategies, a target to reduce HCAI ***E. coli* bacteraemia (ECB)** was set. A HCAI is defined as a patient who has had contact with healthcare within a defined period prior to their positive sample date (more detail provided in surveillance protocol).

In **2025**, there were **2,559 healthcare associated ECB** reported in Scotland, which **exceeds** the **baseline financial year 2023/2024** (**n=2,270**) by **12.7%**.

Scottish HCAI target: By March 2026, there should be no increase in the incidence (number of cases) of ECB from the FY 2023/2024 baseline

- In 2025, **the incidence of HCAI ECB exceeded** the FY 2023/2024 baseline.





ARHAI Scotland will review the number of cases reported for the year ending March 2026, assess whether the current targets have been met, and provide recommendations to the Scottish Government on future targets.

For further information on HCAI targets, see the ARHAI Scotland Annual Report.

Incidence of Gram-negative bacteraemia

Gram-negative bacteria are a common cause of serious infection in both healthcare and community settings. AMR in Gram-negative bacteria, particularly *E. coli*, significantly contributes to the overall burden of AMR.

In **2025**, there were **6,085 Gram-negative bacteraemia** in Scotland, caused by five key pathogens: *E. coli*, *P. aeruginosa*, *Klebsiella pneumoniae* (*K. pneumoniae*), *Klebsiella oxytoca* (*K. oxytoca*) and *Acinetobacter* species.

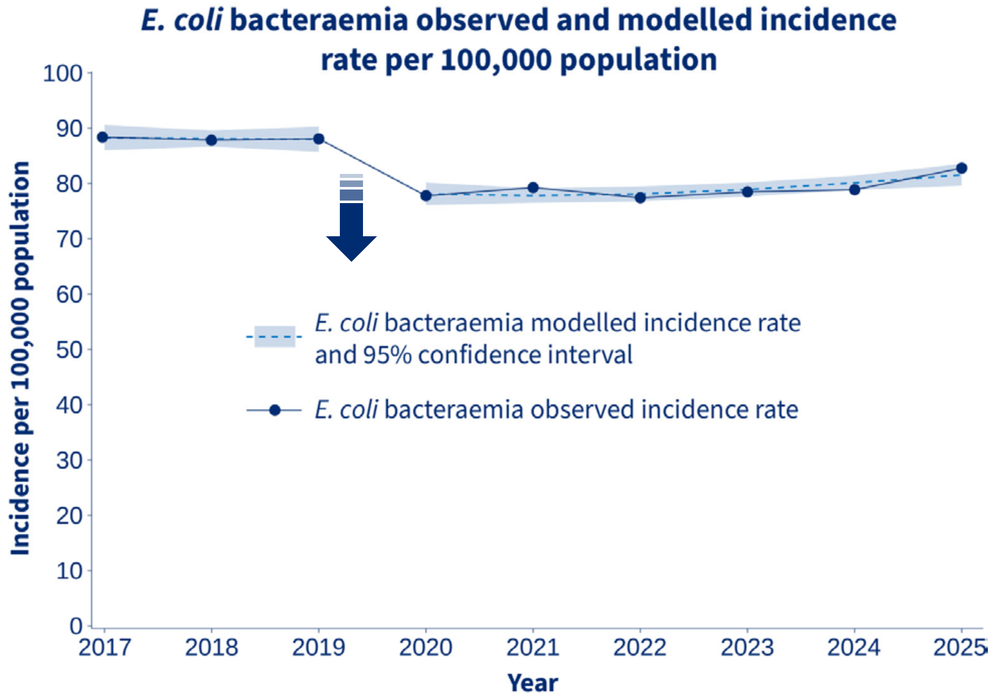
E. coli bacteraemia

In **2025**, there were **4,592** cases of ***E. coli* bacteraemia (ECB)** reported in Scotland, compared to **4,375** cases in **2024**. The **annual incidence rate** in **2025** was **82.8** per 100,000 population.

There has been a **5.0% increase** in the rate between **2024** and **2025**.

Looking at longer term trend modelling…

From 2017 to 2019 there was **no observed increasing or decreasing trend**, however, the average rate of ECB has been **lower since 2020**, than compared to **2017 to 2019**. **Since 2020**, there has been an **average increase of 0.9%** each year.



See ARHAI Scotland Annual Report 2025 for further information on *E. coli* bacteraemia in Scotland.

Klebsiella pneumoniae bacteraemia

In **2025**, there were **900** cases of ***K. pneumoniae* bacteraemia** reported in Scotland, compared to **857** cases in **2024**. The **annual incidence rate** in **2025** was **16.2** per 100,000 population. There has been **no change** in the rate between **2024** and **2025**.

Looking at longer term trend modelling…

From 2017 to 2019 there was **no observed increasing or decreasing trend** in the incidence of ***K. pneumoniae* bacteraemia**, however **since 2020**, there has been an **average increase of 4.1% each year**.

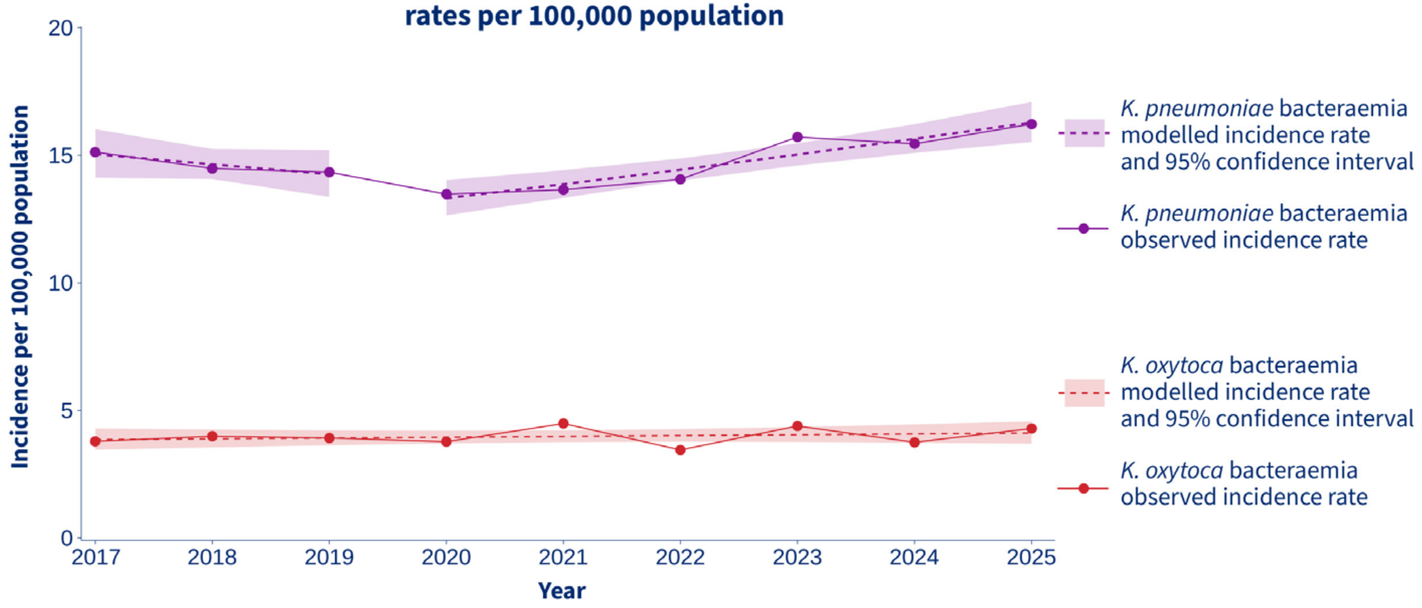
Klebsiella oxytoca bacteraemia

In **2025**, there were **238** cases of ***K. oxytoca* bacteraemia** reported in Scotland, compared to **208** cases in 2024. The **annual incidence rate** in **2025** was **4.3** per 100,000 population. There has been **no change** in the rate between **2024** and **2025**.

Looking at longer term trend modelling…

There has been **no observed increasing or decreasing trend** in the incidence rate of ***K. oxytoca* bacteraemia** since **2017**.

***K. pneumoniae* and *K. oxytoca* bacteraemia observed and modelled incidence rates per 100,000 population**



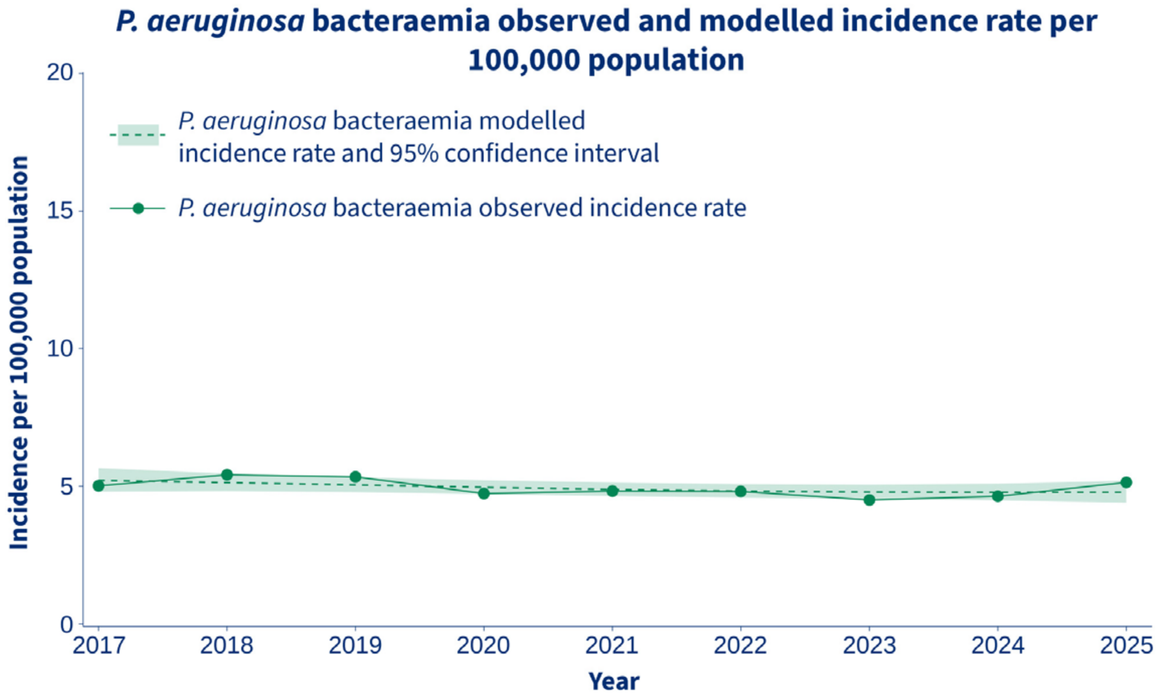
For more information see Appendix 2.

P. aeruginosa bacteraemia

In **2025**, there were **285** cases of ***P. aeruginosa* bacteraemia** reported in Scotland, compared to **257** cases in **2024**. The **annual incidence rate** in **2025** was **5.1** per 100,000 population. There has been **no change** in the rate between **2024** and **2025**.

Looking at longer term trend modelling…

There has been **no increasing or decreasing trend** in the incidence rate of ***P. aeruginosa* bacteraemia since 2017**.

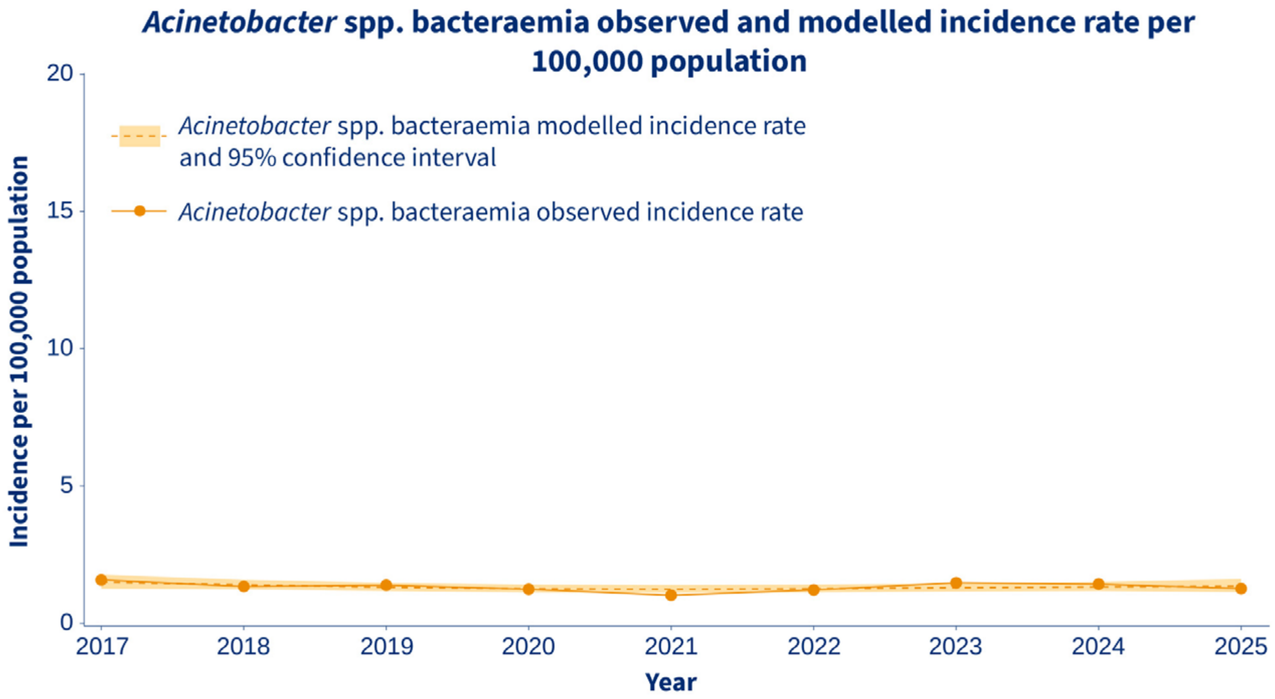


Acinetobacter spp. bacteraemia

In **2025**, there were **70** cases of ***Acinetobacter* spp. bacteraemia** reported in Scotland, compared to **79** cases in **2024**. The **annual incidence rate** in **2025** was **1.3** per 100,000 population. There has been **no change** in the rate between **2024** and **2025**.

Looking at longer term trend modelling…

There has been **no increasing or decreasing trend** in the incidence rate of ***Acinetobacter* spp. bacteraemia since 2017**.

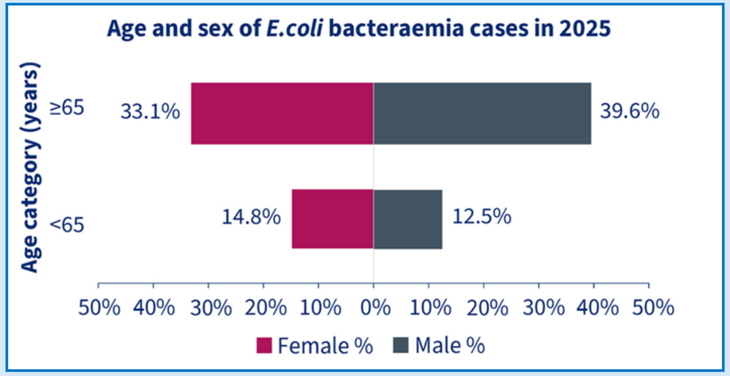


Gram-negative bacteraemia and health inequalities: Age and sex

E. coli bacteraemia

In **2025** out of **4,592** ***E. coli*** **bacteraemia cases**

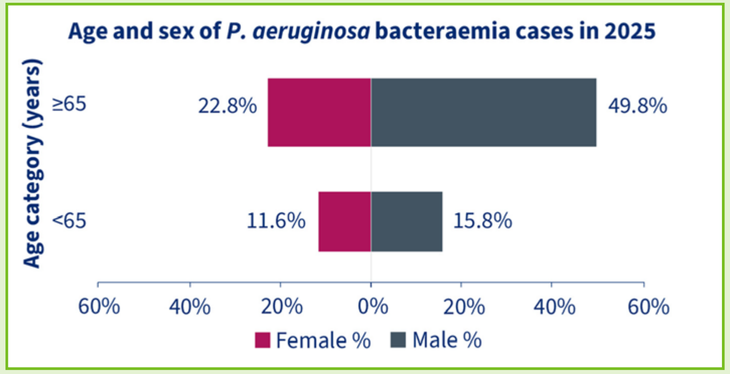
- **52.1%** were **male** and
- **72.7%** were **aged 65 and over**



P. aeruginosa bacteraemia

In **2025** out of **285** ***P. aeruginosa*** **bacteraemia cases**

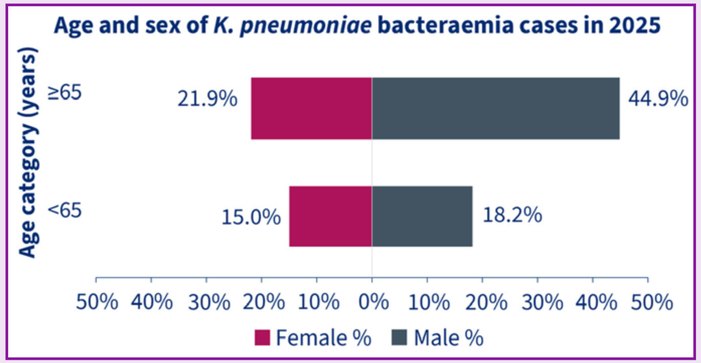
- **65.6%** were **male** and
- **72.6%** were **aged 65 and over**



K. pneumoniae and *K. oxytoca* bacteraemia

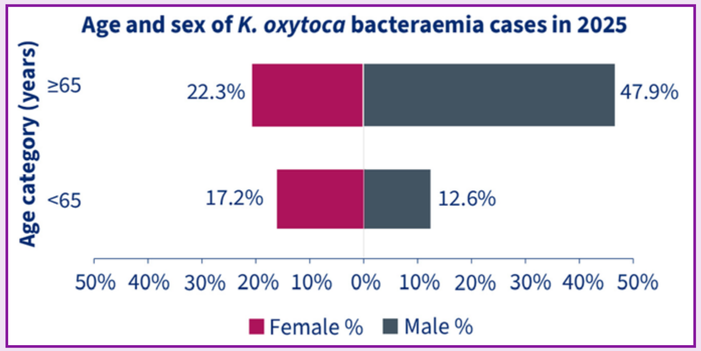
In **2025** out of **900** ***K. pneumoniae*** **bacteraemia cases**

- **63.1%** were **male** and
- **66.8%** were **aged 65 and over**



In **2025** out of **238** ***K. oxytoca*** **bacteraemia cases**

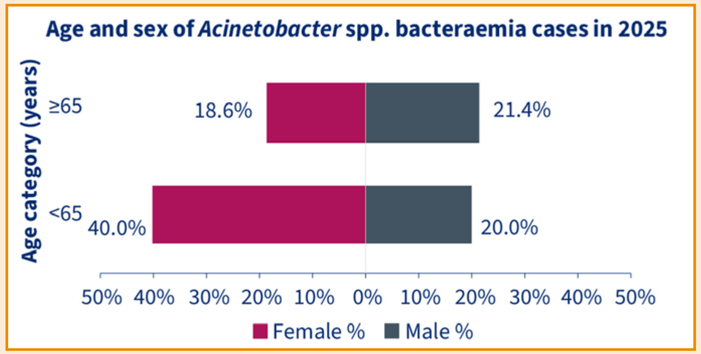
- **60.5%** were **male** and
- **70.2%** were **aged 65 and over**



Acinetobacter spp. bacteraemia

In **2025** out of **70** ***Acinetobacter*** **spp. bacteraemia cases**

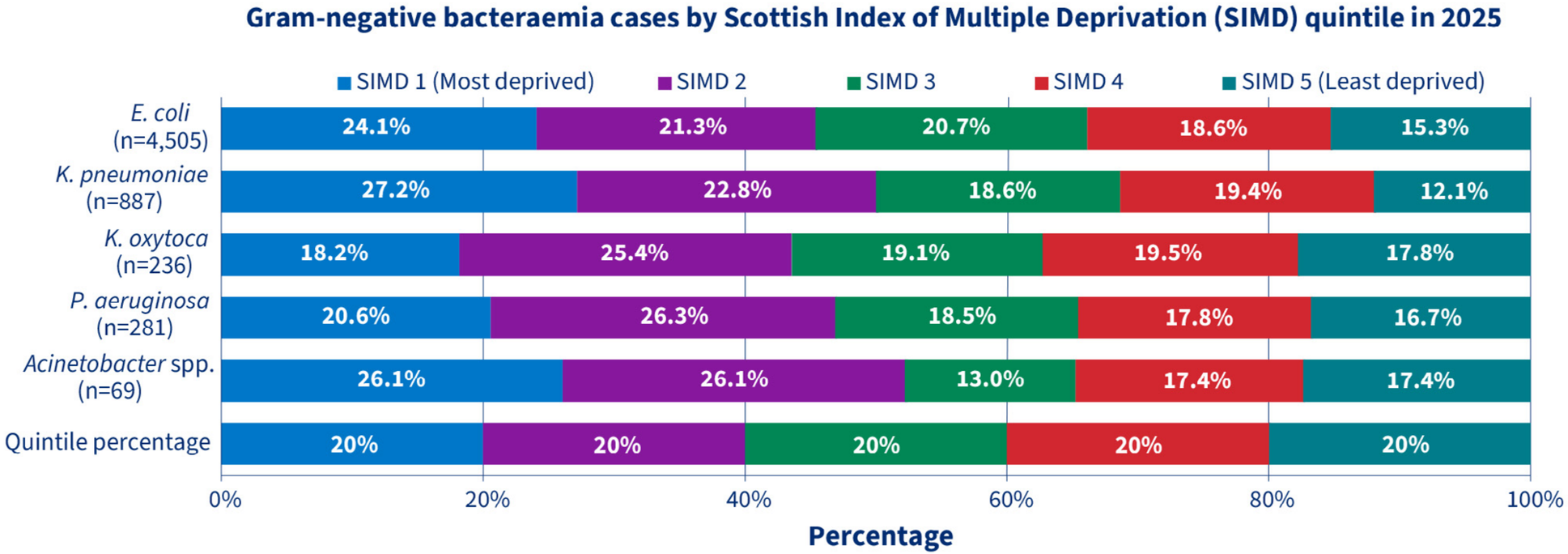
- **41.4% were male** and
- **40.0%** were **aged 65 and over**



Gram-negative bacteraemia and health inequalities: Deprivation

In **2025**, the **percentage of cases**[1] **living** in the **40% most deprived areas** of **Scotland** were:

- **45.4%** of ***E.coli* bacteraemia**;
- **50.0%** of ***K. pneumoniae* bacteraemia**;
- **43.6%** of ***K. oxytoca* bacteraemia**;
- **46.9%** of ***P. aeruginosa* bacteraemia**;
- **52.2%** of ***Acinetobacter* spp. bacteraemia**.



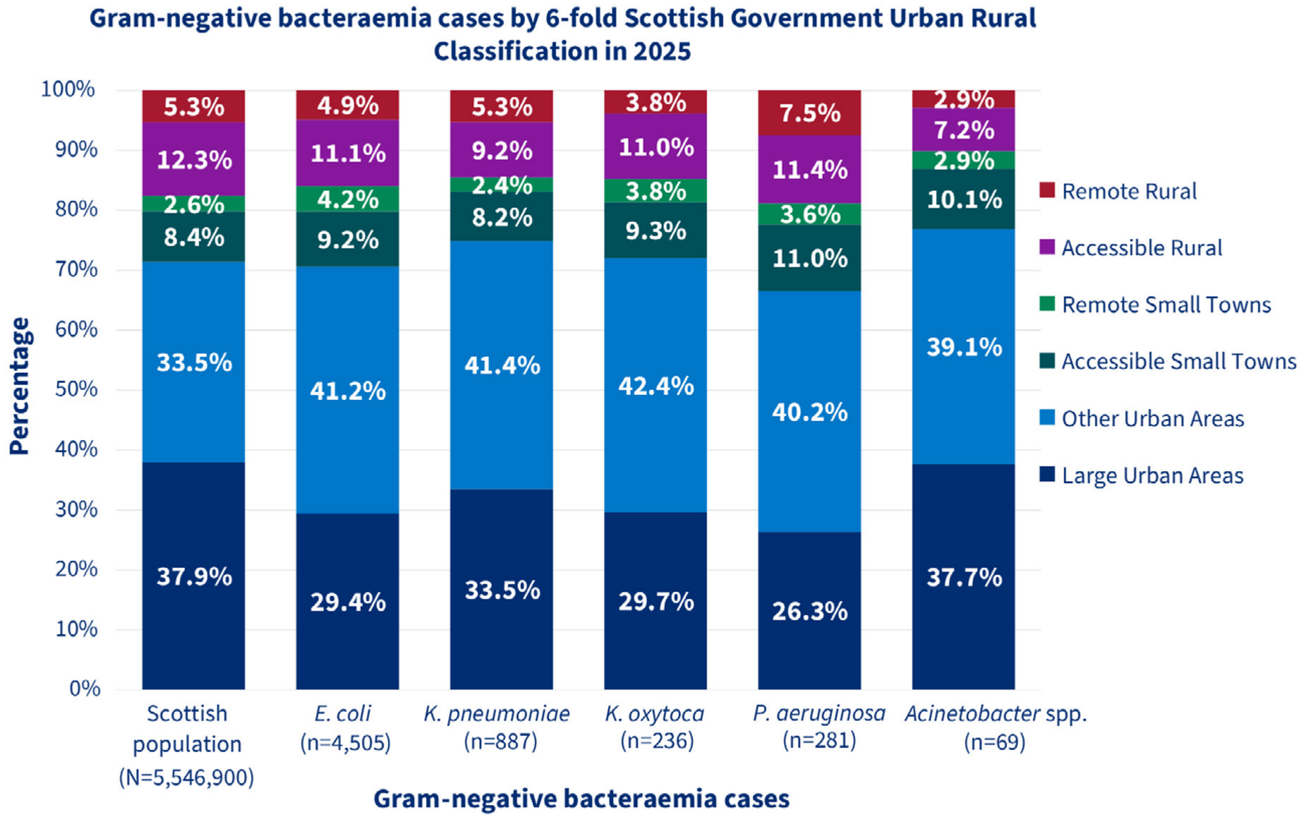
[1]Data for SIMD quintiles were not available for 1.9% of *E. coli* bacteraemia, 1.4% of *K. pneumoniae* bacteraemia, 0.8% of *K. oxytoca* bacteraemia, 1.4% of *P. aeruginosa* bacteraemia, and 1.4% of *Acinetobacter* spp. bacteraemia patients in 2025, therefore percentages include only patients for whom these data were available.

See ARHAI Scotland Annual Report 2025 for further information on *E. coli* bacteraemia in Scotland.

Gram-negative bacteraemia and health inequalities: Urban, rural, and remote areas

In **2025**, the **majority** of **Gram-negative bacteraemia cases**[1] were in **people living in large urban and other urban areas** of **Scotland**.





In **2025**, the **percentage of cases**[1] which comprised **people living in rural areas** and **remote areas** of **Scotland**, **respectively** were:

- **16.0%** and **9.1%** of ***E. coli* bacteraemia**;
- **14.5%** and **7.7%** of ***K. pneumoniae* bacteraemia**;
- **14.8%** and **7.6%** of ***K. oxytoca* bacteraemia**;
- **18.9%** and **11.0%** of ***P. aeruginosa* bacteraemia**;
- **10.1%** and **5.8%** of ***Acinetobacter* spp. bacteraemia**.

[1]Data for Urban/Rural classification were not available for 1.9% of *E. coli* bacteraemia, 1.4% of *K. pneumoniae* bacteraemia, 0.8% of *K. oxytoca* bacteraemia, 1.4% of *P. aeruginosa* bacteraemia, and 1.4% of *Acinetobacter* spp. bacteraemia patients in 2025, therefore percentages include only patients for whom these data were available.

For more information see Appendix 2 and Supplementary Data.

Antimicrobial Resistance in Gram-negative bacteraemia

Resistance of Gram-negative bacteraemia to key antibiotics in 2025

	Meropenem	Temocillin	Ceftazidime	Cefotaxime/ Ceftriaxone	Gentamicin	Piperacillin-Tazobactam	Ciprofloxacin	Trimethoprim	Co-amoxiclav
Escherichia coli	<0.1%	1.4%	9.5%	10.5%	11.9%	9.8%	18.4%	37.2%	45.0%
Klebsiella pneumoniae	0.5%	0.4%	11.4%	12.4%	8.9%	19.3%	15.9%	25.7%	24.3%
Klebsiella oxytoca	0.0%	0.0%	3.1%	6.2%	3.0%	8.7%	3.4%	7.5%	11.0%
Pseudomonas aeruginosa	1.1%		2.5%		3.4%	8.2%	7.4%		
Acinetobacter spp.	1.5%				1.4%		1.7%		





Between **2024** and **2025**, there were **decreases** in resistance for

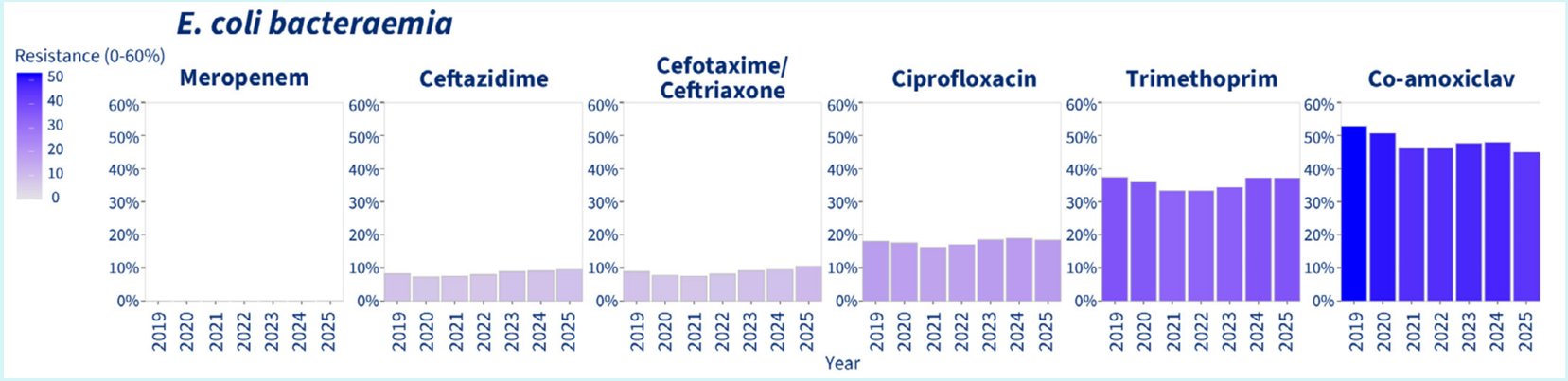
- **Co-amoxiclav resistance** in ***E. coli* bacteraemia**, from **48.1%** in **2024**, to **45.0%** in **2025**
- **Ceftazidime resistance** in ***P. aeruginosa* bacteraemia**, from **10.1%** in **2024** to **2.5%** in **2025**.



There was **no change** in **resistance** to other **key antibiotics** in Gram-negative bacteraemia between **2024** and **2025**.

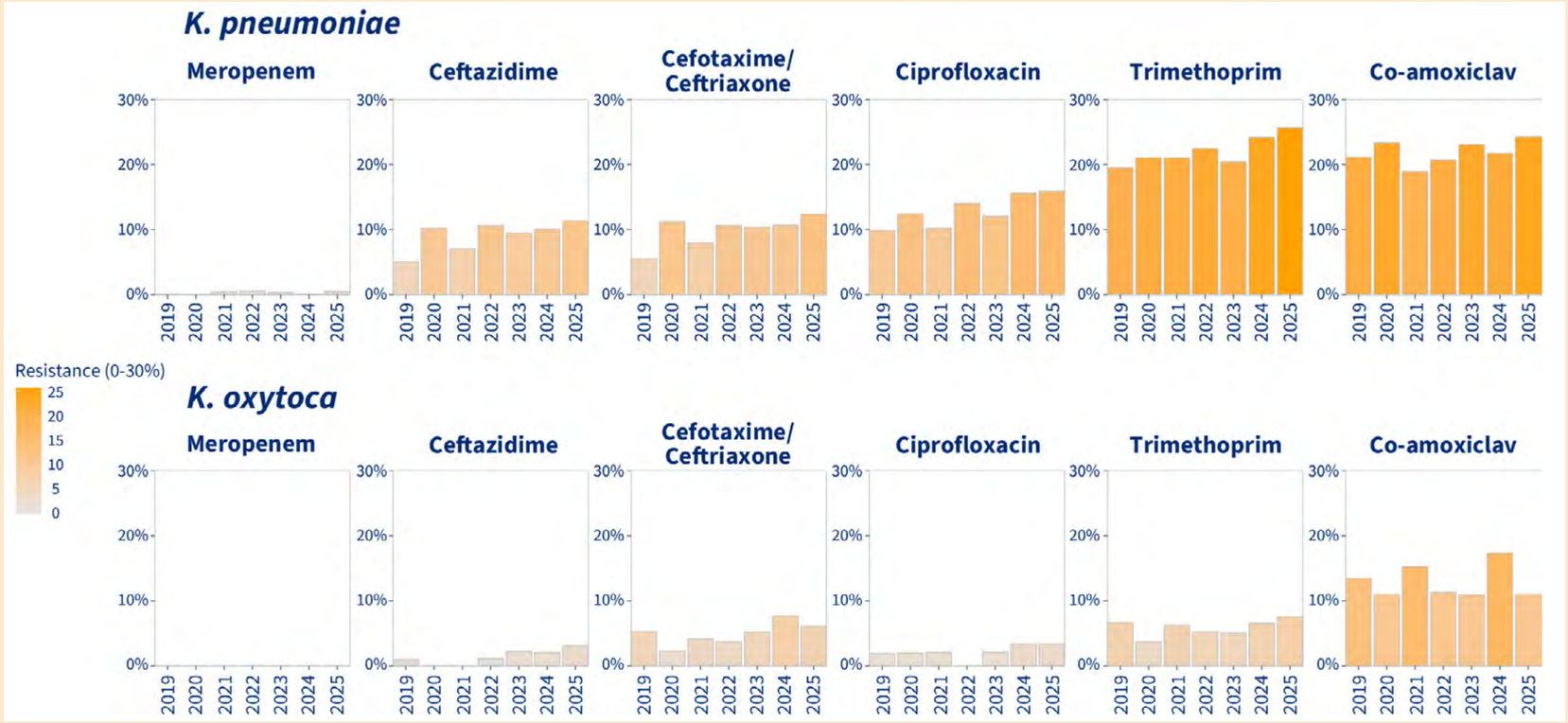
For more information see Appendix 2 and Supplementary Data.

Resistance of **Gram-negative bacteraemia** to **key antibiotics** between **2019** and **2025**



For ***E. coli*** **bacteraemia** between **2019** and **2025**:

- There has been an **increasing trend** in **resistance** to **ceftazidime** and **cefotaxime/ceftriaxone**.
- There has been a **decreasing trend** in **resistance** to co-amoxiclav.
- **No increasing or decreasing trend** in **resistance** to **meropenem**, **ciprofloxacin**, or **trimethoprim**.



For ***K. pneumoniae*** **bacteraemia** between **2019** and **2025**:

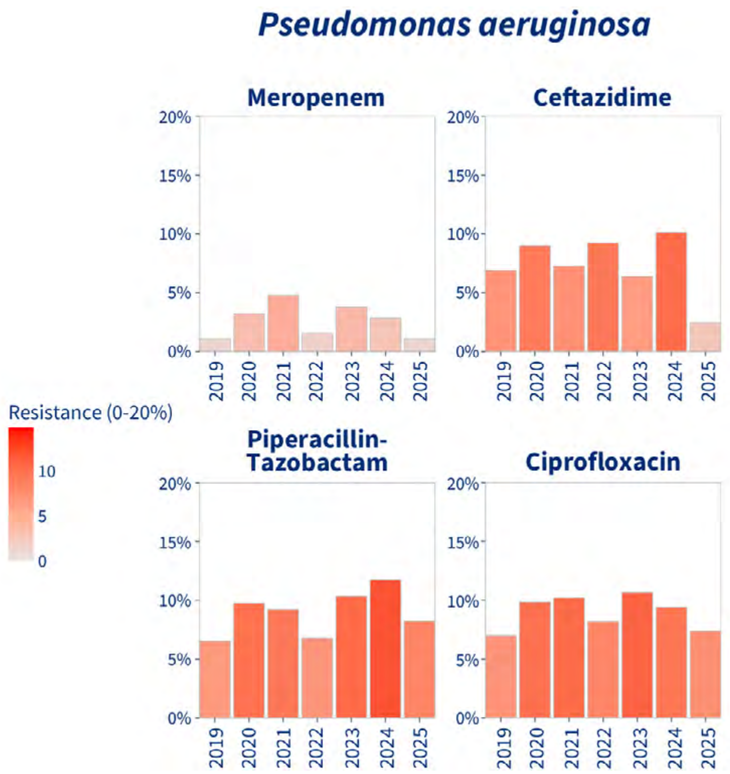
- There has been an **increasing trend** in **resistance to ceftazidime**, **cefotaxime/ceftriaxone**, **ciprofloxacin** and **trimethoprim**.
- **No increasing or decreasing trends** in **resistance** to **meropenem** and **co-amoxiclav**.

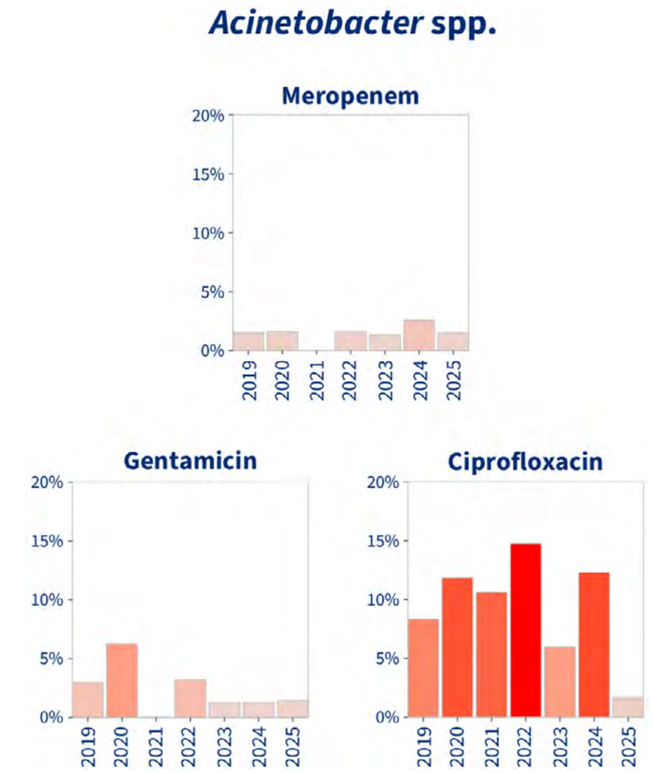
For ***K. oxytoca*** **bacteraemia** between **2019** and **2025**:

- There has been an **increasing trend** in **resistance to ceftazidime**.
- **No increasing or decreasing trends** in **resistance** to **cefotaxime/ceftriaxone**, **ciprofloxacin**, **trimethoprim** and **co-amoxiclav**.

There has been **no resistance** to **meropenem**.

Resistance in ***P. aeruginosa*** and ***Acinetobacter* spp. bacteraemia** to **key antibiotics** between **2019** and **2025**





For ***P. aeruginosa*** **bacteraemia** between **2019** and **2025**:

- **No increasing or decreasing trend** in **resistance** to **ceftazidime**, **meropenem**, **piperacillin-tazobactam** and **ciprofloxacin**.

For ***Acinetobacter* spp. bacteraemia** between **2019** and **2025**:

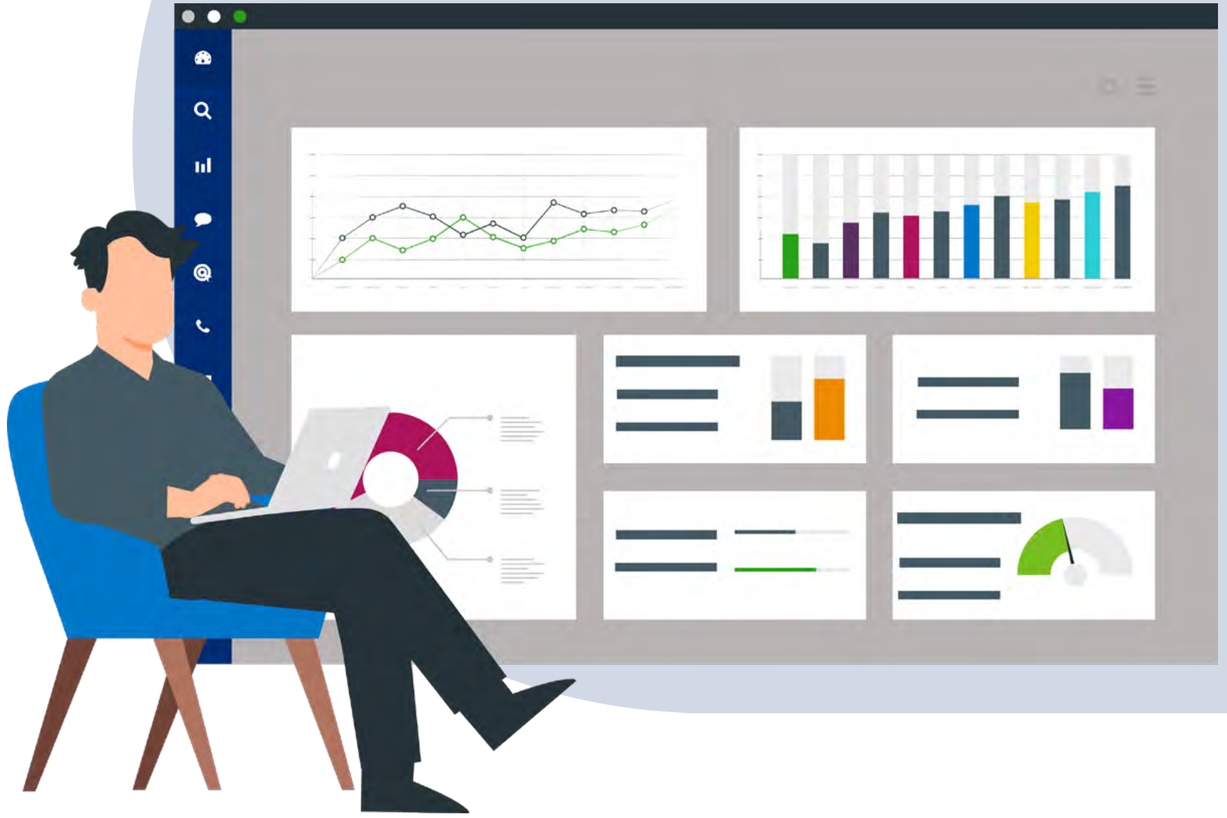
- **No increasing or decreasing trend** in **resistance** to **meropenem**, **gentamicin** and **ciprofloxacin**.

Data on Gram-negative bacteraemia in Scotland:

- Are shared via Discovery Dashboards supporting local NHS boards with data for monitoring and benchmarking and informing quality improvement and reduction strategies.
- Inform antimicrobial stewardship and quality improvement initiatives at local and national levels.
- Guide empirical antibiotic prescribing decisions by providing data on resistance patterns to improve patient outcomes.

For information on AMR in Gram-negative organisms see Supplementary Data.

For further information on Discovery Dashboards see What is Discovery?



Urinary tract infections caused by *E. coli*

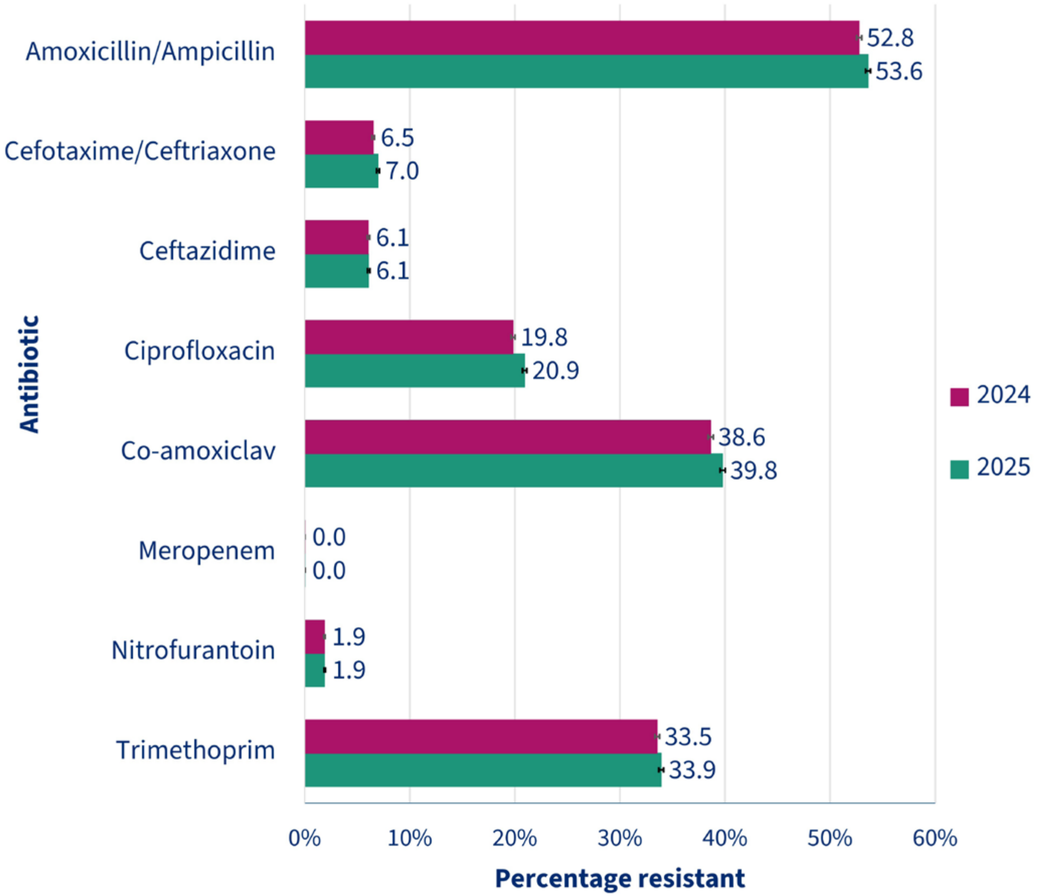
Urinary tract infections (UTIs) are frequently diagnosed across community and healthcare settings, and AMR in urinary isolates contributes significantly to the overall burden of resistance. Monitoring AMR in urinary isolates provides valuable intelligence to inform clinical decision making and local prescribing policies. ***E. coli*** was the most commonly reported organism in urinary isolates.

In **2025**, there were **170,612 episodes of *E. coli*** isolated from urine, compared with **171,123** in **2024**.

Between **2024** and **2025**,

- **resistance** in ***E. coli* urinary isolates** to key antibiotics including **amoxicillin/ampicillin, cefotaxime/ceftriaxone, ciprofloxacin** and **co-amoxiclav** has **increased**.
- **No change** in **resistance** to **ceftazidime, meropenem, nitrofurantoin** and **trimethoprim**.

Resistance of *E. coli* urinary isolates to key antibiotics in 2024 and 2025



ARHAI Scotland use these data to support the Scottish Antimicrobial Prescribing Group (SAPG) and NHS board Antimicrobial Management Teams (AMTs) to optimise antibiotic prescribing and stewardship ensuring empirical guidelines are based on current trends in AMR.

Data on AMR in *E. coli* urinary isolates are shared via Discovery Dashboards.

For further information on AMR in *E. coli* urinary isolates see Supplementary Data.



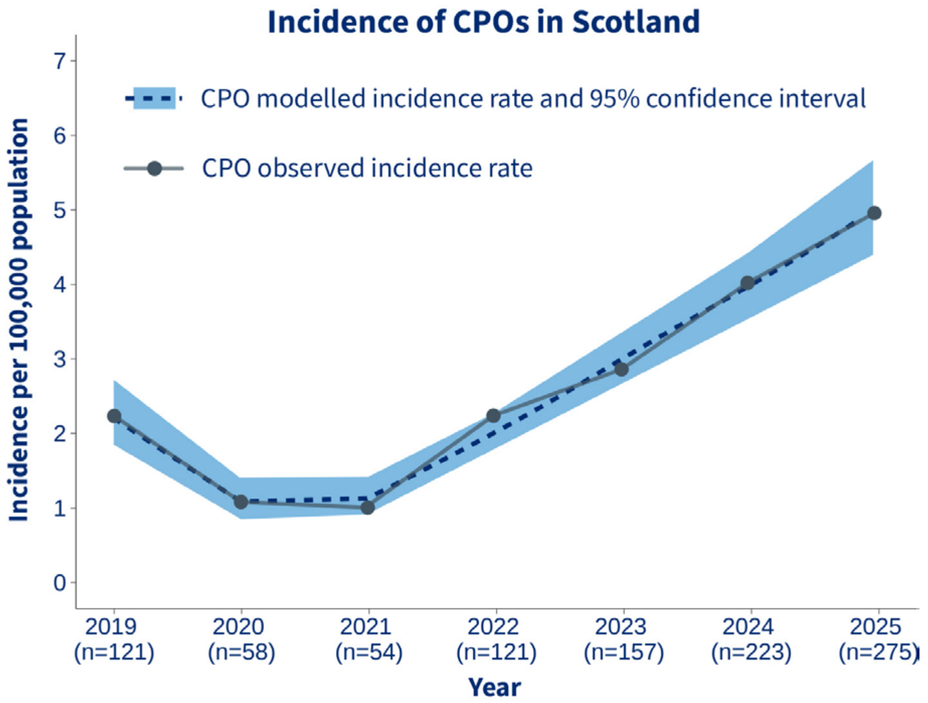
Carbapenemase-producing organisms

Carbapenems are beta-lactam antibiotics with a very broad spectrum of activity, often reserved as last-line agents for the treatment of bacterial infections. The primary mechanism of carbapenem resistance is the production of acquired carbapenemases, enzymes which inactivate carbapenem antibiotics rendering many beta-lactams ineffective. Bacteria that have this ability are referred to as carbapenemase-producing organisms (CPOs).

In **2025**, there were **275** cases of **CPO** reported in Scotland, compared to **223** in **2024**. The annual **CPO incidence rate** was **5.0** per 100,000 population.

There has been a **23.3% increase** in the incidence rate between **2024** and **2025**.

90.9% of **CPOs** identified in **2025** were **carbapenemase-producing Enterobacterales (CPE)**. The remaining were **non-fermenters** (*Acinetobacter* species and *Pseudomonas* species).



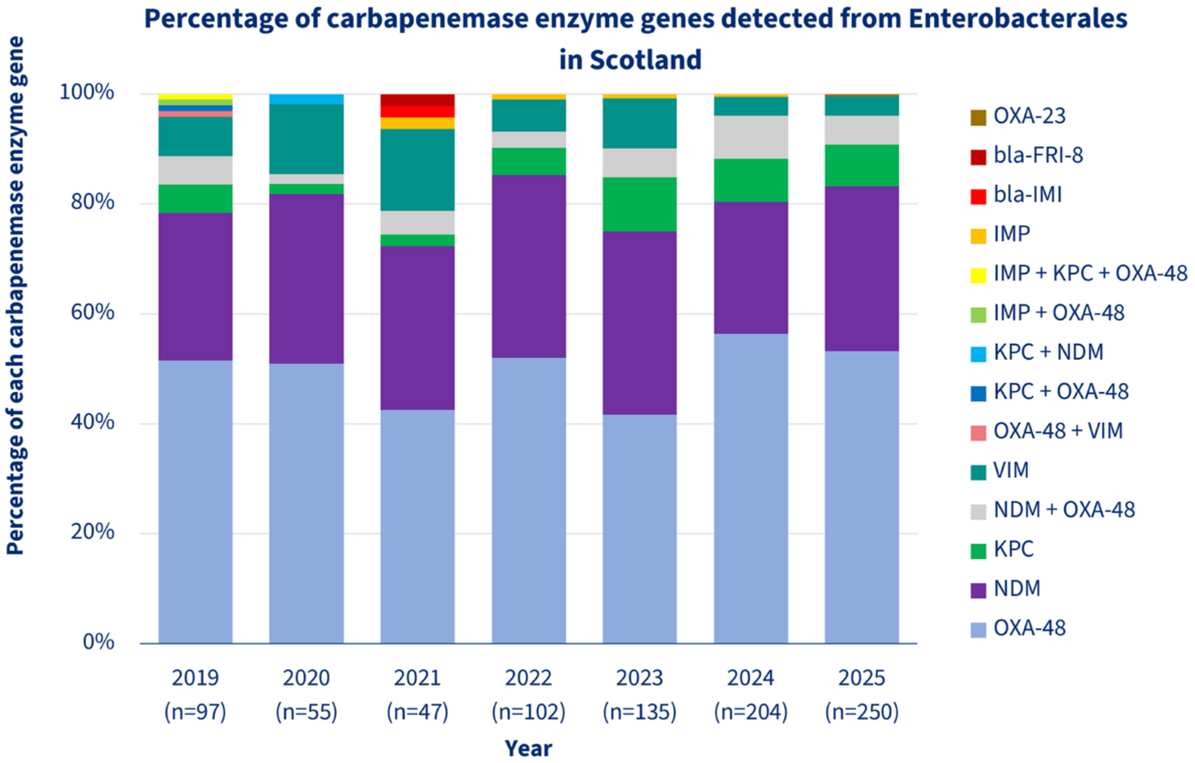
Since **2021**, there has been an **average increase** of **40.2%** in CPO incidence each year.[1]

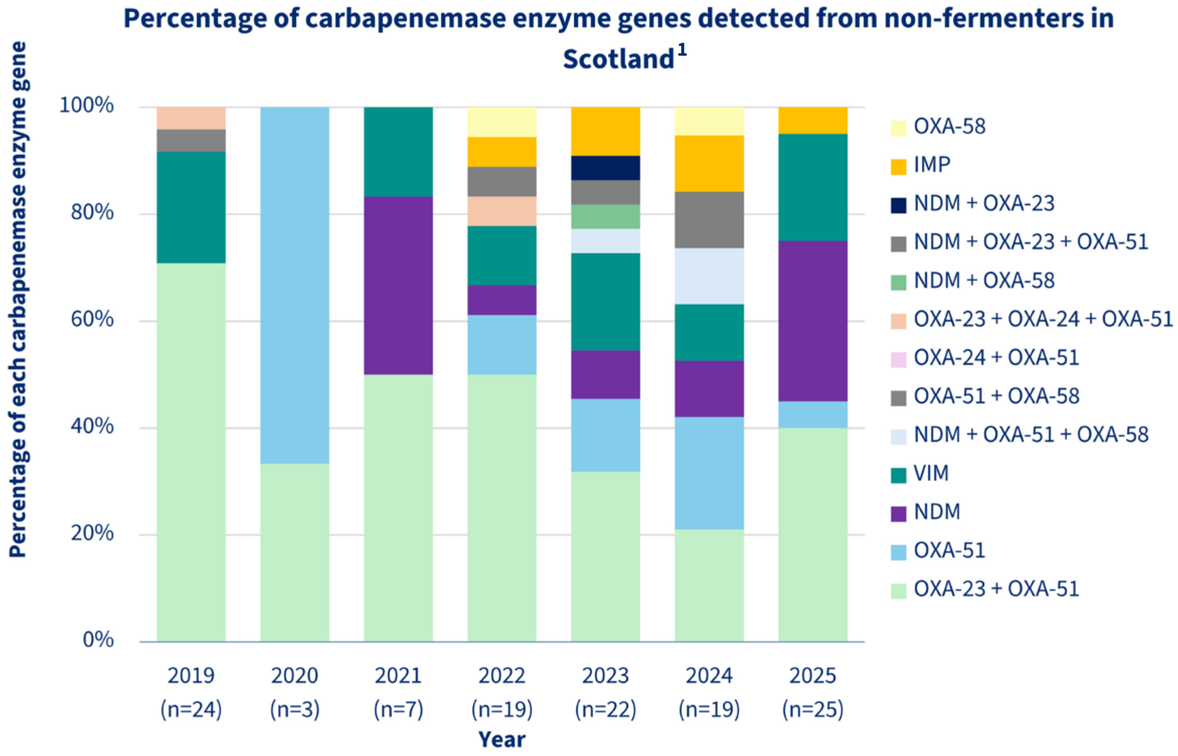
[1] CPO incidence is influenced by a number of external factors including changes in local screening practices and travel, therefore rates may not be comparable over time. The COVID-19 pandemic, including international travel restrictions, may have influenced incidence in 2020 - 2022.

In **2025**, the **most frequently detected carbapenemase genes** in…

Enterobacterales were **oxacillinase (OXA)-48-like** and **New Delhi Metallo-beta-lactamase (NDM)**.

…**non-fermenters** were combinations containing **OXA-51** and **OXA-23** and **NDM**.





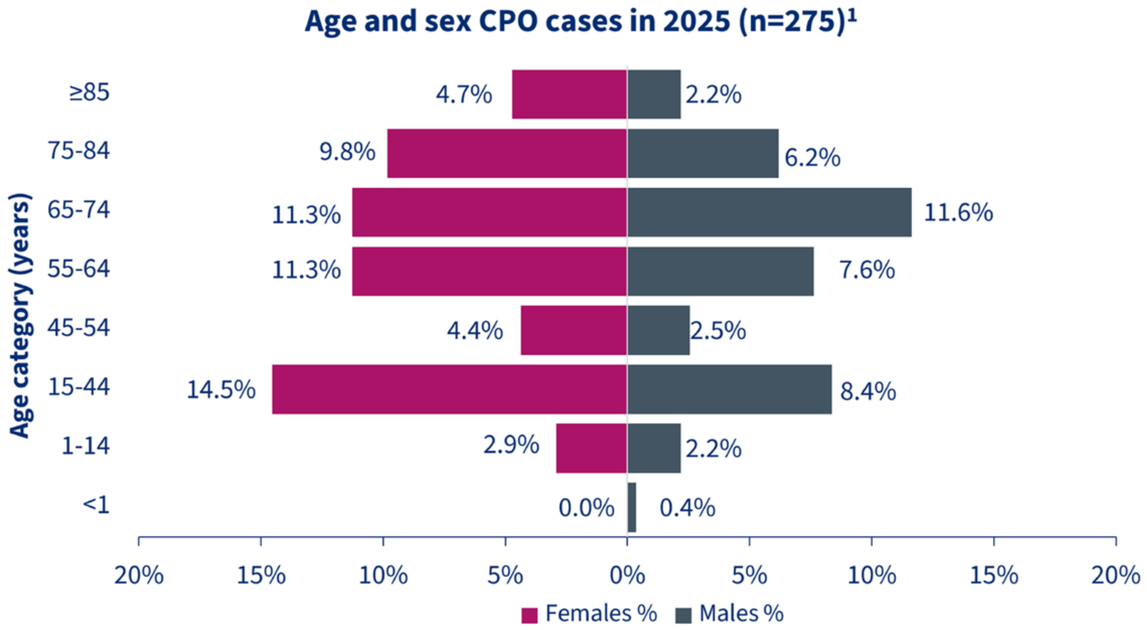
[1]The percentage of carbapenemase enzyme genes from non-fermenters in Scotland is based on small numbers, so should be interpreted with caution.

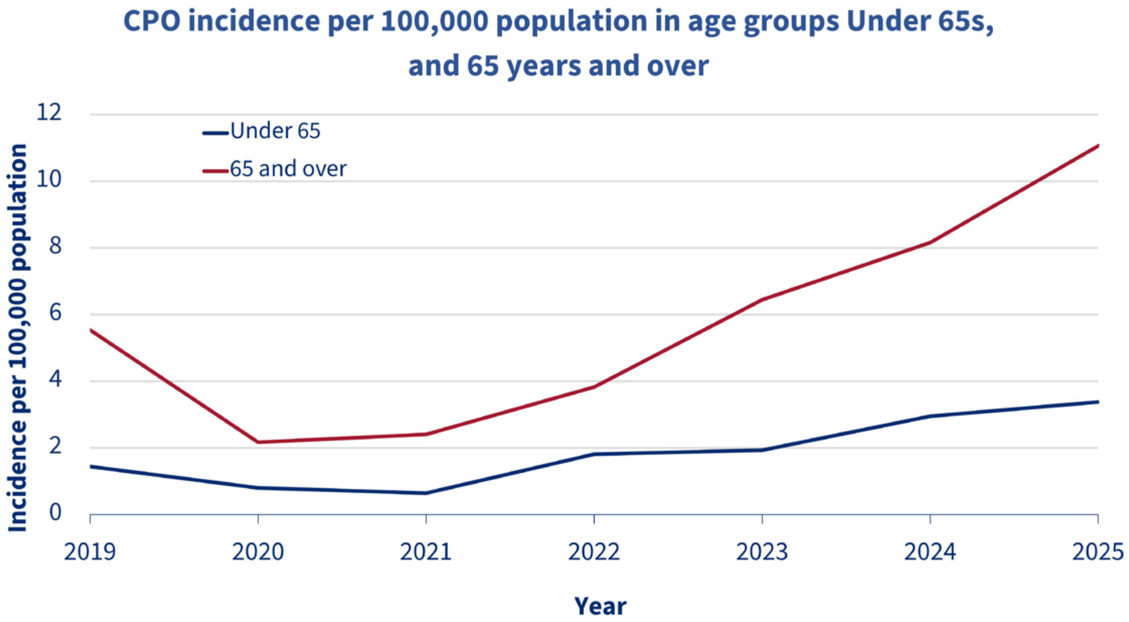
Carbapenemase-producing organisms - health inequalities

Age and sex

In **2025**, **58.9%** of **CPO** cases were **female**, and **54.2%** of cases were **aged under 65 years old**.

The **annual incidence rate** in patients **aged 65 and over** was **11.1** per 100,000 population in **2025**. This was **higher** than the **annual incidence rate** in those **aged under 65** (**3.4** per 100,000 population).



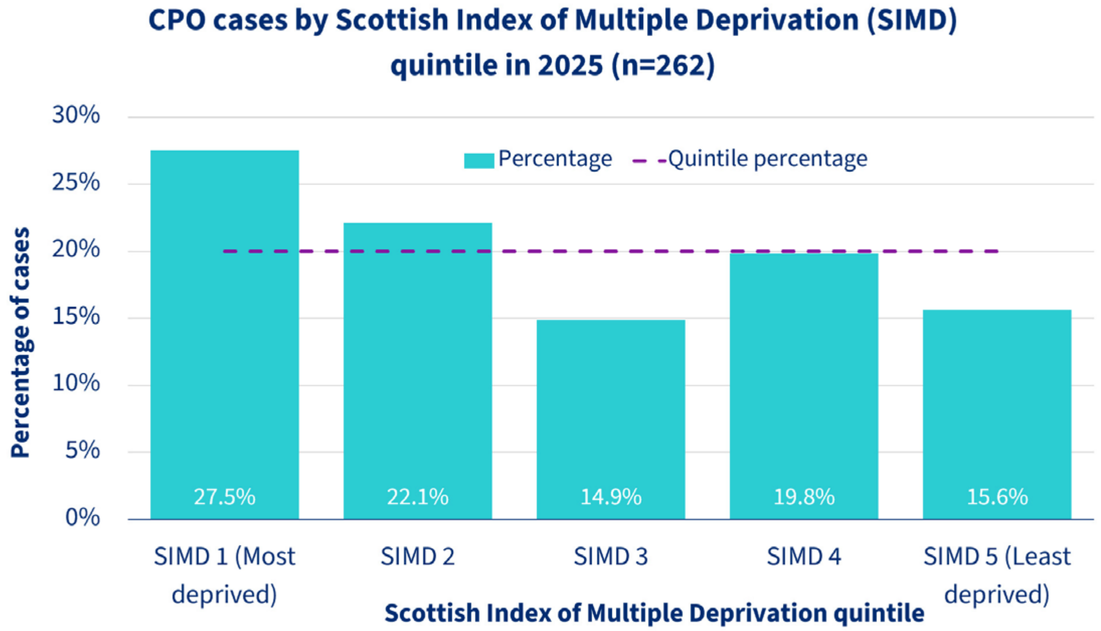


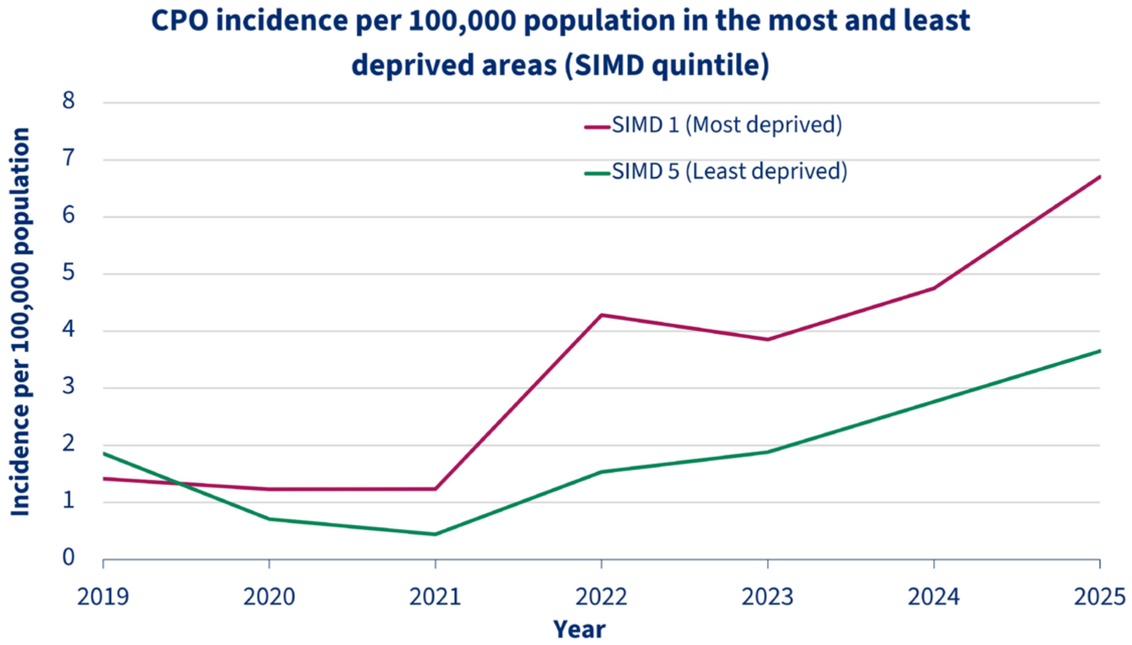
[1]The percentage breakdown of CPO cases by age and sex are based on small numbers, so should be interpreted with caution.

CPOs and health inequalities: Deprivation

In **2025**, **49.6%** of **CPO** cases[1] were people living in the **40% most deprived areas** of Scotland.

The **annual incidence rate** of **CPO cases** in **2025** was **6.7** per 100,000 population in the **most deprived areas**. This was **higher** than the **annual incidence rate** in the **least deprived areas** (**3.72** per 100,000 population).





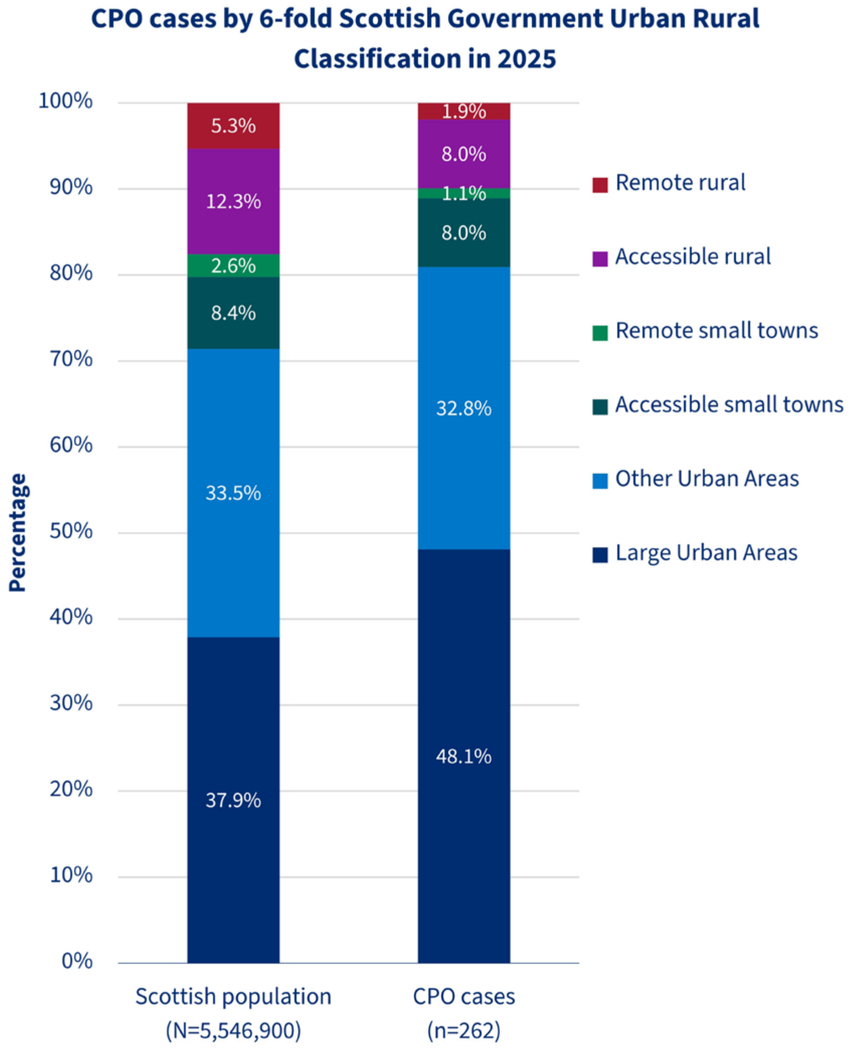
[1]Data for SIMD quintiles were not available for 4.7% of CPO cases in 2025, therefore percentage include only patients for whom these data were available.

CPOs and health inequalities: Urban, rural, and remote areas

In **2025**, the **majority** of **CPO cases** were in people living in **large urban and other urban areas** (**80.9%**) **of Scotland**. People living in **remote and rural areas** accounted for **3.0%** and **9.9%** of **CPO** cases[1] respectively, compared with **7.9%** and **17.6%** of the **Scottish population**.



For further information including AMR data on CPOs see Supplementary Data.



[1]Data for Urban/Rural classification were not available for 4.7% of CPO cases in 2025, therefore percentage include only patients for whom these data were available.

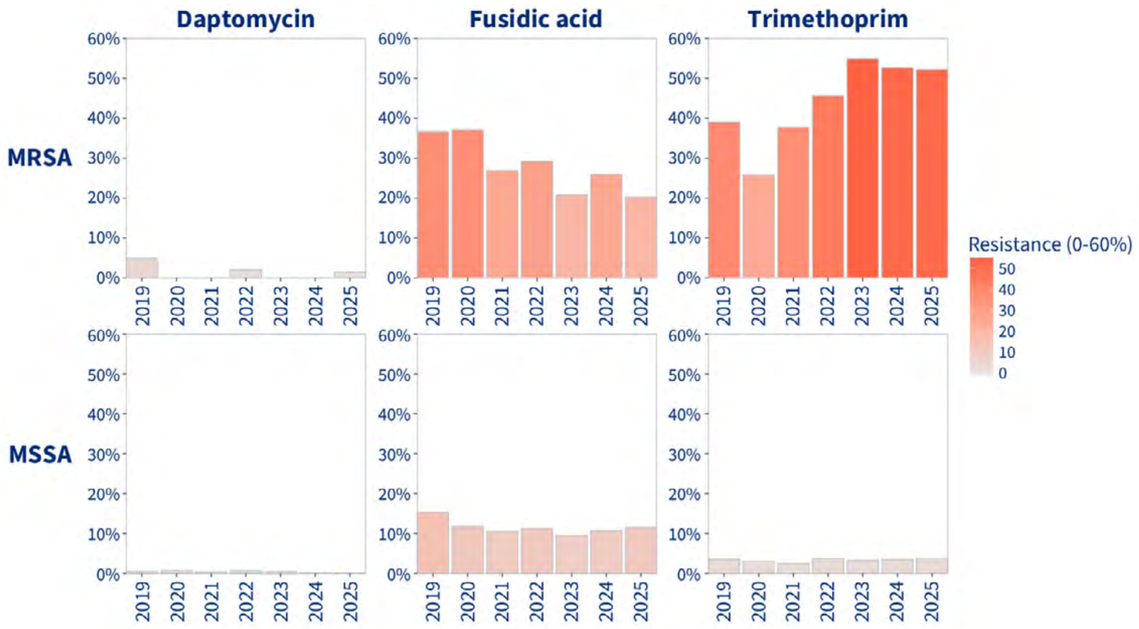
Antimicrobial resistance in Gram-positive organisms

***Staphylococcus aureus* bacteraemia (SAB)**

In **2025**, there were **1,701** cases of **(SAB)**, **4.2%** of which were **meticillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia**.

The ARHAI Annual Report 2025 provides intelligence and epidemiology of *S. aureus* bacteraemia (SAB) in Scotland including MRSA bacteraemia. The report highlights that in Scotland, the rate of MRSA bacteraemia has been increasing since 2020.

AMR in *S.aureus* bacteraemia



For both MRSA and meticillin-sensitive *S. aureus* (MSSA) bacteraemia, between **2024** and **2025**:

- **No change** in **resistance** to **fusidic acid**, and **trimethoprim**
- **Daptomycin** resistance has **remained low**.

Looking at longer term trend modelling...

For **MRSA bacteraemia** between **2019** and **2025**:

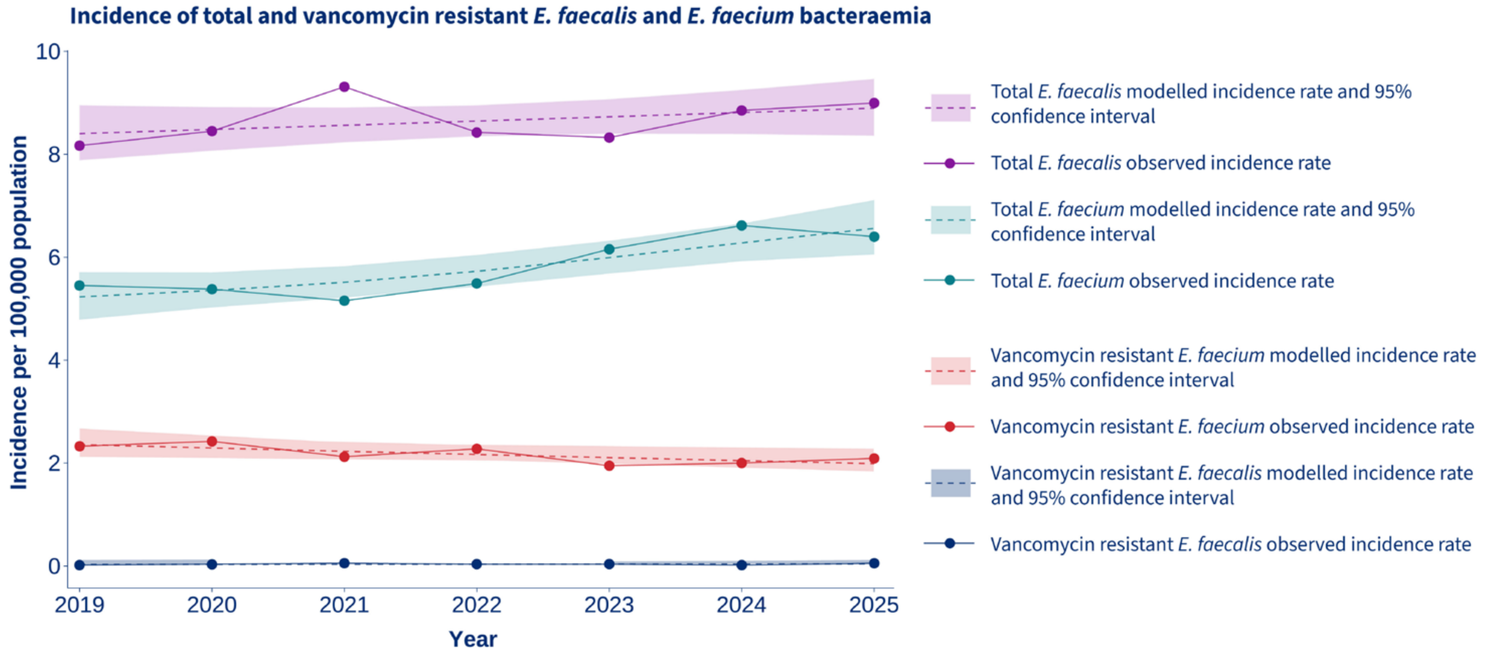
- There has been an **increasing trend** in **resistance** to **trimethoprim**.
- **No increasing or decreasing trend** in **resistance** to **daptomycin** and **fusidic acid**.

For **MSSA bacteraemia** between **2019** and **2025**:

- There has been a **decreasing trend** in **resistance** to **fusidic acid**.
- **No increasing or decreasing trend** in **resistance** to **daptomycin** and **trimethoprim**.

Enterococcus faecalis and *Enterococcus faecium* bacteraemia

In **2025**, the total **incidence** of ***Enterococcus faecalis (E. faecalis)*** **bacteraemia** and ***Enterococcus faecium (E. faecium)*** **bacteraemia** was **9.0** and **6.4** per 100,000 population, respectively. There has been **no change** in the annual incidence rates between **2024** and **2025**.



Looking at longer term trend modelling…

Between **2019** and **2025**:

- **no observed increasing or decreasing trends** in the total **incidence** of ***E. faecalis*** **bacteraemia**.
- there has been an **average increase of 4.0% each year** in ***E. faecium*** **bacteraemia** total **incidence** since **2019**.

Vancomycin Resistant Enterococci (VRE): In **2025**, the **incidence** of **vancomycin resistant *E. faecalis*** **bacteraemia** and ***E. faecium*** **bacteraemia** was **0.05** and **2.09** per 100,000 population, respectively.

AMR in *E. faecalis*

In **2025**, **vancomycin resistance** was reported in **0.6%** of ***E. faecalis* bacteraemia**.

In ***E. faecalis* bacteraemia** between **2024** and **2025**:

- **no change** in **resistance** to **high level gentamicin, teicoplanin, vancomycin**.
- **Linezolid resistance** was not compared as **resistance remained low**.

Looking at longer term trend modelling…

Between **2019** and **2025**:

- **no increasing or decreasing trends** in **resistance** to **high level gentamicin, linezolid, teicoplanin** and **vancomycin**.

AMR in *E. faecium*

In **2025**, **vancomycin resistance** was reported in **33.1%** of ***E. faecium* bacteraemia**.

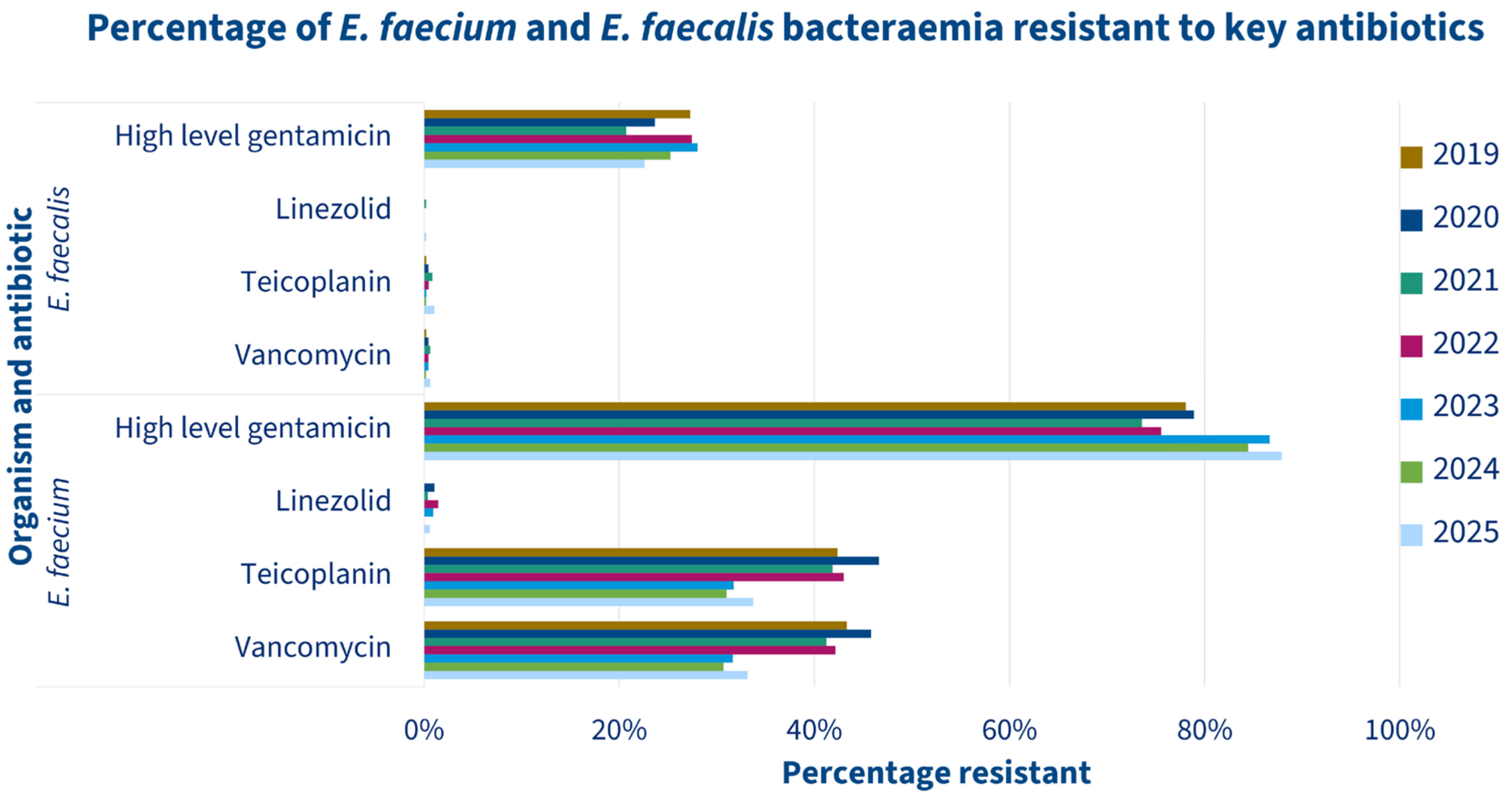
In ***E. faecium* bacteraemia** between **2024** and **2025**:

- **no change** in **resistance** to **high level gentamicin, teicoplanin** and **vancomycin**.
- **Linezolid resistance** was not compared as **resistance remained low**.

Looking at longer term trend modelling…

Between **2019** and **2025**:

- **no increasing or decreasing trends** in **resistance** to **linezolid**.
- There has been a **decreasing trend in resistance** to **teicoplanin** and **vancomycin**.
- There has been an **increasing trend in resistance** to **high level gentamicin**.



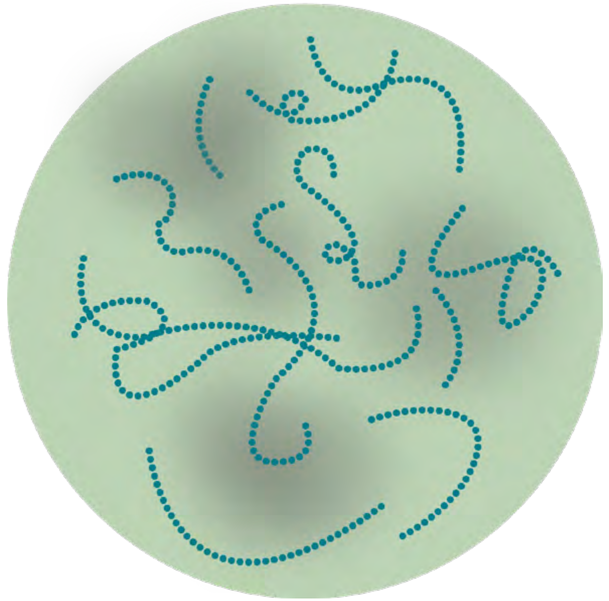
For further information on AMR in enterococcal bacteraemia see Supplementary Data. Data on AMR enterococcal bacteraemia are also shared via Discovery Dashboards.

Streptococcus pyogenes (Group A Streptococcus) bacteraemia

Streptococcus pyogenes (Group A Streptococcus) is a major pathogen, particularly in children. It can cause diseases such as erysipelas, tonsillitis, scarlet fever, rheumatic fever, and post streptococcal glomerulonephritis.

AMR in *Streptococcus pyogenes* bacteraemia:

S. pyogenes bacteraemia resistance in 2025



Clindamycin 10.2%

Tetracycline/ Doxycycline 55.5%

Penicillin 0.0%

Macrolides* 15.4%

*Macrolide resistance – resistance to azithromycin, clarithromycin, or erythromycin

- **10.2% resistance** to **clindamycin** in **2025**, and **no change** compared to **2024**

Looking at longer term trend modelling…

- **no increasing or decreasing trends in resistance** to **clindamycin** compared to **2019**.
- **no resistance** to **penicillin** has been reported between **2019** and **2025**.

More information on **Group A Streptococcus (GAS)** incidence in Scotland is published by PHS in the GAS quarterly surveillance report.

For information on AMR in Gram-positive bacteraemia see Supplementary Data. Data on AMR in Gram-positive organisms are also shared via Discovery Dashboards.

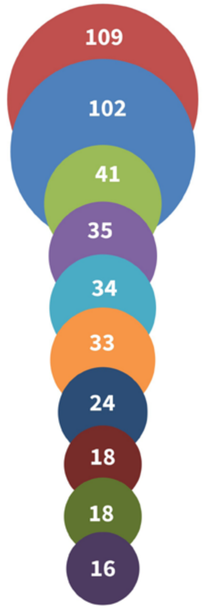
Unusual AMR phenotypes

ARHAI Scotland monitor unusual AMR phenotypes, in accordance with Appendix 13 of the National Infection Prevention and Control Manual, to support the early identification of emerging resistance and enable a timely scientific and public health response to potential emerging AMR issues. This informs infection prevention and control practices, antimicrobial treatment decisions and is critical to limiting the spread of resistance. Where appropriate, ARHAI Scotland communicate any identified issues with other public health bodies.

Local monitoring ensures that microbiology clinicians, the Infection Prevention and Control Team (IPCT), the Health Protection Team (HPT) and the Antimicrobial Management Team (AMT), as appropriate, are made aware of identified cases in line with local protocols.

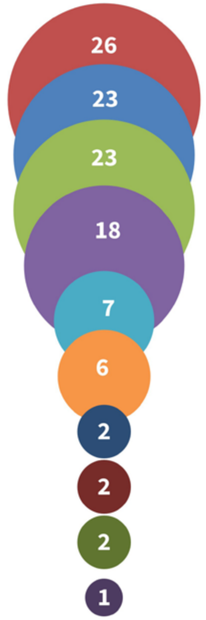
In **2025**, **602** instances of unusual AMR phenotypes were reported through the **AMR Early Warning System**. The **ten most frequently reported unusual AMR phenotypes** in **Gram-negative** and **Gram-positive bacteria** were:

Gram-negative bacteria



- 109 meropenem resistant Enterobacterales
- 102 ceftazidime-avibactam resistant Enterobacterales
- 41 meropenem/imipenem and ceftazidime and piperacillin-tazobactam resistant *Pseudomonas aeruginosa*
- 35 colistin resistant Enterobacterales
- 34 ceftolozane-tazobactam resistant *Pseudomonas aeruginosa*
- 33 cefotaxime resistant *Haemophilus influenzae*
- 24 ceftriaxone resistant *Haemophilus influenzae*
- 18 imipenem resistant *Acinetobacter baumannii*
- 18 meropenem resistant *Acinetobacter baumannii*
- 16 meropenem and ceftazidime and piperacillin-tazobactam resistant *Pseudomonas aeruginosa*

Gram-positive bacteria



- 26 cefotaxime susceptible at increased dose *Streptococcus pneumoniae* (MIC >0.5 mg/L)
- 23 linezolid resistant Enterococci
- 23 tigecycline resistant Group A,B,C and G β-haemolytic streptococci
- 18 ceftriaxone susceptible at increased dose *Streptococcus pneumoniae* (MIC >0.5 mg/L)
- 7 penicillin resistant *Streptococcus pneumoniae* (MIC > 2 mg/L)
- 6 daptomycin resistant *Enterococcus faecium* (MIC >4 mg/L)
- 2 amoxicillin resistant *Enterococcus faecalis*
- 2 daptomycin resistant *Corynebacterium* species
- 2 linezolid resistant Coagulase-negative staphylococci
- 1 for single instances of unusual AMR phenotypes in Gram Positive bacteria in 2025, see Supplementary Data

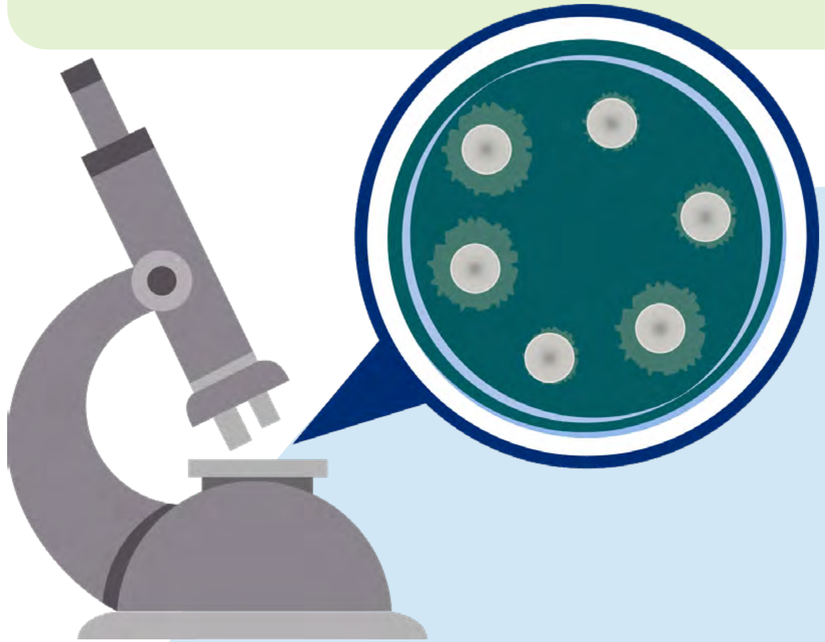
ARHAI Scotland will continue to build on intelligence relating to unusual AMR phenotypes in Scotland. For more information, see Supplementary Data.

Candidozyma auris

C. auris is a fungal pathogen which was designated a critical priority fungal pathogen by the World Health Organisation in 2022. *C. auris* can result in patient colonisation as well as severe invasive infections and can cause outbreaks. This is of concern within healthcare settings and several prolonged outbreaks have been reported worldwide including hospitals in England.

C. auris has also developed resistance to many available classes of antifungals, including the first-line agent fluconazole, and strains of *C. auris* which are resistant to all antifungals have been detected.

In Scotland, seven cases of *C. auris* were reported between 2023 and 2025 including 3 cases in 2025. All cases had a recent history of healthcare outside of Scotland with no evidence of onward transmission in Scotland.



During 2025, Public Health Scotland (PHS) led on a project to develop *C. auris* guidance for use in Scotland. The guidance covers laboratory investigation, the management of cases and contacts, and infection prevention and control (IPC) practices related to *C. auris* in health and care settings. It also provides advice for health protection teams (HPTs) on managing *C. auris* in community settings.

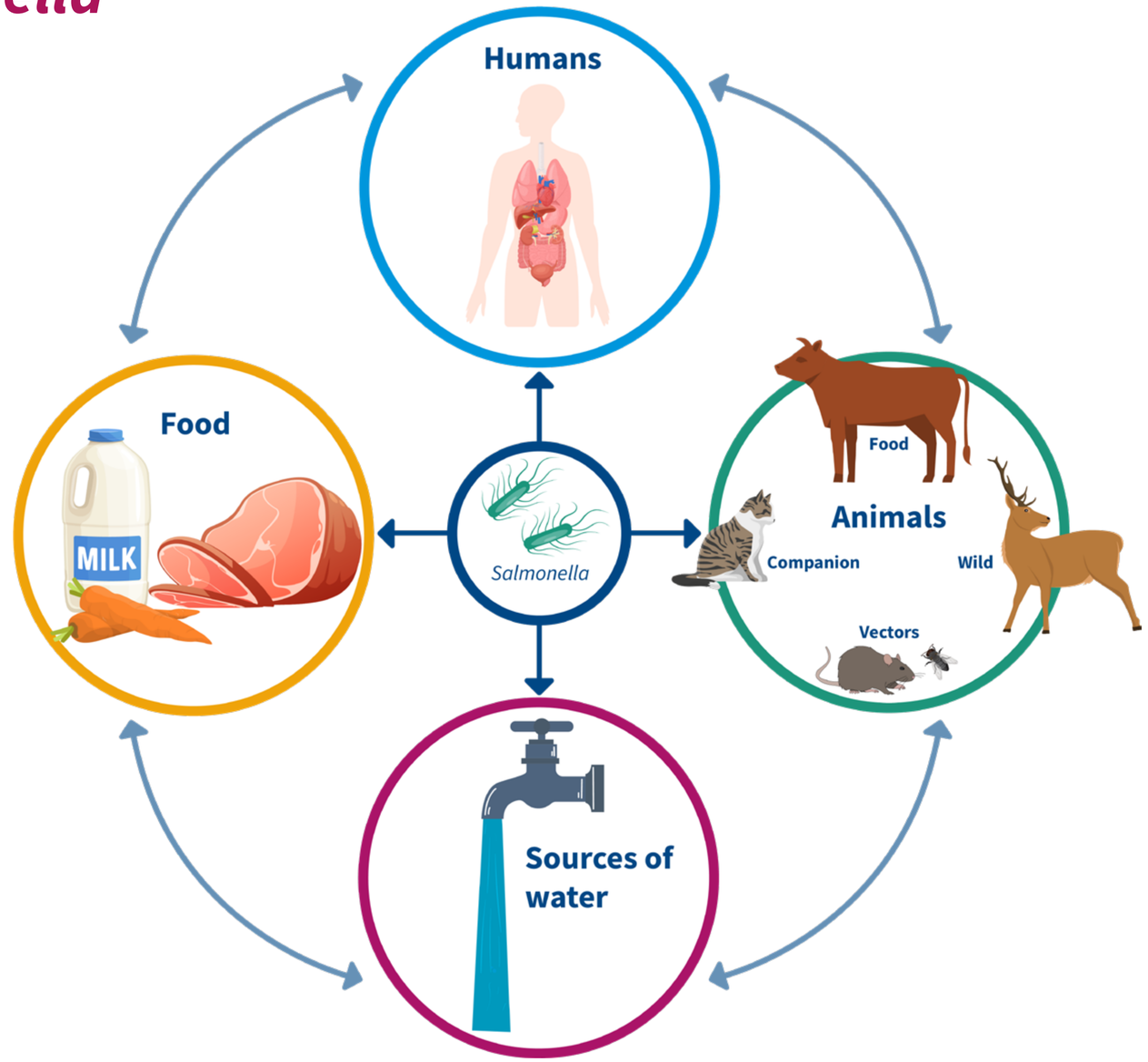
Publication of the guidance is anticipated in late 2026 and will support boards in preparedness for any future increase in *C. auris* cases and the implementation of screening.

In 2025, UK Health Security Agency declared a national incident in response to increasing cases of *C. auris* in English hospitals. ARHAI collaborated with UKHSA to share learning and inform preparedness in Scotland.

Antimicrobial resistance in *Salmonella*

Salmonella is a Gram-negative bacterium, ubiquitous in nature and a common cause of gastrointestinal illness in humans. *Salmonella* is usually a self-limiting infection and treatment with antibiotics is not routinely recommended. However, in some individuals, antimicrobial therapy may be required, particularly for severe or extraintestinal infections.

Salmonella is a zoonosis - a wide range of domestic and wild animals can act as a reservoir, including cattle, sheep, pigs, poultry, reptiles and household pets. Infected animals are often asymptomatic. *Salmonella* is notifiable in humans and a reportable animal pathogen in food producing animals and dogs in the UK.



Percentage of resistant non-typhoidal salmonellae, inferred from Whole Genome Sequencing (WGS)[1,2]

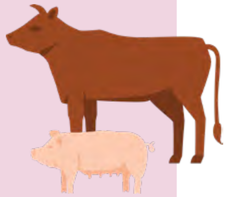


Comparing 2025 to 2024, in humans, resistance to key antibiotics remained unchanged between 2024 and 2025



Comparing 2025 to 2024, in animals, resistance to ampicillin, streptomycin, sulphonamides and tetracycline decreased between 2024 and 2025.

Resistance to ciprofloxacin remained unchanged

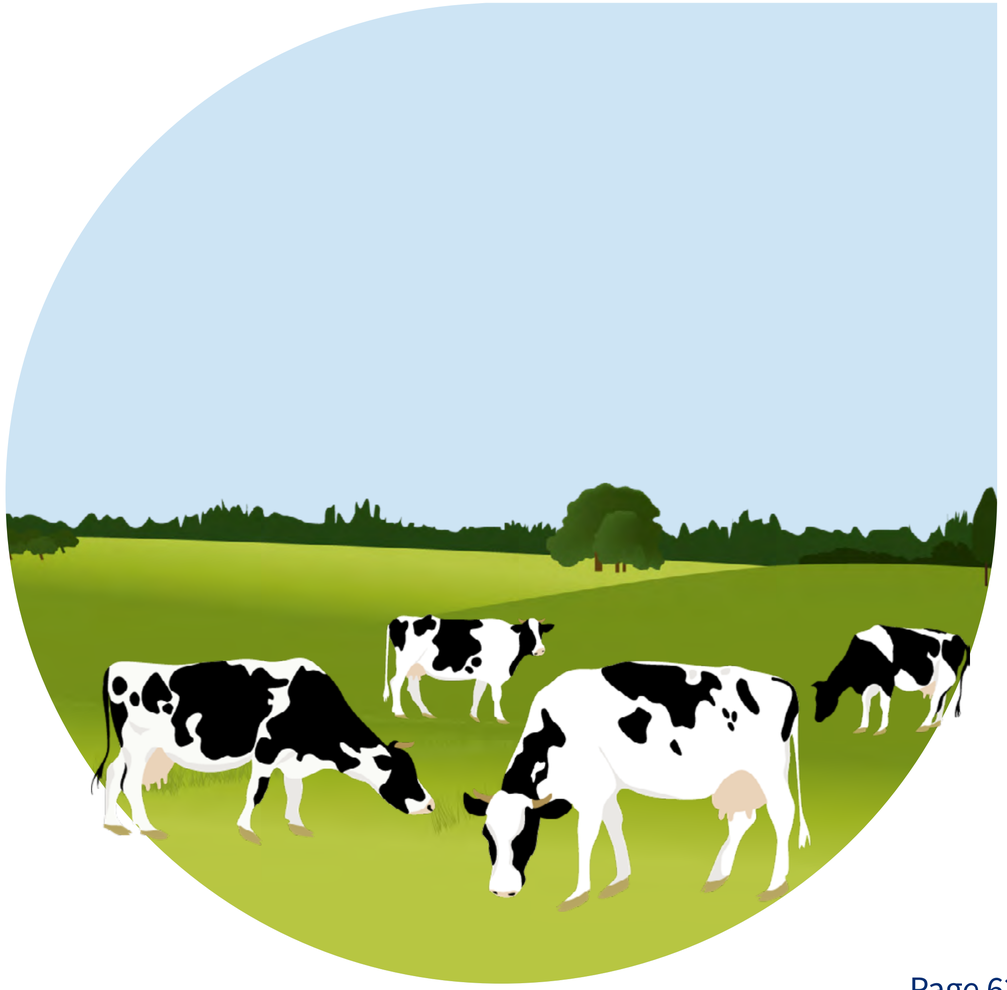


[1] For ciprofloxacin this includes mutations and acquired genes associated with reduced susceptibility above the *Salmonella* specific breakpoint of greater than 0.06mg/L as recommended by EUCAST, Jan 2024.

[2] For animal data, this includes isolates from different animal species, as well as different *Salmonella* serotypes, therefore year to year comparisons should be treated with caution.

- There were **133 non-typhoidal salmonella isolates** from animals in **2025**, the **majority** of which were from **cattle** (n=80, **61.3%**) and **sheep** (n=27, **19.5%**).
- Eleven (**8.3%**) of these **non-typhoidal Salmonella isolates** from animals **carried genes for resistance** in **2025**. Most of the resistant isolates were ***S.* Typhimurium** (n=7, **62.8%**) (of non-monophasic Group B) with the rest **Monophasic B group Typhimurium** (n=3) and single ***S.* Dublin**. **All but one** (**90.9%**) of the resistant isolates were **multi-dug resistant (MDR)**.
- In **2025**, the observed **lower levels** of resistance in animal isolates compared to **2024** reflects the relatively higher submissions of ***S.* Dublin** samples, which is a serotype that rarely carries resistance in the UK. Most (n=68, **84.8%**) of **cattle isolates** were ***S.* Dublin** and ***S.* Dublin** formed over half (n=74, **56.4%**) of all isolates from all animal species. **Salmonella Typhimurium** (n=12, **8.8%**) and ***S.* Mbandaka** (n=10, **7.6%**) and ***S.* Arizonae** (n=10, **7.6%**) were the next most common isolates. The remaining 27 isolates were of 16 serotypes.
- Caution is advised when interpreting year-on-year resistance trend data from animal populations from passive surveillance as the salmonella serotypes and the animal species submissions from which they are isolated are highly variable between years and numbers of resistant isolates generally small; apparent increases or decreases in resistance across animal populations, as a whole, are very dependent on the serotypes involved as some serotypes are more likely than others to be carrying genes for resistance.

For information on antimicrobial resistance in *Salmonella* from humans and animals see Supplementary Data.



Antimicrobial resistance in animals

Antimicrobial resistance in veterinary clinical isolates from livestock

For 2025, detailed information on AMR in veterinary clinical isolates from livestock species are presented in Supplementary Data. These data are derived from clinical specimens submitted to the farm animal diagnostic services offered by Scotland's Rural College (SRUC) Veterinary Services. These samples are tested on a 'charged for' basis to inform private veterinary treatment of diseased animals. There is a cost to the animal keeper that affects the submission of samples to these services.

The primary purpose of screening for AMR is to inform veterinary treatment, and isolates from animals are tested against a panel of antimicrobials relevant for that purpose at, where they exist, species-relevant clinical breakpoints.

The micro-organisms included, such as *Staphylococcus* species, *Streptococcus* species, *Pasteurellaceae* and *E. coli* are selected based both on their prevalence among all submissions, i.e. their importance as causes of animal morbidity, as well as, in some cases, their similarity to micro-organisms that cause morbidity in humans.

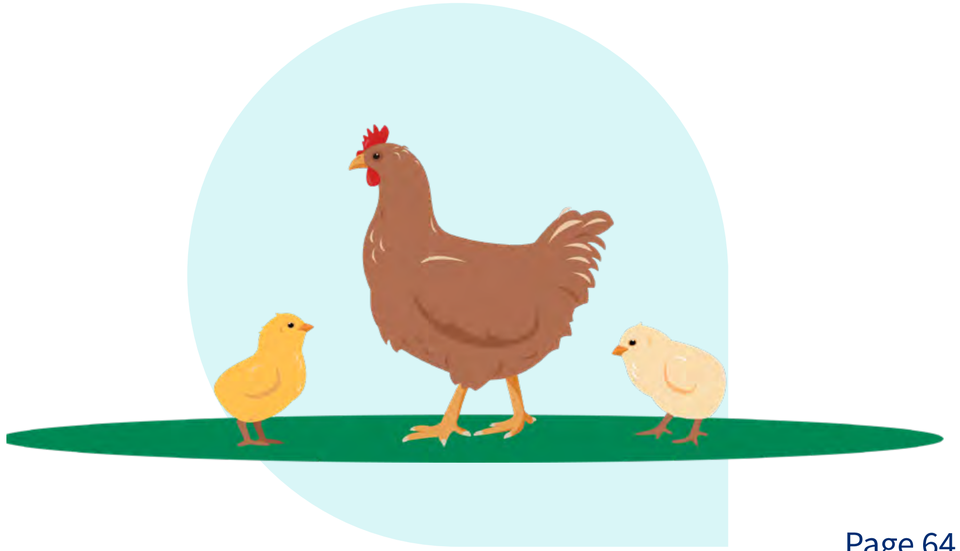


Antimicrobial resistance in *E. coli* isolates from healthy livestock

In addition to diagnostic isolates, *E. coli* collected from enteric samples of healthy animals are tested as a measure of the background resistance in livestock entering the food chain. This is undertaken in collaboration with Food Standards Scotland, monitoring AMR in *E. coli* from cattle, sheep, pigs and poultry presenting at abattoirs in Scotland for slaughter for human consumption. The antibiotics tested for resistance were selected for their relevance for human treatment, rather than veterinary practice.

Amongst high priority critically important antimicrobials (HP-CIAs):

- In **2025**, resistance to **co-amoxiclav** continued to be detected in all four livestock species with **highest rates** in **poultry** (45 of 479 isolates; **9.4%**) and **lower levels** in **pigs** (11 of 471 isolates; **2.3%**), **cattle** (two of 474 isolates; **0.4%**) and **sheep** (two of 463 isolates; **0.4%**)
- **Resistance to ciprofloxacin** was **not detected** in isolates from **pigs**, **cattle** or **sheep** in **2024** or **2025** but continued to be **detected** in **poultry** (35 of 479 isolates (**7.3%**) tested in **2025**; 23 of 475 isolates (**4.8%**) in **2024**).
- In **2025**, **resistance** to **third generation cephalosporins (cefotaxime, ceftazidime)** was **detected** in **three** isolates from **pigs** (**0.6%** of 471 tested).
- **Resistance** to **ertapenem** continued to **not be detected** in isolates from **poultry, pigs, cattle** or **sheep** in the period **2020-2025**.



Amongst non-HP-CIAs:

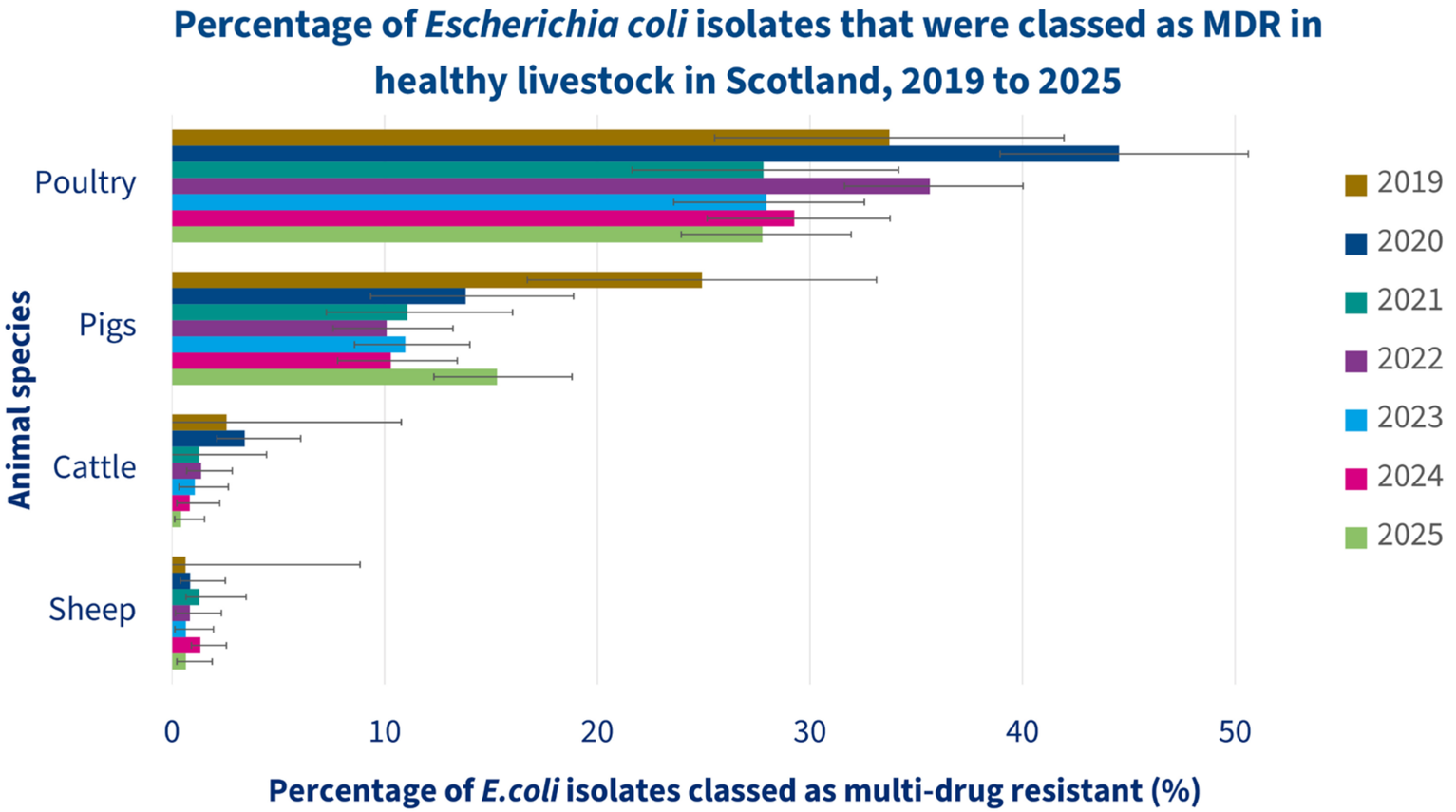
- **Resistance** to **gentamicin** in **poultry** isolates **decreased** from **10.5%** (50 of 475 isolates) in **2024**, to **5.0%** (24 of 479 tested) in **2025**. Gentamicin resistance was **not detected** in **pigs** or **sheep** in **2025** but was detected in a single **cattle isolate** in **2025** (**0.2%** of 474 tested).
- **Resistance** to **ampicillin** was **not detected** in cattle in **2025**.
- **Resistance** to **sulphonamides** was **unchanged** between **2024** and **2025** across all four livestock species. In **2025**, **resistance** to **co-trimoxazole** remained **highest** in isolates from **poultry** (**37.2%**; 178 of 479) and **pigs** (**19.7%**; 93 of 471 in 2025) and at **lower levels** from **cattle** (**1.5%**; 7 of 474) and **sheep** (**0.7%**; 3 of 463). **Similar levels** for each species were observed for **trimethoprim**.
- **Resistance** to **tetracyclines** was also **unchanged** between **2024** and **2025** across all four livestock species with **highest levels** in **pigs** (**34.2%**; 161 of 471) and **poultry (32.2%**; 154 of 479) and **lower levels** in **cattle** (**4.9%**; 23 of 474) and **sheep** (**4.5%**; 21 of 463).



Proportions of antimicrobial resistance to key antibiotics in *E. coli* isolates from pigs, poultry, sheep and cattle over the last six years are presented in the Supplementary Data.

Multi Drug Resistance in *E. coli* isolates from healthy livestock

The percentage of multi drug resistant (MDR) *E. coli* isolates reported in **2025** **remained unchanged** compared to **2024** and remained **higher** in **poultry** and **pigs** than in **cattle** and **sheep**, where MDR **remained low**.



For information on AMR in *E. coli* from healthy animals see Supplementary Data.

Antimicrobial resistance in the environment

Why the environment matters

Natural, semi-natural and built environments all influence the selection, dissemination and transmission of antimicrobial resistance. Understanding this environmental dimension is essential to delivering a One Health approach and supporting the ambitions of the UK AMR National Action Plan.

The environment acts as a reservoir, source and pathway for antimicrobial resistant organisms and AMR-driving substances, linking human, animal, plant and ecosystem health. Strengthening our understanding of this as part of an integrated One Health approach is essential to improving risk management, reducing AMR transmission, and protecting public and ecosystem health.

What we are seeing

Environmental AMR surveillance in Scotland is evolving, and cefotaxime-resistant *E. coli* have been monitored in bathing waters since 2018. These data are published in near real-time on SEPA's AMR surveillance portal and the work has supported further microbiological analysis through collaboration with partner laboratories.

Research partnerships are also helping to strengthen the evidence base. Collaborative work with organisations including the Roslin Institute, through the UK PATH-SAFE programme, has demonstrated the value of integrating environmental data into national surveillance. Source attribution modelling has improved understanding of how *E. coli* can move through the agri-food chain and the wider environment.

Key pressures

Many everyday chemicals such as medicines and biocides co-select for and exacerbate the spread of AMR through the environment. Pharmaceutical pollution is a major global One Health problem which impacts ecosystems, wildlife and people. Evidence from monitoring and risk assessment indicates that concentrations of some medicines, including antimicrobials, exceed safe levels in the environment and support the development and spread of antimicrobial resistance.

These pressures come from many sources, including treated and untreated wastewater, agriculture and other diffuse sources of pollution. The interaction between environmental contamination and AMR is complex and not yet fully understood, highlighting the need for continued research and surveillance.

What action is being taken

SEPA is working with many partners in Scotland and across the UK, including:

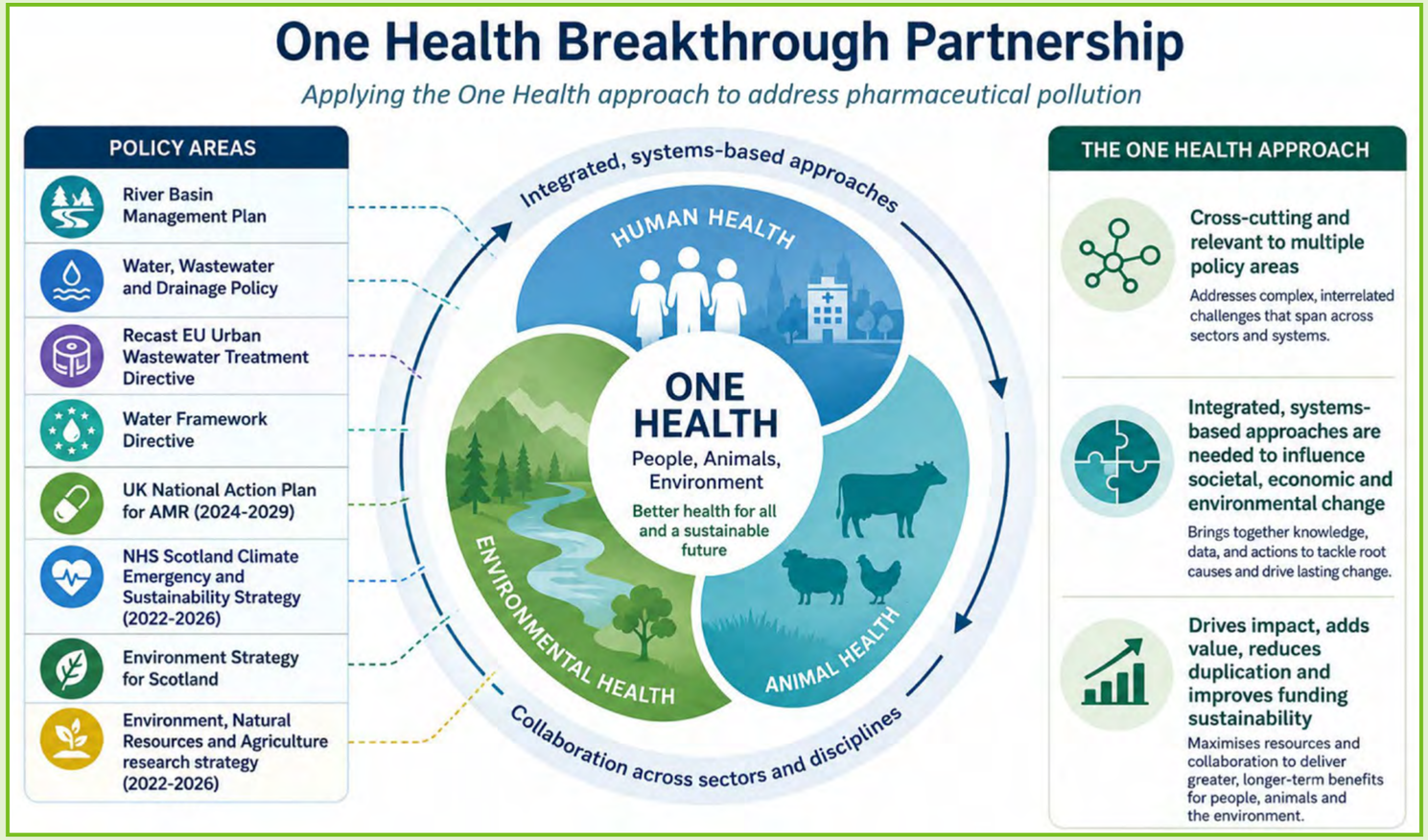
- Scotland's One Health Breakthrough Partnership
- The UK cross-government group on pharmaceuticals in the environment
- The UK Water Industry Research Chemical Investigations Programme.

These collaborations are supporting research, policy development and improved understanding and interventions on pharmaceutical pollution.



Data and tools

- The One Health Breakthrough Partnership has found that safe levels of some medicines have been exceeded in Scottish surface waters and this may exacerbate the spread of AMR.
- SEPA has developed a novel data visualisation tool to explore the relationship between medicines prescribing and the levels of medicines in surface waters.



Environmentally informed prescribing

- Scotland's One Health Breakthrough Partnership (OHBP) has investigated if environmentally informed prescribing could be used to reduce the impact of medicines in the water environment and be built into healthcare decision-making in Scotland as a pollution control measure.
- Focus groups with prescriber and public representatives indicate there is willingness to consider environmental impacts in prescribing decisions.
- This is contingent on clear, accessible information and remains limited by the availability and robustness of comparable environmental data.



Credit: One Health Breakthrough Partnership, 2026

Emerging risks

- Work is ongoing to assess the environmental impact of commonly used chemicals in veterinary medicines and develop pollution control measures.
- Broader research highlights emerging challenges, including fungal AMR and the interaction between climate change and antimicrobial resistance.

What this means

Addressing environmental AMR is a crucial component of the One Health response to the growing global threat of antimicrobial resistance and important gaps remain in evidence, surveillance and intervention. While progress has been made through targeted research and partnership working, there is currently no comprehensive environmental AMR surveillance programme in place in the UK.

Strengthening environmental data, improving integration with human, animal and plant health surveillance, and supporting evidence-based policy are critical to addressing AMR as a One Health challenge.



The Environmental AMR Evidence Gap

Environmental AMR is a crucial component of the one health response to the pandemic and important gaps remain in evidence, surveillance, and interventions.

What we know

- The environment plays a critical role in AMR
- The environment acts as a pathway for AMR transmission, linking human, animal, plant, and ecosystem health.
- Many widely used chemicals co-select for and exacerbate the spread of AMR through the environment
- Parternships are driving action and innovation

Evidence gaps

- Limited and fragmented environmental data
- No comprehensive national environmental AMR surveillance programme
- There is a need for improved integration across One Health surveillance
- Further research is required to understand complex interactions

Stronger environmental data, better integration and evidence-based policy are critical to addressing AMR as a One Health challenge.

Key messages

- The environment plays a critical role in the emergence, development and spread of AMR and must be included and adequately resourced as part of an integrated One Health approach to understanding, managing and reducing AMR risks.
- Environmental surveillance of AMR (pathogens and genes) and AMR driving chemicals can provide an early warning of AMR risks relevant to human, animal, plant and ecosystem health.
- Many widely used everyday chemicals such as medicines and biocides can co-select for and exacerbate the spread of AMR through the environment so chemical monitoring and pollution control must consider AMR.



Food Standards Scotland: UK PATH-SAFE Study

Antimicrobial resistance in *Escherichia coli* from raw pet food

As part of the UK Pathogen Surveillance in Agriculture, Food and the Environment (PATH-SAFE) programme, Food Standards Scotland sequenced **~5,900 *E. coli*** from animal, environmental, food and human sources across Scotland (**2021 – 2025**), and analysed the genomic relationships between isolates. This provided novel insights on the attribution and transmission of ***E. coli***, and the antimicrobial resistance (AMR) profiles of isolates from these different sources. Reported AMR is based on the presence/absence of antibiotic resistance genes (ARG) based on the genetic sequence of the isolate.



AMR in ***E. coli*** isolated from food products varied depending on the source. Isolates from **raw meat for human consumption** (e.g. beef, venison, chicken, pork; **n=166**) were sequenced and compared to *E. coli* isolated from **commercial raw pet food** (constituted of various meat species which is sold unprocessed or uncooked; **n=85**).

Raw pet food is predominantly given to dogs and cats and its growing popularity with consumers means that it is being increasingly handled in domestic kitchens. Commercial raw pet food has been previously linked to increased numbers of pathogenic bacteria and bacteria with antimicrobial resistance[1].

Unlike meat for human consumption, raw pet food is a product that is not cooked before serving; therefore, isolates from raw pet food could be more likely to be spread to owners, throughout homes and into the environment.

This analysis aimed to assess how the AMR risks in raw pet food compare to those of raw meat, to support the development of specific public health advice on the safe handling of these products.

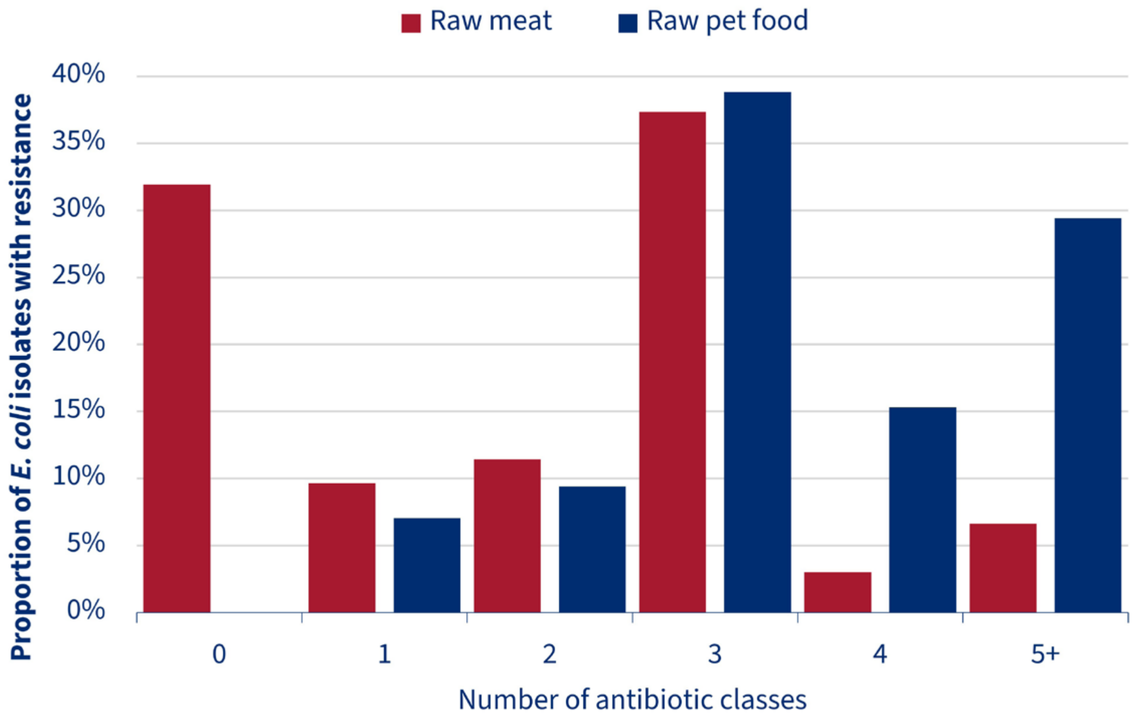


[1] A Survey of Microbiological and Antimicrobial Resistance (AMR) Contamination Found in Raw Dog and Cat Food on Retail Sale in the UK | Published in FSA Research and Evidence

Key Findings

- **Raw meat for human consumption is more likely to contain *E. coli* with no antibiotic resistance** (31.9% of isolates, no **antibiotic resistance genes (ARG)** detected) compared to commercial raw pet food (0.0% of isolates; Figure 1).
- **Raw pet food is more likely to contain *E. coli* with multidrug resistance (MDR) compared to raw meat.** Resistance to 5 antibiotic classes or more was higher in isolates from raw pet food (29.4%) compared to those from raw meat (6.6%; Figure 1).
- Isolates from raw pet food were resistant to a greater number of antibiotic classes overall (Wilcoxon rank-sum test: W = 3,146.5, $p < 0.001$) and were significantly more likely to occur in higher multidrug resistance categories (Cochran-Armitage trend test: Z = -7.35, $p < 0.001$).

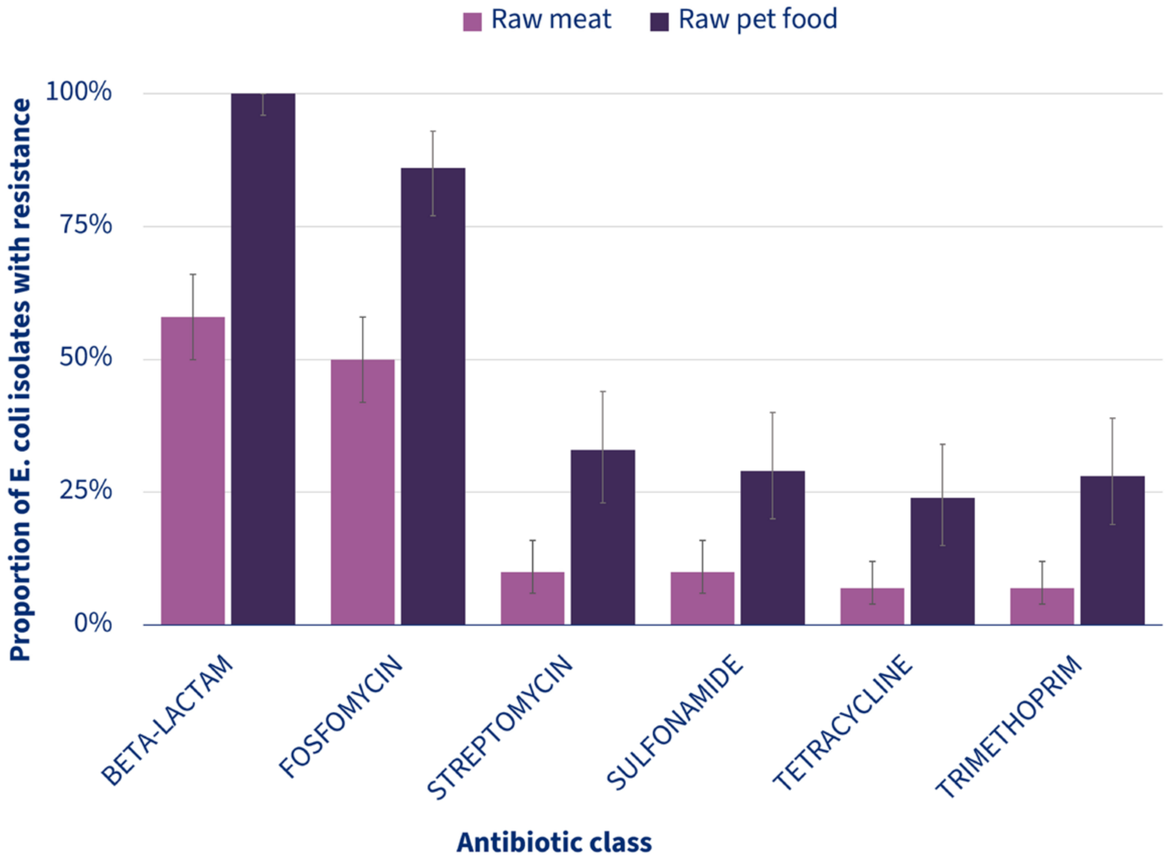
Figure 1. Proportion (expressed as a percentage) of *E. coli* isolates from raw meat (n=166) and raw pet food (n=85) with ARG to multiple antibiotic classes.



- The most common antibiotic classes the *E. coli* were resistant to were beta-lactam, fosfomycin, streptomycin, sulphonamide, tetracycline and trimethoprim, with each antibiotic class having significantly more resistant isolates from raw pet food compared to raw meat (Fisher's Exact test: $p < 0.001$; Figure 2).

Overall, these findings indicate that raw pet food was associated not only with a higher prevalence of AMR, but also with greater levels of MDR, with resistant *E. coli* isolates from raw pet food tending to contain resistance genes for a larger number of antibiotic classes than those recovered from raw meat.

Figure 2. Proportion (expressed as a percentage) of *E. coli* isolates from raw meat (n=166) and raw pet food (n=85) with ARG to the most common antibiotic classes detected. Error bars show 95% confidence intervals.



Caveats and Limitations

These findings are based only on the products sampled in this study and should not be assumed to represent the wider market for raw meat and raw pet food. Potentially important confounding factors, including meat type, animal species, country of origin, and production practices, were not collected. Consequently, it is not possible to determine whether the observed differences are due to food category itself, other underlying characteristics of the sampled products, or a combination of both.

Results are based on presence/absence of ARG genes to determine likely resistance of an isolate. The dataset was validated with phenotypic analysis in a subset of isolates, with 95-100% accuracy in predicting resistance for the majority of antibiotics tested.

Acknowledgements

This study was funded by Food Standards Scotland as part of the PATH-SAFE programme (Food Standards Agency), with raw meat (n=131) and raw pet food (n=35) samples taken from retail sale across Scotland and *E. coli* isolated by public analyst laboratories. *E. coli* isolates from a previous survey[1] on retail beef mince (n=35) in Scotland were included, provided by Scotland's Rural College and the Scottish *E. coli* O157/STEC Reference Laboratory. An additional subset of *E. coli* isolates from raw pet food (n=50) from a previous study[2] were provided by the University of Liverpool for sequencing and analysis. Sequences were analysed using AMRFinderPlus to identify ARG by the Roslin Institute, University of Edinburgh (A. Chalka, D. Gally). Statistical analysis and report written by Food Standards Scotland.

[1] Bishop, H., Evans, J., Eze, J. I., Webster, C., Humphry, R. W., Beattie, R., White, J., Couper, J., Allison, L., Brown, D., Tongue, S. C. (2022). Bacteriological Survey of Fresh Minced Beef on Sale at Retail Outlets in Scotland in 2019: Three Foodborne Pathogens, Hygiene Process Indicators, and Phenotypic Antimicrobial Resistance. Journal of Food Protection, 85(9), 1370-1379. doi:https://doi.org/10.4315/JFP-22-051

[2] Morgan, G., Pinchbeck, G., Taymaz, E., Chattaway, M. A., Schmidt, V., & Williams, N. (2024). An investigation of the presence and antimicrobial susceptibility of Enterobacteriaceae in raw and cooked kibble diets for dogs in the United Kingdom. Frontiers in Microbiology, Volume 14 - 2023. doi: 10.3389/fmicb.2023.1301841

List of Abbreviations and Acronyms

Acronym	Definition
AMR	Antimicrobial Resistance
AMS	Antimicrobial Stewardship
AMT	Antimicrobial Management Team
AMU	Antimicrobial Use
ARG	Antibiotic Resistance Genes
ARHAI Scotland	Antimicrobial Resistance and Healthcare Associated Infection Scotland
ASAP	Association of Scottish Antimicrobial Pharmacists
AST	Antimicrobial Susceptibility Testing
AWaRe	Access, Watch, Reserve, classification of antibiotics
BNF	British National Formulary
BSAC	British Society for Antimicrobial Chemotherapy
C. auris	*Candidozyma auris*
CAESAR	Central Asian and European Surveillance of Antimicrobial Resistance
CI	Confidence Interval
CHI	Community Health Index
CLSI	Clinical and Laboratory Standards Institute
COVID-19	Coronavirus disease 2019
CPE	Carbapenemase-producing Enterobacterales
CPO	Carbapenemase-producing Organism
DCVP	Data Capture Validation and Pricing

Acronym	Definition
DDDs	Defined Daily Doses
DIDs	Defined Daily Doses per 1,000 Inhabitants per Day
E. coli	*Escherichia coli*
ECB	*E. coli* bacteraemia
edf	Effective degrees of freedom
E. faecalis	*Enterococcus faecalis*
E. faecium	*Enterococcus faecium*
EDRIP	ECOSS Roll-out Implementation Programme
ECDC	European Centre for Disease Prevention and Control
ECOSS	Electronic Communication of Surveillance in Scotland
ESPAUR	English Surveillance Programme for Antimicrobial Utilisation and Resistance
EUCAST	European Committee on Antimicrobial Susceptibility Testing
FSS	Food Standards Scotland
GAM	Generalised Additive Model
GGC	Greater Glasgow and Clyde
GLASS	Global Antimicrobial Resistance and Use Surveillance System
GLM	Generalised Linear Model
GN-BSI	Gram-negative bloodstream infections
GP	General Practitioner
HHARPS	Human Health Antimicrobial Resistance & Prescribing Surveillance

Acronym	Definition
HCAI	Healthcare associated infection
HMUD	Hospital Medicines Utilisation Database
HP-CIA	High Priority Critically Important Antimicrobials
HPT	Health Protection Team
iGAS	Invasive Group A Streptococcus
ISO	International Organization for Standardization
IMP	Imipenemase
IPCT	Infection Prevention and Control Team
IV	Intravenous
K. oxytoca	*Klebsiella oxytoca*
K. pneumoniae	*Klebsiella pneumoniae*
KPC	*Klebsiella pneumoniae* Carbapenemase
LIMS	Laboratory Information Management System
MDR	Multi Drug Resistant
MIC	Minimum Inhibitory Concentration
MSSA	Meticillin-sensitive *S. aureus*
NAP	National Action Plan
NDM	New Delhi Metallo-beta-lactamases
NICE	National Institute for Health and Care Excellence
NHS	National Health Service
NRS	National Records of Scotland
NSS	NHS National Services Scotland
OBD	Occupied Bed Days
OHBP	One Health Breakthrough Partnership (OHBP)
OPAT	Outpatient Parenteral Antimicrobial Therapy
OXA	Oxacillinase
PATH-SAFE	Pathogen Surveillance in Agriculture, Food and the Environment
P. aeruginosa	*Pseudomonas aeruginosa*

Acronym	Definition
PHS	Public Health Scotland
PHA	Public Health Agency
PIS	Prescribing Information System
PSD Scotland	Public Services Delivery Scotland
S. aureus	*Staphylococcus aureus*
S. pneumoniae	*Streptococcus pneumoniae*
SAPG	Scottish Antimicrobial Prescribing Group
SAMRS SMiRL	Scottish Antimicrobial Resistance Service, Scottish Microbiology Reference Laboratories
SANG	Scottish Antimicrobial Nurses Group
SAVSNET	Small Animal Veterinary Surveillance Network
SEPA	Scottish Environmental Protection Agency
SIMD	Scottish Index of Multiple Deprivation
SMVF	Scottish Microbiology and Virology Forum
SONAAR	Scottish One Health Antimicrobial Use and Antimicrobial Resistance
spp.	species
SRUC	Scotland's Rural College
UK	United Kingdom
UK-AWaRe	UK Access, Watch, Reserve, and Other classification for antibiotics
UKHSA	United Kingdom Health Security Agency
UKAS	United Kingdom Accreditation Service
UTI	Urinary Tract Infection
VIM	Verona integron-encoded metallo-beta-lactamase
VRE	Vancomycin resistant enterococci
WGS	Whole Genome Sequencing
WHO	World Health Organization

Appendix 1 – Background information

Revisions to surveillance are summarised below. See Appendix 2 for further information on revisions.

Description of Revision	First report revision applied	Report section(s) revision applies to	Rationale for revision
Implementation of new Biomerieux® VITEK antimicrobial susceptibility testing (AST) cards within laboratories	2020	Antimicrobial resistance in humans	Implementation of new Biomerieux® VITEK AST cards in late 2018 that test amoxicillin in combination with a fixed clavulanic acid minimum inhibitory concentration (MIC)of 2 mg/L as per the EUCAST recommendations. Roll out across National Health Service (NHS) boards was variable due to laboratories depleting existing stock of older cards. This change was associated with an increase in co-amoxiclav non-susceptibility in 2019.
Temocillin breakpoints (Enterobacterales)	2020	Antimicrobial resistance in humans	No EUCAST breakpoint available. Initially all Biomerieux® VITEKs used the British Society for Antimicrobial Chemotherapy (BSAC) legacy urinary tract infection breakpoint of 16. NHS Greater Glasgow and Clyde (GGC) moved to systemic breakpoint of 8 in ~2015. Other NHS boards moved variably up until end 2017. NHS GGC and some others retained an 'I' category (minimum inhibitory concentration 16) up until October 2019 when all moved to S<8 and R>8.
Implementation of v_12.0 EUCAST breakpoints	2022	Antimicrobial use in humans, Antimicrobial resistance in humans and antimicrobial resistance in *Escherichia coli* isolates from healthy livestock	Changes can be accessed here. Breakpoints were generally lower in the EUCAST breakpoint tableV12.0 compared to V9.0. Exceptions to this are trimethoprim for both Enterobacterales and *Staphylococcus aureus (S. aureus)* and azithromycin for *S. aureus* only, where the breakpoint increased. Changes to EUCAST breakpoints involved prescribing guidance updates with the key change relating to the category "Intermediate" moving to "Susceptible at Increased Dose".

Description of Revision	First report revision applied	Report section(s) revision applies to	Rationale for revision
Exclusion of specified antibiotics from total antimicrobial use metrics.	2025	Antimicrobial use in humans	Specified antimicrobial agents are excluded from total antimicrobial use metrics in accordance with the UKHSA antimicrobial use methodology. This methodology has been applied retrospectively to all antimicrobial use measures included in this publication for all years presented (2019 to 2025) to ensure consistency of reporting and comparability over time.
Update to antimicrobial use reporting terminology - Defined Daily Doses per 1,000 inhabitants per day (DIDs).	2025	Antimicrobial use in humans	To align with UKHSA and four nations antimicrobial use surveillance reporting conventions.
Data on antimicrobial use in animals	2025	Antimicrobial use in animals	Data on antimicrobial use in companion animals from veterinary practices in Scotland participating in the Small Animal Veterinary Surveillance Network (SAVSNET) were included in the report. These data were not available for inclusion in the 2024 report.
Methenamine use in Scotland	2025	Antimicrobial use in humans	Methenamine has been excluded from all antimicrobial use (AMU) metrics to align with the UK Antimicrobial Resistance (AMR) National Action Plan (NAP) 2024 to 2029 methodology, as it is not classified as an antibiotic and is therefore outside the scope of national antibiotic prescribing targets. Total methenamine use is reported separately.
Scottish national indicators for antibiotic use: primary care, secondary care and dental care targets	2025	Antimicrobial use in humans	This report includes data for the Scottish national antibiotic prescribing indicators for primary care, secondary care and dental care to monitor progress towards national antibiotic prescribing targets and support delivery of the UK AMR NAP 2024 to 2029 ambitions in Scotland.

Description of Revision	First report revision applied	Report section(s) revision applies to	Rationale for revision
Updated list of acute hospitals for antimicrobial use in humans (secondary care)	2025	Antimicrobial use in humans	The acute hospital list used for acute care antimicrobial use analyses has been updated and applied retrospectively to all years (2019-2025). This affects all acute care antimicrobial use measures reported in the report and Supplementary Data. See Appendix 2 for more information.
Health inequalities in primary care (excluding dental) prescribing	2025	Antimicrobial use in humans	This report includes analysis of health inequalities in primary care prescribing (excluding dental), assessing variation in antimicrobial use by age & sex, and by Scottish Index of Multiple Deprivation (SIMD) quintile.
Scottish Antimicrobial Prescribing Group (SAPG) methodology update for identifying duration of courses of antibiotics	2025	Antimicrobial use in humans	In 2026, the Scottish Antimicrobial Prescribing Group (SAPG) agreed upon new methodology for identifying five-day courses of amoxicillin, and doxycycline. For further information, see Appendix 2.
UK National Action Plan 2024 to 2029 target 1b progress update for Scotland	2025	Antimicrobial resistance in humans	An update on human health target 1b data for the UK AMR NAP 2024 to 2029 'Confronting antimicrobial resistance' is presented in this report.
Inclusion of 2017 and 2018 data for Gram-negative bacteraemia, including for long-term trends analysis	2025	Antimicrobial resistance in humans	Data starting 2017 is provided for Gram-negative bacteraemia (including *Escherichia coli* bacteraemia), to align with the first complete year of enhanced data for this surveillance programme.
Scottish supplementary HCAI *Escherischia coli (E. coli)* bacteraemia (ECB) target	2025	Antimicrobial resistance in humans	This report includes an update on the Scottish supplementary target for Healthcare Associated Infection (HCAI) E.coli bacteraemia.

Description of Revision	First report revision applied	Report section(s) revision applies to	Rationale for revision
Health inequalities information for cases of Gram-negative bacteraemia, drug resistant bacteraemia, and cases with carbapenemase-producing organisms (CPO).	2025	Antimicrobial resistance in humans	This report includes analysis of health inequalities in cases of Gram negative bacteraemia, drug resistant bacteraemia, and cases with carbapenemase-producing organisms (CPO), including by age, sex, deprivation (SIMD), and Urban-Rural classification.
Change in the antimicrobial panels for certain bacteria isolates from veterinary clinical specimens	2025	Antimicrobial resistance in veterinary clinical isolates from livestock	At the end of 2024, there was a change in the antimicrobial panels used by Scotland's Rural College (SRUC) to assess resistance for certain bacterial isolates from veterinary clinical specimens; these changes are visible in the Supplementary Data (Tabs 42-45) where resistance data for some antimicrobials are available for 2025 but not 2024, and vice versa. It is envisaged that these changes for 2025 represent the baseline panels going forward for subsequent years.
Food Standards Scotland study on *E. coli* in raw pet food and raw meat for human consumption in 2025 from UK Pathogen Surveillance in Agriculture, Food and the Environment (PATH-SAFE) Programme	2025	Food Standards Scotland: UK PATH-SAFE Study	Included in this report are information and data on *E. coli* from raw meat for human consumption and raw pet food in 2025 via the UK Pathogen Surveillance in Agriculture, Food and the Environment (PATH-SAFE) programme.

Appendix 2 –Publication Metadata

Publication title
Scottish One Health Antimicrobial Use and Antimicrobial Resistance in 2025 (SONAAR report, 2025)

Description
This annual report provides data and intelligence on trends relating to antimicrobial use (AMU) and antimicrobial resistance (AMR) in Scotland during 2025.

Theme
Health and Care (ARHAI Scotland, Public Services Delivery Scotland (PSD Scotland) and Public Health Scotland (PHS)).

Topic
Antimicrobial use and resistance in humans, animals and the environment.

Format
Online resource (PDF).

Data source(s)
Antimicrobial use in humans

Antibiotic use in primary care: Prescribing Information System (PIS), PHS and Public Services Delivery Scotland.

Population/Inhabitants denominator data: Mid-year population projections for Scotland, National Records of Scotland (NRS) population estimates.

Antibiotic use in secondary care (including acute hospitals): Hospital Medicines Utilisation Database (HMUD), PHS and PSD Scotland.

Healthcare associated denominator: Total occupied bed days (OBDs), Sum of OBDs for all hospitals in numerator: Public Health Scotland ISD(S)1.

Health inequalities:
Health inequalities Scottish Index of Multiple Deprivation (SIMD): Scottish Government Scottish Index of Multiple Deprivation

Denominators:
Population denominator data: National Records of Scotland (NRS) mid-year population estimates.
Health inequalities population denominator data: NRS Other geographies mid-year population estimates

Antimicrobial use in animals

Prescribing trends in companion animals from veterinary practices in Scotland participating in the Small Animal Veterinary Surveillance Network (SAVSNET), University of Liverpool.

Antimicrobial resistance in humans

Bacteraemia (excluding *Escherichia coli* and *Staphylococcus aureus* bacteraemia):
Case data: Electronic Communication of Surveillance in Scotland (ECOSS).

***Escherichia coli* and *Staphylococcus aureus* bacteraemia:**
Case data: ECOSS and ECOSS Enhanced Surveillance Web Tool.

UK AMR NAP Targets on estimated drug resistant infections and Gram-negative bloodstream infections: ECOSS and ECOSS Enhanced Surveillance Web Tool.

Urinary tract infections caused by *Escherichia coli*: ECOSS.

Carbapenemase-producing organisms:

Case data: ECOSS and the Scottish Antimicrobial Resistance Service, Scottish Microbiology Reference Laboratories (SAMRS
SMiRL, Glasgow).

Unusual AMR phenotypes: ECOSS.

Health inequalities:
Health inequalities SIMD: Scottish Government SIMD

Health inequalities Urban/Rural: Scottish Government Urban/Rural Classification

Denominators:
Whole population, and age- and sex- specific denominator data:
National Records of Scotland (NRS) mid-year population estimates.

Health inequalities population denominator data: NRS Other geographies mid-year population estimates

Antimicrobial resistance in Salmonella: Inferred genotypic resistance to antimicrobials, derived from whole genome sequencing (WGS) of isolates, conducted by Scottish Antimicrobial Resistance Service, Scottish Microbiology Reference Laboratories (SAMRS SMiRL, Glasgow).

Antimicrobial resistance in animals: Data from two sources:
i) Phenotypic resistance of isolates from clinical sample submissions collected from food producing animals, sent by private veterinary practices for diagnostic testing to Scotland's Rural College (SRUC) Veterinary Services.
ii) Phenotypic resistance of *Escherichia coli* (*E. coli*) isolates collected from enteric samples of healthy food producing animals from abattoirs in Scotland, from SRUC in collaboration with Food Standards Scotland (FSS).

Antimicrobial resistance in the environment: N/A

Food Standards Scotland:
E. coli isolates from raw meat:

1) Isolated by public analyst laboratories from food samples purchased from retail shops in four regions of Scotland (n=131)
2) see Bacteriological Survey of Fresh Minced Beef on Sale at Retail Outlets in Scotland in 2019: Three Foodborne Pathogens, Hygiene Process Indicators, and Phenotypic Antimicrobial Resistance - ScienceDirect (n=35).

E. coli isolates from raw pet food:

1) Isolated by public analyst laboratories from food samples purchased from retail shops in four regions of Scotland (n=35)
2) See A Survey of Microbiological and Antimicrobial Resistance (AMR) Contamination Found in Raw Dog and Cat Food on Retail Sale in the UK and Frontiers | An investigation of the presence and antimicrobial susceptibility of Enterobacteriaceae in raw and cooked kibble diets for dogs in the United Kingdom (n=50).

Date that data are acquired

Antimicrobial use in humans

Antibiotic use in primary care:
Primary Care Trend Data: 05 May 2026
Course Duration Data: 05 May 2026
Patient Data: 23 September 2026
Health Inequalities Data: 13 May 2026
Antifungals Data: 29 September 2026
Population denominator data: Mid-year population estimates for Scotland, NRS population estimates: 20 March 2026

Antibiotic use in secondary care:
Secondary Care Trend Data: 06 May 2026
Antifungals Data: 29 September 2026
Healthcare denominator data: Total occupied bed days (OBDs), sum of OBDs for all hospitals in numerator: 14 April 2026

Antimicrobial use in animals

Prescribing trends in companion animals: 29 May 2026

Antimicrobial resistance in humans

Bacteraemia:
E. coli bacteraemia case data: 19 March 2026
Gram-negative exc. *E. coli* bacteraemia case data: 10 July 2026
Gram-positive case data: 10 July 2026

UK AMR NAP Targets on estimated drug resistant infections and Gram-negative bloodstream infections:
Human health target 1a: 10 July 2026
Human health target 1b: 22 July 2026

Urinary tract infections caused by *Escherichia coli*:
Case data between 2023 and 2025: 18 June 2026

Carbapenemase-producing organisms:
Case data: 15 May 2026

Unusual AMR phenotypes: 14 August 2026

Whole population, and age- and sex- specific denominator data: 30 April 2026

Health inequalities population denominator data: 20 March 2026

Antimicrobial resistance in Salmonella: 06 May 2026

Antimicrobial resistance in animals

Antimicrobial resistance in veterinary clinical isolates from livestock: 08 July 2026

Antimicrobial resistance in Escherichia coli isolates from healthy livestock: 26 June 2026

Antimicrobial resistance in the environment: N/A

Food Standards Scotland: 31 March 2026

Release date
17 November 2026

Frequency
Annual

Timeframe of data and timeliness
The latest iteration of data are to 31 December 2025, therefore the data are 11 months in arrears.

Continuity of data

Antimicrobial use in humans:

Seven years of data from 2019 to 2025 are presented in this report, whereby any changes in antimicrobial use over this period must be interpreted with caution. Figures may vary due to changes in healthcare delivery, prescribing guidance and diagnostics over time.
In addition, changes in healthcare activity during the COVID-19 pandemic may have affected antimicrobial use and comparison of results should be interpreted with caution.

The Data Capture Validation and Pricing (DCVP) system, used to produce payment schedules for pharmacies, dispensing doctors and appliance suppliers on behalf of NHS boards, was implemented in NHS Scotland in May 2023. Following implementation of the DCVP system, differences in how medicines are mapped to the British National Formulary (BNF) were identified. This may affect a small number of drugs and presentations intended for systemic use and should be considered when interpreting antimicrobial use data from 2023 onwards.

Annual revisions to EUCAST guidelines over the years includes changes to doses as well as clinical breakpoints for the interpretation of antimicrobial susceptibility testing results in diagnostic laboratories in Scotland. A key change in EUCAST Version 12.0, in 2022, involved the "Intermediate" category changing to "Susceptible, at Increased Dose". Changes to EUCAST should be considered in the interpretation of antimicrobial use over time.

Changes to the guidance and expansion of outpatient parenteral antimicrobial therapy (OPAT) services should be considered in the interpretation of antibiotic use over time. The range of antibiotics available for OPAT is limited due to delivery schedules. (See the Scottish Antimicrobial Prescribing Group (SAPG) website for more information on OPAT.)

Antimicrobial use in animals:

A change in the veterinary practice software used by the majority of veterinary practices participating in SAVSNET was observed between 2023 and 2024, with 90% of practices using the same software in 2025. Differences in the way that consultations were recorded by different practice software systems were adjusted for by incorporating an extra step to select for instances in which clients were invoiced for a consultation, as a subset of electronic health records.

Antimicrobial resistance in humans:

New Biomerieux® VITEK antimicrobial susceptibility testing (AST) cards were implemented in late 2018 that test amoxicillin in combination with a fixed clavulanic acid concentration of 2 mg/L as per the EUCAST recommendations. Roll out across National Health Service (NHS) boards was variable due to laboratories depleting existing stock of older cards. This change was associated with an increase in co-amoxiclav non-susceptibility in 2019.

Temocillin breakpoints (Enterobacterales): No EUCAST breakpoint available. Initially all Biomerieux® VITEKs used the British Society for Antimicrobial Chemotherapy (BSAC) legacy urinary tract infection breakpoint of 16 (minimum inhibitory concentration (MIC)). NHS Greater Glasgow and Clyde (GGC) moved to systemic breakpoints of 8 during 2015. Other NHS boards moved variably up until end 2017. NHS GGC and some others retained an 'I' category (minimum inhibitory concentration 16) up until October 2019 when all moved to S<8 and R>8.

Throughout 2022, the majority of Scottish National Health Service (NHS) diagnostic laboratories, on a phased basis, changed from version 9.0 of the European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoint table to version 12.0. NHS boards have continued with a phased approach to implementing more recent versions of EUCAST yearly updated breakpoint tables.
MIC breakpoints are generally lower in the more recent EUCAST breakpoint table versions 12.0 (2022) to 15.0 (2025) compared to version 9.0 (2019). Exceptions to this were trimethoprim for both Enterobacterales and *Staphylococcus aureus* (*S. aureus*) and azithromycin for *S. aureus*, where the breakpoint increased in version 12.0. A reduction in a breakpoint will result in an increase in the number of isolates falling into the resistant category. Conversely, an increased breakpoint will result in a reduction in the numbers in the resistant category. Furthermore, later EUCAST versions also include revisions to, or the introduction of, multiple clinical breakpoints for certain species. This must be considered when interpreting results for this report.

EUCAST have noted that testing for fosfomycin susceptibility in *E. coli* urinary isolates using VITEK 2 may lead to errors, and recommend that this method of testing is not used (see here for further details). The majority of laboratories in NHS Scotland use VITEK 2 and therefore AST results for fosfomycin may be unreliable. Consequently, fosfomycin resistance is not included in this report.

A number of NHS laboratories have undergone changes to their Laboratory Information Management Systems (LIMS) with further roll-out planned. Any changes to LIMS may affect how results have been reported to ECOSS.

There is a degree of variation in testing practices, and organism reporting protocols to ECOSS between NHS boards and diagnostic laboratories.

Changes in healthcare activity and patient populations during the COVID-19 pandemic may have affected the epidemiology of infections included in this report and comparison of results should be interpreted with caution.

Unusual AMR Phenotypes: Changes to the unusual AMR phenotypes criteria in Table 6 of National Infection Prevention and Control Manual (NIPCM) Appendix 13, as well as the Reference laboratory referral guide for confirmation of unusual organism/antimicrobial resistance profiles guidance will affect comparisons of data over time.

Antimicrobial resistance in *Salmonella*:

Changes in healthcare activity, patient populations and contact between animals and their vets during the COVID-19 pandemic may have affected the epidemiology of *Salmonella* and comparison of results between 2020 and 2022 should be interpreted with caution.

Antimicrobial resistance in animals:

The COVID-19 pandemic may have affected the level of contact between animals and their vets between 2020 and 2022. Comparison of results should be interpreted with caution.
At the end of 2024 there was a change in the antimicrobial panels used by SRUC to assess resistance for certain bacterial isolates from veterinary clinical specimens. It is envisaged that these changes for 2025 represent the baseline panels going forward for subsequent years.

Antimicrobial resistance in the environment: N/A

Food Standards Scotland: N/A

Revisions statement

These data are not subject to planned major revisions. However, ARHAI Scotland and PHS aim to continually improve the interpretation of the data and therefore analysis methods are regularly reviewed and may be updated in the future.

Revisions relevant to this publication

National Records of Scotland (NRS) mid-year population estimates

Population estimates for mid-2024 were revised following publication of the NRS mid-year population estimate for 2024.

Antimicrobial use in humans:

Methenamine has been excluded from all AMU metrics to align with the UK AMR National Action Plan (NAP) 2024 to 2029 methodology, as it is not classified as an antibiotic and is therefore outside the scope of national antibiotic prescribing targets. Total methenamine use is reported separately.

The following Supplementary Data Tables have been also revised.

- Supplementary Data Tables: 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 5.1, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 9.3, 10.1, 11.1, 11.2, 12.1, 12.2, 12.3, 14.1, 14.2, 14.3, 14.4, 15.1, 16.1, 16.2, 17.1, 19.1, 19.2, 21.1

In line with the UKHSA antimicrobial use methodology, the following agents are excluded from total antibiotic use metrics for all years presented in this report : Methenamine, Spiramycin, Tinidazole (oral), Spectinomycin, Gentamicin (oral), Colistin (oral), Neomycin, Demeclocycline, Bedaquiline, Capreomycin, Cycloserine, Delamanid, Ethambutol, Ethambutol hydrochloride/isoniazid/pyrazinamide/rifampicin, Isoniazid, Pyrazinamide, Rifampicin, Rifampicin/isoniazid, Rifampicin/isoniazid/pyrazinamide, Clofazimine, Chlortetracycline hydrochloride/demeclocycline hydrochloride/tetracycline hydrochloride, Telithromycin, Telavancin, Tobramycin (oral), Doxycycline (periodontal gel), Bezlotoxumab, Rifaximin and Taurolidine.

The revisions to total antimicrobial Defined Daily Doses (DDDs) are shown in Table 1, including total volume of DDDs in the financial year 2019/20, which is used in the calculation of UK AMR NAP Human Health target 4a baseline. The revisions also impact the AMU measure on the percentage of total AMU from the Access category of the UK-Access, Watch, Reserve (UK-AWaRe) antibiotic classification, which is part of the UK AMR NAP target 4b, shown in Table 2.

Table 1: Total antimicrobial use (DDDs) compared to the previous year's report due to revisions

Year	Total Volume of antimicrobial DDDs 2024 data	2025 data
2019/20*	43,602,105	43,372,766
2019	43,583,226	43,381,929
2020	38,435,321	38,134,131
2021	38,081,415	37,650,454
2022	41,961,824	41,203,035
2023	44,137,907	42,684,036
2024	46,637,431	44,157,326

*the total volume of DDDs in financial year 2019/2020 is used in the calculation for UK AMR NAP human health target 4a baseline target.

Table 2: Percentage of total antibiotic use in DDDs which were from the Access category of UK-Access, Watch, Reserve (UK-AWaRe) antibiotic classification.

Year	% Access antibiotics out of total antibiotic use	
	2024 data	2025 data
2019	61.8%	62.0%
2020	62.1%	62.6%
2021	63.2%	63.9%
2022	65.1%	66.3%
2023	65.2%	67.4%
2024	63.7%	67.3%

The following Supplementary Data tables have been also revised.

- Supplementary Data Tables: 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 5.1, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 9.3, 10.1, 11.1, 11.2, 12.1, 12.2, 12.3, 14.1, 14.2, 14.3, 14.4, 15.1, 16.1, 16.2, 17.1, 19.1, 19.2, 21.1

In addition, Nystatin and Oral Amphotericin B have been excluded from antifungal Supplementary Data.

- This includes the following Supplementary Data tables: 20.1, 20.2, 20.3

See SONAAR report 2024 for data using the previous methodology.

In 2025, the calculation for the UK AMR NAP human health target 4a was updated from a rate expressed as the total volume of DDDs per 1,000 population, to a rate expressed as total volume of DDDs per 1,000 inhabitants per day.

To better reflect local prescribing practices across Scotland, SAPG updated its methodology in 2026 for estimating antibiotic course durations. Course duration is not recorded in Prescribing Information System (PIS) and so this must be estimated through quantity of tablets / capsules prescribed. Prescribers use different pack sizes and dosing instructions, so broadening the definitions helps ensure antimicrobial use is measured more accurately and consistently. A five-day course of amoxicillin is now defined as a prescription of 15, or 30 capsules. The definition of a three-day course of trimethoprim is now defined as 6 tablets of 200mg. A five-day course of doxycycline is defined as 6 or 10 100mg capsules or tablets per prescription. These definition changes have been applied retrospectively. Revisions are shown in Tables 3-5.

Table 3: Percentage of amoxicillin courses in Primary Care which were for five-day duration, compared to the previous year's report due to revisions

Year	% Amoxicillin courses which were for 5-days	
	2024 data	2025 data
2019	46.3%	45.2%
2020	55.4%	54.0%
2021	61.3%	59.9%
2022	68.2%	67.0%
2023	72.6%	71.1%
2024	77.5%	76.1%

Table 4: Percentage of trimethoprim courses in Primary Care which were for three-day duration compared to the previous year's report due to revisions

Year	% Trimethoprim courses which were for 3-days	
	2024 data	2025 data
2019	68.6%	75.8%
2020	68.9%	74.9%
2021	69.3%	75.4%
2022	70.5%	76.8%
2023	72.0%	78.0%
2024	74.1%	79.6%

Table 5: Percentage of doxycycline courses in Primary Care which were for five-day duration compared to the previous year's report due to revisions

Year	% Doxycycline courses which were for 5-days	
	2024 data	2025 data
2019	15.0%	14.9%
2020	24.0%	23.9%
2021	27.7%	27.5%
2022	34.2%	34.0%
2023	36.9%	36.7%
2024	42.9%	42.6%

The following tables in the Supplementary Data tables have been revised to reflect this change.

- Supplementary Data Tables: 1.1, 1.2, 13.1, 13.2

See the SONAAR report 2024 for data using the previous methodology.

In 2025, the acute hospital list used to measure antibiotic use in acute hospitals was revised and changes retrospectively applied to analyses in this report (2019 to 2025). A summary of revisions to antimicrobial use in acute hospitals are shown in Table 6. These changes were also applied to the acute occupied bed days denominator used to calculate rates, as shown in Table 7. The list of acute hospitals is included in Table 8, including the revisions since the previous year's report.

Table 6: Antimicrobial use in acute hospitals (DDDs) compared to the previous year's report due to revisions.

Year	Total Volume of antimicrobial DDDs in acute hospitals	
	2024 data	2025 data
2019	6,180,816	6,117,919
2020	5,040,997	4,993,861
2021	5,235,135	5,177,305
2022	5,903,792	5,830,158
2023	6,291,789	6,192,381
2024	6,552,249	6,437,270

Table 7: Occupied bed days in acute hospitals, compared to the previous year's report due to revisions

Year	Occupied bed days in acute hospitals	
	2024 data	2025 data
2019	4,391,020	4,330,205
2020	3,695,376	3,643,341
2021	4,133,362	4,108,950
2022	4,466,326	4,449,526
2023	4,511,931	4,494,278
2024	4,514,196	4,565,199

Table 8: List of included acute hospitals for use in acute care AMU and acute occupied bed days[a]

NHS Board	Hospital
NHS Ayrshire & Arran	University Hospital Ayr
	University Hospital Crosshouse
	Arran War Memorial Hospital
NHS Borders	Borders General Hospital
NHS Dumfries & Galloway	Dumfries & Galloway Royal Infirmary
	Galloway Community Hospital
NHS Fife	Queen Margaret Hospital
	Victoria Hospital (Including National Treatment Centre Fife Orthopaedics)
NHS Forth Valley	Forth Valley Royal Hospital
NHS Golden Jubilee	Golden Jubilee National Hospital
NHS Grampian	Aberdeen Royal Infirmary
	Dr Gray's Hospital
	Royal Aberdeen Children's Hospital
	Aberdeen Maternity Hospital*
NHS Greater Glasgow & Clyde	Vale of Leven General Hospital
	Glasgow Royal Infirmary
	Inverclyde Royal Hospital
	Queen Elizabeth University Hospital
	Royal Alexandra Hospital
	Gartnavel General Hospital (Including West Glasgow)
	Royal Hospital for Children
	Princess Royal Maternity Unit
NHS Highland	Belford Hospital
	Caithness General Hospital
	Lorn & Islands Hospital
	Raigmore Hospital (Including National Treatment Centre – Highland)
	Belford Hospital
NHS Lanarkshire	University Hospital Hairmyres
	University Hospital Monklands
	University Hospital Wishaw
NHS Lothian	Royal Infirmary of Edinburgh at Little France
	St John's Hospital
	Western General Hospital
	Royal Hospital for Children and Young People
	Princess Alexandra Eye Pavilion
NHS Orkney	Balfour Hospital
NHS Shetland	Gilbert Bain Hospital
NHS Tayside	Ninewells Hospital
	Perth Royal Infirmary
NHS Western Isles	Western Isles Hospital

*In 2025, this hospital was added to the acute hospital list
a – the following hospitals were removed in 2025: New Victoria Hospital (NHS GGC), Stobhill hospital (NHS GGC), and Stracathro hospital (NHS TY)

The measure providing the percentage of the population receiving at least one course of antibiotics in Primary Care (excluding dental) has been removed from the report, but is reported in the Supplementary Data.

Antimicrobial use in animals:

The section on antimicrobial use in companion animals has been reinstated. This uses data from veterinary practices in Scotland participating in the Small Animal Veterinary Surveillance Network (SAVSNET), the University of Liverpool. These data were not available for inclusion in the 2024 report.

Antimicrobial resistance in humans:

Bacteraemia:
In 2025, it was identified that there were a small number of post-mortem blood culture specimens between 2017 and 2025 which were incorrectly included as bacteraemia episodes in previous reports. These have been retrospectively excluded from all human bacteraemia analyses in this report. Additionally, in 2025, it was identified there were a small number of vancomycin resistant *Enterococcus faecium* between 2019-2025 where the species information were previously unavailable. These have now been retrospectively included in analyses in this report. Changes to the case numbers of bacteraemia in this report compared to the previous year's SONAAR report are shown in the Tables 9 and 10 below.

Table 9: Counts of Gram-negative bacteraemia episodes in 2025 SONAAR report compared to the previous year due to revisions

Year	*Acinetobacter* spp.		*Klebsiella pneumoniae*		*Klebsiella oxytoca*		*Pseudomonas aeruginosa*	
	2024 data	2025 data	2024 data	2025 data	2024 data	2025 data	2024 data	2025 data
2017	89	85	819	815	205	204	-	-
2018	-	-	783	781	217	215	-	-
2019	79	75	777	776	214	212	-	-
2020	-	-	-	-	-	-	-	-
2021	56	55	741	739	246	243	-	-
2022	-	-	767	766	190	188	-	-
2023	82	81	-	-	242	241	248	247
2024	-	-	860	857	210	208	-	-

Table 10: Counts of Gram-positive bacteraemia episodes in 2025 SONAAR report compared to the previous year due to revisions

Year	*Enterococcus faecalis*		*Enterococcus faecium*		*Streptococcus pneumoniae*		*Streptococcus pyogenes*	
	2024 data	2025 data	2024 data	2025 data	2024 data	2025 data	2024 data	2025 data
2019	451	442	294	295	-	-	200	199
2020	463	457	290	291	240	239	138	137
2021	515	504	276	279	265	264	-	-
2022	463	459	290	299	-	-	-	-
2023	462	457	335	338	414	412	366	363
2024	504	491	363	367	-	-	233	234

UK AMR NAP Target on estimated drug resistant infections:
Following the identification of a small number of post-mortem blood culture specimens which were incorrectly included as bacteraemia episodes, there has been retrospective revisions made to the calculation of Human health target 1a. These are included in Table 11. The increase in the estimates are largely due to the post-mortem episodes being excluded from the denominator of the estimate calculations.

Table 11: UK AMR NAP human health target on estimated number of drug resistant infections.

Year	Estimated drug resistant infections as per the UK AMR NAP 2024 data	2025 data
2019/20*	678	679
2019	700	700
2020	636	637
2021	612	615
2022	665	675
2023	717	721
2024	772	777

* the estimated drug resistant infections in financial year 2019/20 is used in the calculation for UK AMR NAP human health target 1a baseline target.

Carbapenemase-producing organisms: Information on antimicrobial susceptibility testing data for tobramycin has been removed. Aztreonam-avibactam and cefiderocol in 2025 are now included in the Supplementary Data.
Antimicrobial resistance in *Salmonella*: None.

Antimicrobial resistance in animals:
Antimicrobial resistance in bacterial isolates from veterinary clinical specimens: At the end of 2024 there was a change in the antimicrobial panels used by SRUC to assess resistance for certain bacterial isolates from veterinary clinical specimens. It is envisaged that these changes for 2025 represent the baseline panels going forward for subsequent years.
The following Supplementary Data tables have been also revised, where resistance data for some antimicrobials are available for 2025 but not 2024, and vice versa.

- Data tables found in Supplementary Data Tabs 42-45.

Antimicrobial resistance in *Escherichia coli* isolates from healthy animals:
None

Antimicrobial resistance in the environment: None

Concepts and definitions

Statistical significance: Please note where an increase or decrease is stated in this report this refers to a statistically significant change. Unless stated, statistical significance has been determined by a p-value of less than (<) 0.05. Where no trend is said to have been observed or there was no change between years, this means that there has been no significant increase or decrease. For multiple testing of organism and drug combinations, due to the number of tests being done at the same time, a Bonferroni correction has been applied and the p-values adjusted to reflect the number of tests undertaken for each organism. In order to keep the amount of multiple testing to a minimum, only organism and drug combinations with enough cases each year have been tested.

Confidence Intervals: Confidence intervals (95% CI) for proportions were calculated to indicate robustness of the proportions presented. Where a 95% CI has been quoted or displayed in a figure as an error bar around a percentage, the method used is the Wilson Score. For *E. coli* isolates from raw meat and raw pet food, the method used to calculate 95% CI is the Clopper-Pearson Exact test.

Rounding: Please note that due to rounding, some percentage values presented in graphs may not add up to calculated percentages presented in the text.

Year to Year Comparisons: The current calendar year 2025 was compared to the previous calendar year 2024. Rates and proportions were compared using Poisson regression and binomial regression respectively. This is performed to determine the presence of a significant change to the rate or proportion between two different years A resulting p-value of less than 0.05 (or Bonferroni-adjusted threshold) was deemed statistically significant to determine an increase or decrease relative to the previous year.

For antimicrobial susceptibility testing results where revisions were made to the EUCAST clinical breakpoints during the time period covered within this report, year to year comparisons have not been reported.

Year to year comparisons of antimicrobial susceptibility testing results where the average number of isolates tested each year is less than 25 were not reported.

Long term trends in incidence

Identifying linear and non-linear relationships

ARHAI Scotland reviewed the change in the incidence rate of Gram-negative bacteraemia between 2017 and 2025, Gram-positive bacteraemia between 2019 and 2025, and Carbapenemase-producing organisms between 2019 and 2025.

Generalised Additive Models (GAMs), flexible statistical models that can detect linear or non-linear relationships in data, were used to assess whether the long-term relationship between year and incidence rates should be modelled as linear or non-linear. Relationships were assessed visually and evidence of the non-linearity of the relationship was supported when the effective degrees of freedom (edf) of the GAM were greater than 1.

Analysing trends

Once the nature of the relationships were determined, segmented negative binomial generalised linear models (GLMs) were fitted to analyse linear trends in more detail.

For Gram-negative bacteraemia (2017-2025) one or two prespecified change points (i.e changes associated with the COVID-19 pandemic) were incorporated. This method allowed any changes in both the intercept (i.e. the level of incidence rate at the prespecified change points) and changes in the slope (i.e. increasing or decreasing trends over time) to be estimated. The most appropriate model for each relationship was selected based on clinical and epidemiological judgement.

Incidence rates of Carbapenemase-producing Enterobacterales (CPE) cases over the past five years were also modelled using Poisson regression. This was performed to determine the presence of a significant upwards or downwards linear trend in the changing incidence rate, and the corresponding rate of change of the best-fit gradient from 2021 to 2025.

Visualising trends

The observed incidence rates have been shown over time using point markers, joined together with a solid unbroken line.

The incidence rates modelled by the negative binomial GAMs are shown as a dashed line, with the associated 95% confidence intervals represented by the surrounding shaded areas.

Where appropriate, change points were applied to the GAM model to aid visualisation. An arrow indicates the direction of the intercept shift between time segments.

Interpreting trends

Trends (i.e. increases or decreases in rate over time) were confirmed when a statistically significant value of $p<0.05$ was calculated by the model.

Where a year-on-year increase or decrease has been reported, this represents a significant linear trend over the identified period.

Where no significant increases or decreases have been detected, these are reported as no observed trend.

When there was no observed trend, but the intercept was higher or lower following a change point, this was described as a difference in the incidence rates between the two time periods.

Long term trends in antimicrobial resistance

Identifying linear and non-linear relationships

Binomial GLMs and GAMs were used to assess the long-term relationship between year (2019 to 2025) and percentage resistance for each organism-antibiotic combination. Relationships were assessed visually and evidence of the non-linearity of the relationship was supported when the effective degrees of freedom (edf) of the GAM were greater than 1.

Analysing trends

For each organism -antibiotic combination, binomial GLMs were used to describe whether there was a statistically significant increasing or decreasing long-term trends across years in the percentage resistance, out of all organisms tested.

Interpreting trends

Trends (i.e. increases or decreases in rate over time) were confirmed when a statistically significant value was calculated, after a Bonferroni adjustment was applied to the p-value.
Where no significant increases or decreases have been detected, these are reported as no observed trend.

Health inequalities:

In this report, data on sex are derived from Community Health Index records. Additionally, the term “women” is used in this report in reference to clinical guidelines.

Scottish Index of Multiple Deprivation (SIMD):
The SIMD is a relative measure of deprivation across 6,976 small areas (called data zones). The SIMD ranks data zones from most deprived (ranked 1) to least deprived (ranked 6,976). The areas have been divided into five quintiles with those in quintile 1 living in the most deprived areas and those in quintile 5 living in the least deprived areas. The SIMD identifies deprived areas, not deprived individuals, and is unadjusted for age and sex. Further details are provided in SIMD 2020.

Urban/Rural six-fold classification:
The Scottish Government Urban Rural Classification is a measure that provides a consistent way of defining urban and rural areas across Scotland which may impact how patients access healthcare. Patients living in remote small towns (UR4) and remote rural areas (UR6) are classified as remote, and patients living in accessible rural areas (UR5) and remote rural areas (UR6) are classified as rural. The percentage of the Scottish population living in each of the 6-fold Urban Rural classification area categories are based on estimates from 2024. Accessible areas are defined as those areas that are within a 30-minute drive time from the centre of a settlement with a population of 10,000 or more. Remote areas have a drive time which is greater than 30 minutes. Further details are provided in Scottish Government Urban Rural Classification 2022.

Antimicrobial use in humans

Prescribing data: details available from Public Health Scotland.

Population estimates: details available from the National Records of Scotland Mid-Year Population Estimates.

Occupied bed days: details available in Public Health Scotland ISD(S)1 data manual.

Defined Daily Doses (DDDs), World Health Organization (WHO): details available from the ATC/DDD Index.

Guidance: UK Access, Watch, Reserve, and Other classification for antibiotics (UK-AWaRe antibiotic classification), UKHSA. Available from UKHSA.

AMU in acute hospitals refers to secondary care AMU data from HMUD from the specified acute hospitals only, as listed in Table 8.

Unless otherwise stated Primary Care figures exclude Dental (GP14) Prescription Forms.
Dental prescribing is excluded from primary care prescribing metrics as it represents a distinct area of clinical practice with different prescribing patterns and stewardship objectives. In the 2025 report, dental prescribing data are reported separately under the national indicators for antibiotic use.

Primary care prescribing information sourced from PIS is linked to patient Community Health Index (CHI) numbers. Using patient CHI numbers, it is possible to analyse demographic information on patients prescribed antibiotics such as age and sex. Patients resident in Scotland have a unique CHI number meaning it is also possible to count numbers of distinct patients receiving a particular treatment or investigate prescribing patterns for particular individuals over time.
Demographic data derived from patient CHI number (female sex) are used as a proxy measurement for progress against the Scottish national indicators for antibiotic use target 2. From 2009 onwards, the majority of prescriptions can be linked to a valid CHI number, however CHI capture rates can vary by drug, geographical area, or prescriber type, with GPs having better capture rates than other prescriber types. When interpreting trends in patient counts over time, the underlying CHI capture rate must also be considered. In the Supplementary Data for this report, where patient level data is used, the relevant CHI capture rates are also presented. It is difficult to identify with certainty how much impact increasing CHI completeness has on the number of patients identified, but the evidence available suggests that the impact is small when considering the scale of change in CHI completeness presented in this report and this should not generally be significantly affecting trends in patient counts.
Parenteral antibiotic DDDs are used to monitor use of intravenous antibiotics.

UK AMR National Action Plan Targets for antimicrobial use:

The UK AMR NAP 2024 to 2029 contains outcomes and commitments that will make progress towards the 20-year vision, which is for AMR to be contained, controlled and mitigated. The targets are to:

- Reduce total antibiotic use in human populations by 5% from the 2019 to 2020 financial year baseline by 2029
- Achieve 70% of total use of antibiotics from the Access category (new UK category) across the human healthcare system by 2029.

Further information available in the UK AMR NAP 2024 to 2029.

Antimicrobial resistance in humans

Case definitions:

Total numbers, incidence rates and AST results for bacteraemia and bacteriuria were calculated using the following case definitions:

A new case of bacteraemia is a patient from whom an organism has been isolated from the patient's blood, and who has not previously had the same organism isolated from blood within a 14-day period (i.e. 14 days from date last positive sample obtained). The most complete then most resistant AST result during each episode is reported for each case.

A new case of *E. coli* bacteriuria (referred to in this report as 'episodes of *E. coli* isolated from urine') is a patient from whom *E. coli* has been isolated from the patient's urine, and who has not previously had the same organism isolated from urine within a 30-day period (i.e. 30 days from date last positive sample obtained). The most complete then most resistant AST result during each episode is reported for each case.

Isolate(s) refers to the organism isolated from each case of bacteraemia or bacteriuria.

With the exception of *E. coli* bacteraemia (ECB) and *S. aureus* bacteraemia (SAB), all human bacteraemia data are based only on positive blood results extracted from ECOSS and are not validated cases.
E. coli bacteraemia and *S. aureus* bacteraemia data use validated data collected as part of mandatory surveillance programme as detailed in the Protocol for National Enhanced Surveillance of Bacteraemia and the ARHAI Annual Report 2025.

Please note –*Klebsiella* spp. bacteraemia episodes are described at the genus level for UK AMR NAP human health target 1b. This uses a definition as per the Protocol for National Enhanced Surveillance of Bacteraemia. *Klebsiella* spp. bacteraemia data use validated data collected as part of a voluntary surveillance programme.

Please note that bacteriuria (bacteria present in urine) is used as a proxy for urinary tract infection (UTI) and not all cases reported will be validated cases of UTI. As part of the NHS Pharmacy First Scotland service, community pharmacists have the ability to supply via patient group direction trimethoprim or nitrofurantoin for uncomplicated UTIs in non-pregnant females aged 16-65 until August 2022, after which the eligible age range extended to 16 years and over). This service has been available in all community pharmacies since August 2020 and is likely to have had an impact on the number of urine samples being referred to laboratories since females with uncomplicated UTIs can be treated by pharmacists without attending their General Practitioner.

A new case of carbapenemase-producing organism (CPO) is a patient from whom an organism-carbapenemase enzyme gene combination has been identified from a clinical or screening specimen, and who has not previously had the same organism- carbapenemase enzyme gene combination identified within the same calendar year.

Population estimates: details available from the National Records of Scotland Mid-Year Population Estimates.

Incidence rates were described as bacteraemia or bacteriuria episode rate per 100,000 population.

Resistance is defined as isolates reported as resistant (R).

For calculations of incidence rates and percentage resistance see Value and Unit of Measurement.

Antimicrobial resistance burden:

The burden of antimicrobial resistant bacteraemia is estimated for select priority organisms of public health importance including: *E. coli*, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Acinetobacter* species, *Pseudomonas aeruginosa*, *Enterococcus faecium*, *Enterococcus faecalis*, *S. aureus* and *Streptococcus pneumoniae* bacteraemia. The percentage of organisms resistant (R) to at least one key antibiotic is reported (see Table 12: Key organism and antibiotic combinations for burden of antimicrobial resistant bacteraemia). Antimicrobial susceptibility results are not available for all bacteraemia cases, therefore the percentage resistance from available results is applied to the total number of bacteraemia cases to provide the estimated number of antimicrobial resistant bacteraemias.

Table 12: Key organism and antibiotic combinations for burden of antimicrobial resistant bacteraemia.

Organism(s)	Key antibiotic(s) resistant
Escherichia coli, *Klebsiella pneumoniae* and *Klebsiella oxytoca*	Carbapenems (imipenem, meropenem or ertapenem). Third generation cephalosporins (ceftazidime, cefotaxime or ceftriaxone), and not resistant to carbapenems. Gentamicin, and not resistant to carbapenems or third generation cephalosporins. Ciprofloxacin, and not resistant to carbapenems or third generation cephalosporins or gentamicin.
Acinetobacter species	Carbapenems (imipenem or meropenem) Aminoglycosides (amikacin or gentamicin) and ciprofloxacin, but not resistant to carbapenems.
Pseudomonas aeruginosa	Carbapenems (imipenem or meropenem). Three or more antimicrobial groups from: aminoglycosides (amikacin or gentamicin), piperacillin-tazobactam (Tazocin), ciprofloxacin or ceftazidime, where NOT resistant to carbapenems.
Enterococcus faecium and *Enterococcus faecalis*	Vancomycin.
Staphylococcus aureus	Meticillin.
Streptococcus pneumoniae	Penicillin and macrolides (erythromycin, azithromycin, clarithromycin). Penicillin, but not resistant to macrolides.

UK AMR NAP Targets on estimated drug resistant infections and Gram-negative bloodstream infections

The UK AMR NAP 2024 to 2029 ‘Confronting Antimicrobial Resistance’ includes human health target 1a which aims by 2029, to prevent any increase in a specified set of drug resistant infections in humans from the 2019 to 2020 financial year baseline and human health target 1b which aims by 2029, to prevent any increase in Gram-negative bloodstream infections (GN-BSI) in humans from the 2019 to 2020 financial year baseline.

Target 1a uses a specified list of organism-antibiotic combinations, which is a subset of the list used to estimate AMR burden in Scotland. The target uses an adapted methodology developed by Cassini and others (see Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. The Lancet Infectious Diseases, 19, 1, pages 56 to 66 (2018)) for a UK specific measure of AMR burden.

To report on Scotland's progress against target 1a, the estimated number of antimicrobial resistant bacteraemia in Scotland is calculated. This is calculated using the percentage resistance per organism-antibiotic combination (number of antimicrobial resistant blood isolates in Scotland, out of all blood isolates tested per organism) applied to the total incidence of bacteraemia per organism, for each calendar year. This was summed (for calendar year) across the organism-antibiotic combinations listed in Table 13 below.

Table 13: Key organisms and antibiotics for burden of antimicrobial resistant infections as measured in the UK AMR NAP 2024 to 2029 human health target 1a.

Organism(s)	Key antibiotic(s) resistant
Escherichia coli and *Klebsiella pneumoniae*	• Carbapenems (imipenem, meropenem or ertapenem). • Third generation cephalosporins (ceftazidime, cefotaxime or ceftriaxone), and not resistant to carbapenems.
Acinetobacter species	• Carbapenems (imipenem or meropenem). • Aminoglycosides (amikacin or gentamicin) and ciprofloxacin, but not resistant to carbapenems.
Pseudomonas aeruginosa	• Carbapenems (imipenem or meropenem). • Three or more antimicrobial groups from: aminoglycosides (amikacin or gentamicin), piperacillin-tazobactam (Tazocin), ciprofloxacin or ceftazidime, where NOT resistant to carbapenems.
Enterococcus faecium and *Enterococcus faecalis*	• Vancomycin
Staphylococcus aureus	• Meticillin.
Streptococcus pneumoniae	• Penicillin and macrolides (erythromycin, azithromycin, clarithromycin). • Penicillin, but not resistant to macrolides.

Target 1b uses a specified list of Gram-negative bloodstream infections, consisting of *E. coli*, *Klebsiella* spp. and *P. aeruginosa* bacteraemia. Please see the Protocol for National Enhanced Surveillance of Bacteraemia for full details of case definitions. To report on Scotland's progress against target 1b, the total number of Gram-negative bloodstream infections by organism in Scotland is calculated and summed for each calendar year.

Scottish supplementary HCAI ECB targets:
Total ECB cases by year are presented by healthcare associated origin of infection. Please see the ECB section of the Protocol for National Enhanced Surveillance of Bacteraemia surveillance protocol for full details of the healthcare associated infection (HCAI) definition.

Carbapenemase-producing organisms:

The term carbapenemase-producing organism (CPO) encompasses all acquired carbapenemase-producing Gram-negative bacteria and is not limited to carbapenemase-producing Enterobacterales.

Further detail on case definitions can be accessed from the Toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae in Scottish acute settings.

Unusual AMR phenotypes:

In 2018, the SONAAR team at ARHAI Scotland introduced an electronic process to run a twice weekly interrogation of ECOSS to identify unusual AMR phenotypes and contact the submitting laboratory requesting confirmation of reported resistance. All alerts are assessed by ARHAI Scotland and if of potential public health concern are drawn to the attention of the wider public health community for appropriate action.

Definitions of an unusual AMR phenotype can be accessed from EUCAST.

Appendix 13 of the National Infection Prevention & Control Manual contains a mandatory alert micro-organism/ condition list. Local monitoring ensures that microbiology clinicians, infection prevention and control teams, health protection teams and antimicrobial management teams, as appropriate, are aware of each identified case as per local protocols.

The identification of an alert is dependent on laboratories actively performing AST and submitting results to ECOSS. This may result in underreporting, or no reporting, of a particular organism-antibiotic combination if there is limited or no testing performed.

An instance of an unusual AMR phenotype was considered as the first isolate of one specific organism per patient per calendar year. Where more than one organism was present in a sample, deduplication was carried out separately for each organism.

Antimicrobial resistance in *Salmonella*

Salmonella is notifiable in humans and a reportable animal pathogen in the UK. All medical diagnostic laboratories are required to forward suspect isolates from humans to the SAMRS SMiRL which is responsible for testing antimicrobial susceptibility in *Salmonella*. All veterinary diagnostic laboratories isolating *Salmonella* from livestock species and dogs are also required to send suspect isolates for confirmation and typing to the SAMRS SMiRL.

For animal data, most of the isolates received by the reference laboratory have been collected by passive surveillance as the result of clinical suspicion in the animals sampled. The submission of animal samples is affected by the willingness of an animal keeper to pay the costs of laboratory testing to inform treatment, in addition to the clinical presentation in the affected animal(s). There is, therefore, likely to be year-on-year variation in the relative proportions of different animal species from which clinical samples are submitted and, also, variation in the proportions of different serotypes identified.

Interpretation of *Salmonella* resistance to individual antibiotics is further complicated by the fact that in some subtypes there are well-recognised genetic elements encoding resistance to multiple agents. Thus, the occurrence of resistance to individual antibiotics is not always independent and the apparent prevalence of resistance to different agents can be strongly influenced by the abundance of *Salmonella* sub-types in the sample set for each reporting period. Therefore, caution is required, within the scope presented in this report, when considering year-on-year comparison on proportions resistant in all *Salmonella* isolates from animals.

Whole genome sequencing (WGS) was introduced into routine use in the SAMRS SMiRL in late 2017 for the identification and characterisation of *Salmonella* isolates.

Following a review of published reports and an extensive validation confirming the high degree of correlation observed between the two approaches, the *in silico* prediction of AMR phenotype from WGS was introduced in January 2020. The predictive tools in use allow the identification of many individual AMR genes. The availability of data from isolates from different source populations (humans and animals) which have undergone the same processing by the same laboratory offers an opportunity to monitor the trends in resistance and identify epidemiological links in these populations.

Antimicrobial resistance in animals

The aim is to report, from a variety of sources, the presence of resistance within certain bacterial populations within certain animal populations. Currently in the SONAAR report this includes resistance detected in clinical specimens from veterinary livestock and resistance detected in *E. coli* in gut contents collected from clinically healthy livestock species in abattoirs, immediately post slaughter.

Antimicrobial resistance in veterinary clinical isolates from livestock:

Surveillance of AMR present in clinical veterinary specimens received by veterinary laboratories allows resistance to be monitored across a wider range of bacterial specimens, while the emphasis is on resistance to antimicrobials used, and at breakpoints of relevance for, veterinary therapeutic use. Currently, in this report, this covers specimens received from livestock species but not companion animals or horses. Typically, bacteria that are commonly isolated from veterinary clinical specimens are *Staphylococcus*, *Streptococcus*, *Pasteurellaceae* and *E. coli*.

Staphylococcus species are common commensal organisms that can act as important opportunist pathogens of humans and other animals.

Streptococcus species can be important pathogens or opportunist colonisers of livestock species, with the potential to cause severe disease of the skin, respiratory tract, body cavities, wounds and urinary tract. Some species, including *Streptococcus agalactiae*, *Streptococcus dysgalactiae*, and *Streptococcus suis*, are also recognised in human infections.

Pasteurellaceae are important causes of potentially severe respiratory and soft tissue infections in livestock animals. In livestock animals, high levels of morbidity and mortality can result with consequential significant economic losses.

While *E. coli* are a normal commensal species in animals, some strains can cause intestinal and extraintestinal disease.

Data presented here represent the percentage of resistant isolates over all tested isolates. These data represent a non-random sample of veterinary practices and veterinary isolates, based on voluntary submission of data to SRUC.
The data from veterinary clinical isolates are subject to a number of important biases. Unlike the clinical samples in humans in Scotland, the samples are tested on a ‘charged for’ basis to inform private veterinary treatment of diseased animals. There is a cost to the animal keeper that affects the submission of samples to these services. In addition, the primary purpose of screening for AMR is to inform veterinary treatment and they are tested against a panel of antimicrobials relevant for that purpose at, where they exist, species-relevant clinical breakpoints, using disc diffusion with breakpoints from EUCAST, CLSIVet or Comité de l’antibiogramme de la Société Française de Microbiologie RECOMMANDATIONS VÉTÉRINAIRES. Interpretation of these data in terms of their relevance to public health is challenging beyond the notion of evidence of impact of a selection pressure existing in another compartment of the ecosystem that humans share closely with animals.

Antimicrobial resistance in *Escherichia coli* isolates from healthy livestock:

E. coli bacteria are a major constituent of the normal faecal flora of humans and warm-blooded animals. The collection of gut contents from healthy food-producing animals at point of slaughter allows the prevalence of resistance to antimicrobials of importance in human health to be monitored in *E. coli* that are present in these host populations. Within a One Health perspective, this helps us to understand more about changes in resistance carried within the different *E.coli* subpopulations by host species.
Data presented here represent the percentage of resistant isolates over all tested isolates. These isolates are from healthy livestock animals and are tested against a panel of antimicrobials, and at breakpoints, relevant to human clinical isolates. The percentage of multi drug resistant isolates, defined as isolates resistant to three or more antimicrobial classes, is also presented.

Breakpoints for AST in *E. coli* isolates from healthy livestock are provided by SRUC and are aligned with EUCAST breakpoints, except tetracycline which uses the Clinical and Laboratory Standards Institute (CLSI) breakpoint value. EUCAST breakpoints are applied to healthy livestock isolates to enable relevant comparisons of resistance with isolates from humans, to human relevant antibiotics. Changes to breakpoints over time have been applied retrospectively to healthy livestock isolates to allow year-on-year comparisons.

Antimicrobial resistance in the environment: N/A

Relevance and key uses of the statistics

Making information publicly available. The report is intended to support planning, prioritisation and evaluation of initiatives to optimise antimicrobial use and to minimise AMR.

Accuracy

Antimicrobial use in humans

Antibiotic use in primary care: A subset of these data are routinely validated by Practitioner Services on a monthly basis.

Healthcare associated denominator, total occupied bed days: Sum of OBDs for all hospitals in numerator, standardised methodology used.

Antimicrobial resistance in humans

Bacteraemia: Data supplied by United Kingdom Accreditation Service (UKAS) accredited laboratories using standardised testing methodologies.
Bacteraemia case data are extracted from the ECOSS database and are therefore subject to the limitations of this national dataset.
Furthermore, ECOSS has been subject to various quality improvement exercises to ensure more accurate case capture. ECOSS can also be susceptible to data lag, which may impact the accuracy of the data for a short time, it is rare that this would impact reporting within this publication as data are 10 months in arrears.
For each case of ECB and SAB, data are extracted from ECOSS and validated by local Infection Prevention and Control (IPC) teams. Teams are asked to ensure that each case meets the national epidemiological surveillance definitions outlined in the respective protocols.

UK AMR NAP Target on estimated drug resistant infections:
Human health target 1a: The calculation of estimated antimicrobial resistant bacteraemia uses data supplied UKAS accredited laboratories using standardised testing methodologies. The number of antimicrobial resistant blood isolates in Scotland, out of all blood isolates tested per organism, is then applied as a percentage of total incidence of bacteraemia per organism. This was summed across the specified list of organism-antibiotic combinations listed in the UK AMR NAP 2024 to 2029.

Health inequalities: Please see data source for any relevant information relating to SIMD and Scottish Government Urban/Rural Classification.

Urinary tract infections caused by *Escherichia coli*: Data supplied by UKAS accredited laboratories using standardised testing methodologies. Case data are extracted from the ECOSS database from 2023 to 2025 and are therefore subject to the limitations of this national dataset. Data before 2023 are not included, due to historical issues identified in the Public Health Scotland ECOSS quality improvement project ECOSS Roll-out Implementation Programme (EDRIP), which highlighted some inconsistent mapping and reporting of urine sample results in ECOSS.

Carbapenemase-producing organisms: Data supplied by UKAS accredited laboratories using standardised testing methodologies.

Unusual AMR phenotypes: Data supplied by UKAS accredited laboratories using standardised testing methodologies. Data are extracted from the ECOSS database and are therefore subject to the limitations of this national dataset. Unusual AMR phenotypes are referred in accordance with the Reference laboratory referral guide for confirmation of unusual organism/ antimicrobial resistance profiles guidance. ECOSS do not currently receive direct electronic data transfer from UK reference laboratories outside Scotland. However, unusual AMR phenotypes are confirmed with the sending laboratory, including confirmation of reference laboratory results, where applicable.

Antimicrobial resistance in *Salmonella*
Data supplied by UKAS accredited laboratories using standardised testing methodologies via SAMRS SMiRL.

Antimicrobial resistance in animals
Data supplied by UKAS accredited laboratories using standardised testing methodologies. SRUC (ISO:17025), SAMRS SMiRL, Glasgow (ISO:15189).

Antimicrobial resistance in the environment: N/A

Food Standards Scotland: All isolates sequenced by single independent external contractor and subjected to quality control checks to ensure genetic information is above accuracy thresholds, both from sequencing and for input into Enterobase. All AMR data has been validated and quality checked by statisticians at Food Standards Scotland.

Completeness

Antimicrobial use in humans:

AMU data are extracted from the PIS and HMUD databases and do not include prescriptions dispensed through private healthcare organisations. Medicines supplied through hospital managed homecare services are included within secondary care antimicrobial use metrics.
The AMU primary care queries use the BNF classification to identify and extract relevant drugs and presentations intended for systemic use. The vast majority of presentations are mapped to a BNF classification, but a small number may not be. In addition, preparations of medicines which do not have a classification in the BNF may subsequently be assigned one. This means that there may be small differences in the data extracted over time.
Secondary Care data are complete for all NHS Health Boards.

Health inequalities: Due to missing data related to CHI capture or postcodes, or instances where postcodes could not be linked to SIMD, 12.1% of cases were excluded from calculations for health inequalities.

Antimicrobial resistance in humans

Bacteraemia: All data for the reporting period have been included in the analysis as reported to ECOSS.

UK AMR NAP Targets on estimated drug resistant infections and Gram-negative bloodstream infections: All data for the reporting period have been included in the analysis.

Health inequalities: Due to missing data or instances where postcodes could not be linked to SIMD or Urban/Rural Classification, the following percentage of cases were excluded from calculations for health inequalities –

- 11 (1.3%) of AMR bacteraemia cases;
- 87 (1.9%) of *E. coli* bacteraemia cases;
- 13 (1.4%) of *K. pneumoniae* bacteraemia cases;
- 2 (0.8%) of *K. oxytoca* bacteraemia cases;
- 4 (1.4%) of *P. aeruginosa* bacteraemia cases;
- 1 (1.4%) of *Acinetobacter spp.* bacteraemia cases;
- 13 (4.7%) of CPO cases.

Urinary tract infections caused by Escherichia coli: All available data within ECOSS have been included in the analysis. In 2022, it was identified that urine isolates from one NHS board had not been reported in ECOSS. Following investigation, isolates were reported from September 2022 onwards. Due to inconsistencies in data collection over time it has not been possible to report and compare incidence and AMR trends in urine isolates.

Carbapenemase-producing organisms: All data for the reporting period have been included in the analysis. For AST data in Supplementary Data table 34.4, routine testing for cefiderocol commenced in March 2025 at the SAMRS SMiRL.

Unusual AMR phenotypes: All laboratory confirmed isolates have been included in the analysis.

Antimicrobial resistance in *Salmonella*

All laboratory confirmed isolates have been included in the analysis.

Antimicrobial resistance in animals

Antimicrobial resistance in veterinary clinical isolates from livestock: These data represent a non-random sample of veterinary practices and veterinary isolates, based on voluntary submission of data to SRUC. Isolates are derived from samples and animal carcases submitted throughout the year to Disease Surveillance Centres operated by SRUC across Scotland.

Antimicrobial resistance in Escherichia coli isolates from healthy livestock: Samples are collected on a monthly basis from a convenience sample of livestock animals of four species (cattle, sheep, pigs and poultry) presenting at abattoirs in Scotland and submitted to SRUC.

Antimicrobial resistance in the environment: N/A
Food Standards Scotland: This case study represents a small sample set of *E. coli* from raw meat and raw pet food taken from different retail sources across Scotland and over several years.

Comparability

Antimicrobial use in humans

The numerator for antibiotic use is based on WHO DDDs, consistent with other national and international surveillance methodologies. Scottish national indicators of antibiotic use reported within SONAAR use the same inclusion and exclusion criteria as the UK AMR NAP 2024 to 2029 targets, supporting comparability across the UK.

AMU data are extracted from live databases (PIS and HMUD). As these databases are updated routinely, historic data may be subject to retrospective amendment and figures may differ from those reported previously.

Occupied bed days (OBDs) are derived using a standardised methodology allowing comparability across years.

ARHAI Scotland contributes to the UK AMU data submission to WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) and the Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR) network. Use of internationally recognised surveillance methodologies supports comparison of Scottish data with data reported by other participating countries.

Antimicrobial resistance in humans

Bacteraemia:
Further details on bacteraemia in Scotland are available in the ARHAI Scotland Annual Report. The UKHSA report rates annually and per quarter (methods and definitions may differ).

Further details on reports on AMR surveillance across the UK (UKHSA, PHW) are reported below, as well as from the European Centre for Disease Prevention and Control (ECDC). ARHAI Scotland submit data annually to the UK AMR NAP ambitions (UKHSA), and to the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) initiative, and ARHAI Scotland are part of the Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR) Network. The comparability of data across these reports should be interpreted with caution, due to differences in inclusion criteria, data definitions and availability.

UKHSA annual English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) report. https://www.gov.uk/ government/publications/ english-surveillance-programme-antimicrobial- utilisation-and-resistance-espaur-report.

Public Health Wales annual Antimicrobial resistance in blood cultures in Wales report.

ECDC report on Antimicrobial resistance surveillance in Europe.

AMR data from ARHAI Scotland, UKHSA and the Public Health Agency, Northern Ireland (PHA) are included in the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) dashboard and the latest WHO Global antibiotic resistance surveillance report 2025

AMR data from ARHAI Scotland, PHA and UKHSA are included in the WHO CAESAR AMR Dashboard.

Escherichia coli and *Staphylococcus aureus* bacteraemia epidemiological data are published quarterly by ARHAI Scotland and annually within the ARHAI Scotland Annual Report.

Urinary tract infections caused by *Escherichia coli*:

UKHSA annual English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) report.

Carbapenemase-producing organisms:

UKHSA collection on carbapenem resistance.
ECDC Surveillance Atlas of Infectious Diseases.

Unusual AMR phenotypes: N/A

Antimicrobial resistance in Salmonella: N/A

Antimicrobial resistance in animals

Antimicrobial resistance in veterinary clinical isolates from livestock: The primary purpose of screening for AMR is to inform veterinary treatment and isolates from animals are tested against a panel of antimicrobials relevant for that purpose at, where they exist, species-relevant clinical breakpoints.

Antimicrobial resistance in *Escherichia coli* isolates from healthy livestock: Breakpoints for AST in *E. coli* isolates from healthy livestock are provided by SRUC and are aligned with EUCAST breakpoints, except tetracycline which uses the CLSI breakpoint value. EUCAST breakpoints are applied to healthy livestock isolates to enable relevant comparisons of resistance with isolates from humans, to human relevant antibiotics.

Changes to breakpoints over time have been applied retrospectively to healthy livestock isolates to allow year-on-year comparisons.

Antimicrobial resistance in the environment: N/A

Food Standards Scotland: As this is a standalone case study, this data is not comparable to other datasets.

Accessibility

It is the policy of PSD Scotland to make its website and products accessible according to published guidelines.

Coherence and clarity

SAB and ECB data are reported according to their respective surveillance protocols.
Tables are accessible via the Supplementary Data on our website.

Data related to human AMR in this report are available via Scottish Health and Social Care Open Data.

Value type and unit of measurement

Antimicrobial use in humans:

Defined daily doses (DDDs)

DDDs per 1,000 population per day (DDDs/1,000/day).

Percentage of antibiotics use belonging to Access group (%) = count of antibiotic items belonging to Access group / total count of antibiotic items.

Count of items and number of items per 1,000 inhabitants per day (items/1,000/day).

Percentage of antibiotic courses of three-day duration (%) = count of antibiotic items of three-day duration / total count of antibiotic items.

Percentage of amoxicillin or doxycycline courses of five-day duration (%) = count of antibiotic items of five-day duration / total count of antibiotic items.

Percentage of trimethoprim or nitrofurantoin courses of three-day duration prescribed to females aged 16 years and over (%) = count of three-day trimethoprim or nitrofurantoin items / total trimethoprim and nitrofurantoin items prescribed to females aged 16 years and over.

Combined percentage of co-amoxiclav and ciprofloxacin courses prescribed in primary care (%) = count of antibiotic items / total count of antibiotic items in primary care.

Percentage of co-amoxiclav or ciprofloxacin courses prescribed in primary care (%) = count of antibiotic items / total count of antibiotic items in primary care.

DDDs per 1,000 inhabitants per day by age group and sex.

Percentage of total DDDs prescribed by area deprivation group.

Percentage of primary care items by prescriber form type (%) = count of antibiotic items by prescriber form type in primary / total count of antibiotic items in primary care.

DDDs per 1,000 occupied bed days (DDDs/1,000 occupied bed days).

Rate of antibiotics given intravenously = count of DDDs for IV antibiotics per 1,000 population per day (IV antibiotic DDDs /1,000 occupied bed days in acute hospitals).

DDDs per 1,000 population (DDDs/1,000).

Percentage of total antibiotic prescribing represented by phenoxymethylpenicillin (%) in dental care.

Antimicrobial resistance in humans

Bacteraemia:

Count of cases and incidence rates (per 100,000 population).

Incidence rates were calculated as follows:

Bacteraemia or bacteriuria episode rate per 100,000 population = (Number of cases per year / mid- year Scottish population) x 100,000

Percentage resistance:

Percentage resistant (%) = count of resistant isolates for organism-antibiotic combination divided by the total number of isolates tested for organism-antibiotic combination multiplied by 100.

AMR Burden:
Estimated count of antimicrobial resistant bacteraemia are calculated based on the percentage of resistant bacteraemia (%) (count of blood isolates resistant for organism-antibiotic combination / total count of blood isolates tested for organism-antibiotic combination), which is then applied to the total incidence of bacteraemia per organism. This was summed across the specified list of organism-antibiotic combinations listed in the SONAAR report.

UK AMR NAP Targets on estimated drug resistant infections and Gram-negative bloodstream infections
Human health target 1a:
Estimated count of antimicrobial resistant bacteraemia are calculated based on the percentage of resistant bacteraemia (%) (count of blood isolates resistant for organism-antibiotic combination / total count of blood isolates tested for organism-antibiotic combination), which is then applied to the total incidence of bacteraemia per organism. This was summed across the specified list of organism-antibiotic combinations listed in the UK AMR NAP 2024 to 2029.

Human health target 1b:
Count of cases individually and summed across the specified list of GN-BSI listed in the UK AMR NAP.

Scottish supplementary HCAI ECB targets:

Count of cases.

Urinary tract infections caused by *Escherichia coli*:

Count of cases.

Percentage of resistant urine isolates (%) = count of urine isolates resistant for organism-antibiotic combination / total count of urine isolates tested for organism-antibiotic combination.

Carbapenemase-producing organisms:

Count of cases and incidence rate (per 100,000 population). Count of cases by enzyme type and organism.

Percentage of cases by organism (%) = count of cases by organism / total count of cases.

Percentage of CPE cases by carbapenemase enzyme gene (%) = count of cases by organism / total count of CPE cases.

Percentage of Carbapenemase-producing Non-fermenter cases by carbapenemase enzyme gene (%) = count of cases by organism / total count of Carbapenemase-producing Non-fermenter cases.

Unusual AMR phenotypes:

Count of confirmed AMR unusual phenotype instances, and count of confirmed unusual AMR phenotype instances per organism-antibiotic combination.

Health inequalities:

Percentage (%) for age and sex = count of cases in age-sex subgroup / total number of cases *100.

Incidence rates (per 100,000 age-specific population) within age groups under 15 years, 15 to 64 years, and 65 years and over for AMR bacteraemia

Incidence rates (per 100,000 age- specific population) within age groups under 65 years, and 65 years and over for CPO.

Percentage (%) for SIMD quintiles = count of cases in SIMD quintile / total number of cases where SIMD quintiles assigned * 100. Those with missing postcodes or where postcodes could not be linked were excluded from the total.

Incidence rates (per 100,000 SIMD-specific population) by SIMD quintile. Those with missing postcodes or where postcodes could not be linked were excluded from the total.
Percentage (%) for Urban/Rural status 6-fold classification = count of cases in Urban/Rural classification category / total number of cases where Urban/Rural 6-fold classification assigned * 100. Those with missing postcodes or where postcodes could not be linked were excluded from the total.

Antimicrobial resistance in *Salmonella*:

Percentage of inferred phenotypic resistance from WGS by antimicrobial (%) = count of isolates with inferred phenotypic resistance / total count of tested isolates.

Antimicrobial resistance in animals

Antimicrobial resistance in veterinary clinical isolates from livestock:

Count of resistant isolates and count of all isolates tested.

Percentage of resistant isolates (%) = count of resistant isolates / total count of all isolates tested.

Antimicrobial resistance in *Escherichia coli* isolates from healthy livestock:

Count of resistant isolates and count of all isolates tested.

Percentage of resistant isolates (%) = count of resistant isolates / total count of all isolates tested.

Antimicrobial resistance in the environment: N/A

Food Standards Scotland: Proportion of *E. coli* isolates with AMR genes present in their genetic sequence (expressed as a percentage (%))

Proportion of *E. coli* isolates with AMR genes to multiple antibiotic classes present in their genetic sequence (expressed as a percentage (%))

Disclosure

The PHS protocol on Statistical Disclosure Protocol is followed.

Official Statistics Accreditation
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Appendix 3 – Early Access Details

Pre-Release Access

Under terms of the 'Pre-Release Access to Official Statistics (Scotland) Order 2008', PSD Scotland are obliged to publish information on those receiving Pre-Release Access ('Pre-Release Access' refers to statistics in their final form prior to publication). The standard maximum Pre-Release Access is five working days. Shown below are details of those receiving standard Pre-Release Access.

Standard Pre-Release Access

- Scottish Government Department of Health and Social Care (DHSC),
- NHS board Chief Executives,
- NHS board Communication leads.

Appendix 4 – PSD Scotland and Official Statistics

About Public Services Delivery Scotland

ARHAI Scotland were formerly part of NHS National Services Scotland and are now part of Public Services Delivery Scotland. From 1 April 2026, NHS Education for Scotland and NHS National Services Scotland combined to form Public Services Delivery Scotland. Public Services Delivery Scotland works at the very heart of the health service across Scotland, delivering services critical to frontline patient care, supporting efficient and effective operation, and delivering training across NHS Scotland.

About Public Health Scotland

PHS is a knowledge-based and intelligence driven organisation with a critical reliance on data and information to enable it to be an independent voice for the public's health, leading collaboratively and effectively across the Scottish public health system, accountable at local and national levels, and providing leadership and focus for achieving better health and wellbeing outcomes for the population.

Official Statistics

Public Services Delivery Scotland has been created under the Common Services Agency which is already a producer of Official Statistics, so there will be no change to the designation of Official Statistics.

Our statistics comply with the Code of Practice for Statistics in terms of trustworthiness, high quality and public value. This also means that we keep data secure at all stages, through collection, processing, analysis and output production, and adhere to the Office for National Statistics 'Five Safes' of data privacy.

This document has been prepared by Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) team of NHS Scotland Assure, part of Public Services Delivery Scotland, and Public Health Scotland.

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