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Healthcare Associated Infection, Antimicrobial Resistance and Prescribing Programme

Antimicrobial Resistance in Blood Cultures Wales in 2016-2023



Version 1

Issued: 23/04/2024

The Healthcare Associated Infection, Antimicrobial Resistance and Prescribing (HARP) Programme can be accessed via the Public Health Wales website at:

<https://phw.nhs.wales/>

Published by Public Health Wales NHS Trust, No. 2 Capital Quarter, Tyndall Street, Cardiff CF10 4BZ

Published 23 April 2024, Version 1

Acknowledgments

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Reference this document as:

Public Health Wales NHS Trust: Antibacterial Resistance in Blood Cultures in Wales 2023

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Introduction

In 2014, Lord O'Neill was commissioned by the UK Prime Minister to review the global impact of antimicrobial resistance. He estimated that by 2050, 10 million lives a year and a cumulative 100 trillion USD of economic output would be at risk due to the rise of drug resistant infections if no proactive solutions were found now to slow down the rise of drug resistance.

In response to Lord O'Neill's report and recommendations, in January 2019, the UK Government published its 20-year vision for antimicrobial resistance, and its five-year national action plan to tackle antimicrobial resistance. The vision is that stakeholders at local, national, and global levels collectively strengthen policy and practice, improve research and surveillance, and develop effective regulation to contain and control resistance.

Antimicrobial resistance is an increasing problem in Wales and has already led to a small number of difficult to treat infections, leading to failed therapy and potential complications. Treatment for most infections is started empirically before antimicrobial susceptibilities are known. A particular problem with the spread of antimicrobial resistance is that it becomes more difficult to select empirical therapy that will have reliable activity.

The aim of this report from the HARP team at Public Health Wales is to provide surveillance data that can be used to design empirical therapy guidance, and to track antimicrobial resistance trends in Wales.

Methodology

Resistance data

Data Sources

Antimicrobial susceptibility testing data was extracted from the Public Health Wales DataStore system.

Antimicrobial Groups

In 2012/2013 the European Committee on Antimicrobial Susceptibility Testing (EUCAST) methodology for antimicrobial susceptibility testing (AST) was implemented across the laboratories in Wales (https://eucast.org/clinical_breakpoints).

Key Points of Interest

Escherichia coli (the commonest cause of blood stream infections in Wales).

- ❖ In the 2023 All-Wales resistance rates to commonly used antibacterials varied:
 - Resistance to co-amoxiclav was **48.2%**.
 - Resistance to co-trimoxazole was **33.8**.
 - Resistance to fluoroquinolones was **18.2%**.
 - Resistance to piperacillin/tazobactam was **15.9%**.
 - Resistance to third generation cephalosporins was **14.6%**.
 - Resistance to gentamicin was **11.8%**.
- ❖ Carbapenem resistance remains below 1% in Wales.

Staphylococcus aureus

- There was no significant increase in the number of *Staphylococcus aureus* in 2023 compared with 2022.

Klebsiella spp.

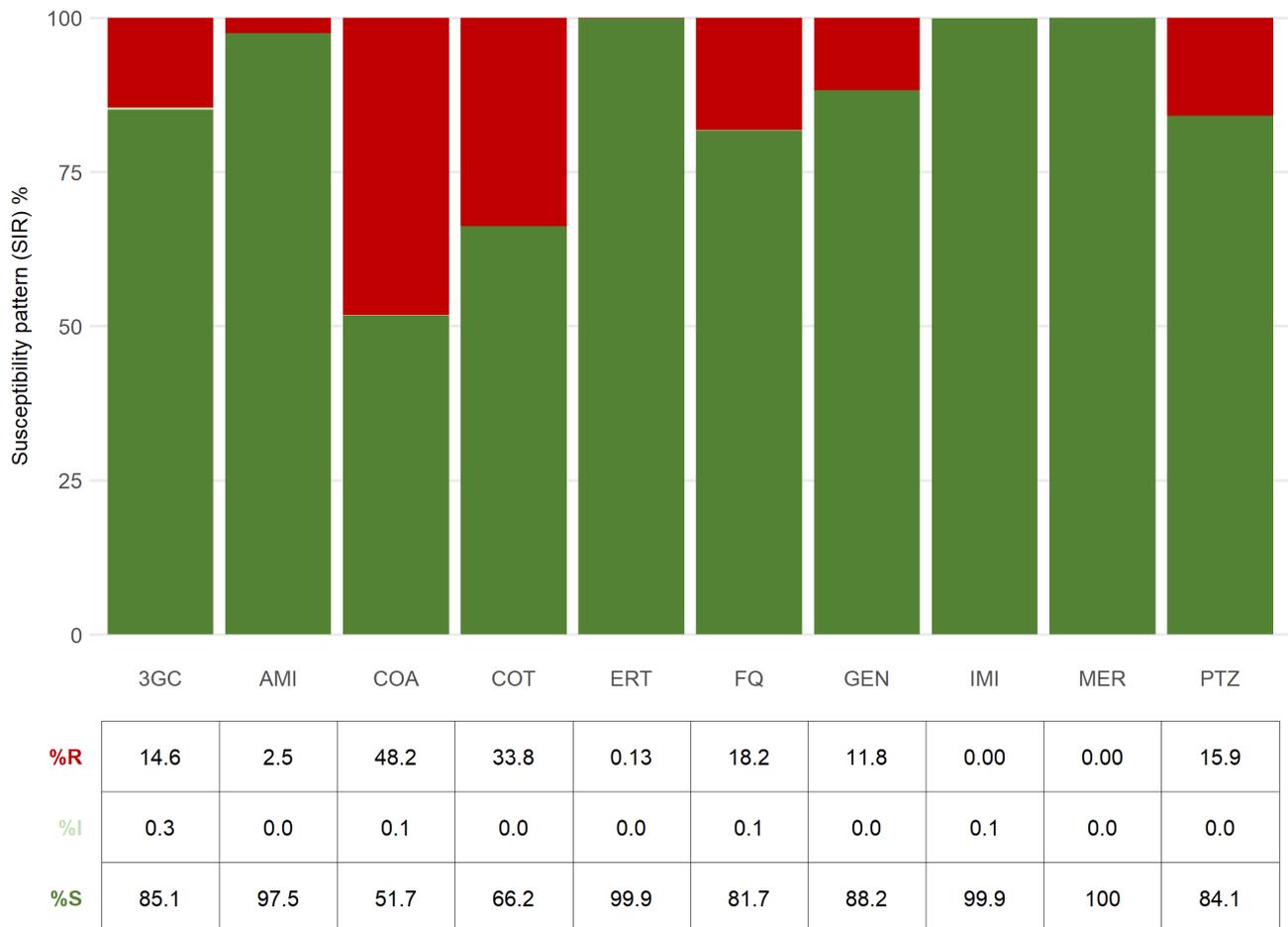
- ❖ In the 2023 All-Wales resistance rates to commonly used antibacterials varied:
 - Resistance to co-amoxiclav was **41.2%**.
 - Resistance to co-trimoxazole was **33.9%**.
 - Resistance to piperacillin/tazobactam was **33.3%**.
 - Resistance to third generation cephalosporins was **27.3%**.
 - Resistance to fluoroquinolones was **23.5%**.
 - Resistance to gentamicin was **18.3%**.
 - Resistance to amikacin was **3.6%**.
 - Resistance to ertapenem was **1.92%**.
 - Resistance to imipenem and meropenem was **0.55%**.

Antimicrobial resistance rates for the most common organisms causing bacteraemia

Escherichia coli (n = 2,352 in 2023)

E. coli is the commonest organism grown from blood cultures in Wales and the UK.

The All-Wales patterns of susceptibility (**S/I/R**) for *E. coli* bacteraemia in 2023 are shown in **Figure 1**. Trends in the resistance rates for the period 2016-2023 are shown in **Figure 2**.

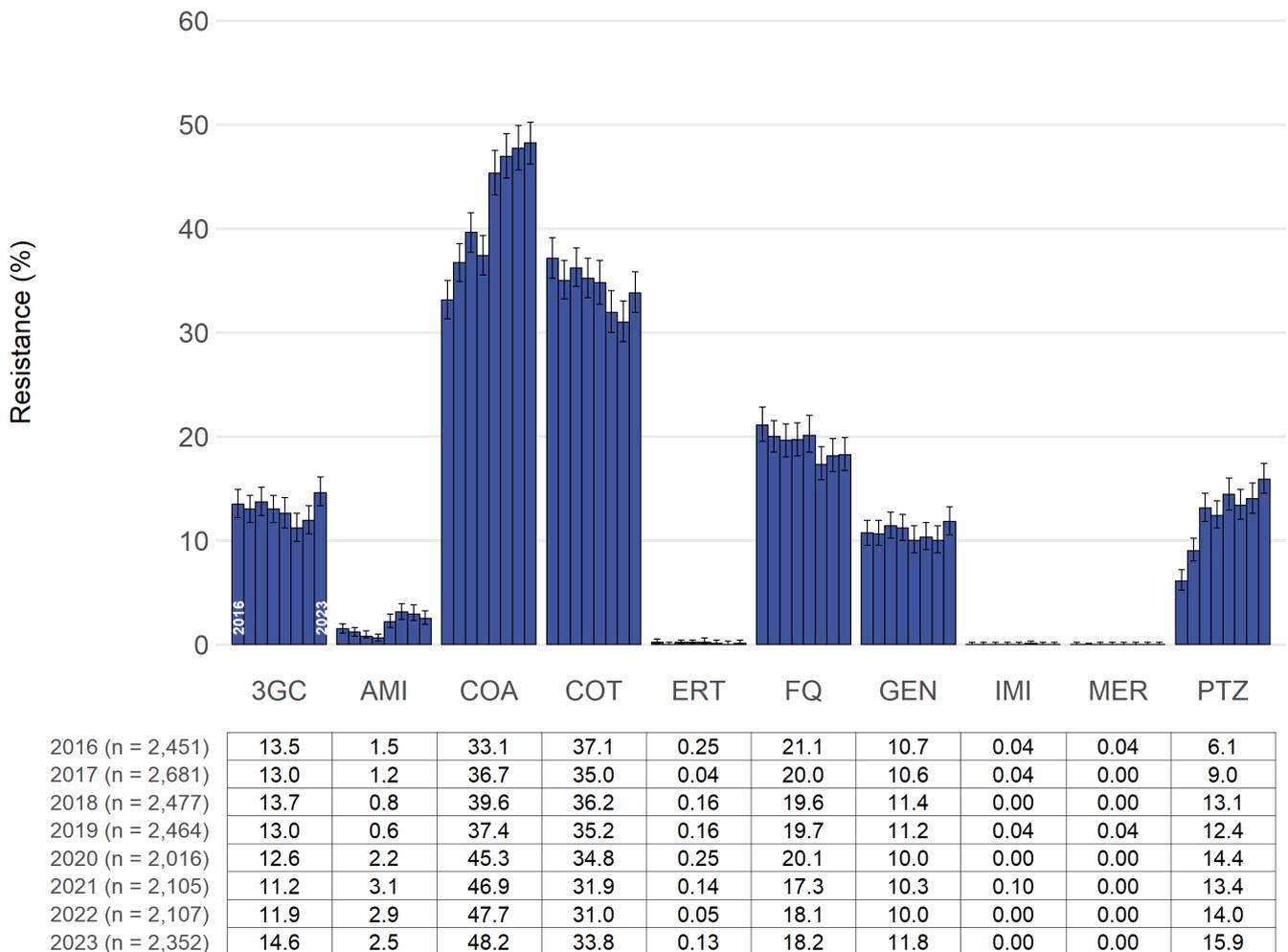


Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefepodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 1: All-Wales susceptibility patterns for *E. coli* bacteraemia in 2023

What the data shows

- Third generation cephalosporin (3GC) resistance was **14.6%** [13.3, 16.1].
- Amikacin (AMI) resistance was **2.5%**. [1.9, 3.2].
- Co-amoxiclav (COA) resistance was **48.2%** [46.2, 50.2].
- Co-trimoxazole (COT) resistance was **33.8%** [31.9, 35.8].
- Fluoroquinolone (FQ) resistance was **18.2%** [16.7, 19.9].
- Gentamicin (GEN) resistance was **11.8%** [10.5, 13.2].
- Piperacillin/tazobactam (PTZ) resistance was **15.9%** [14.5, 17.4].
- Resistance to ertapenem (ERT), imipenem (IMI), and meropenem (MER) was **<0.2%**.



Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

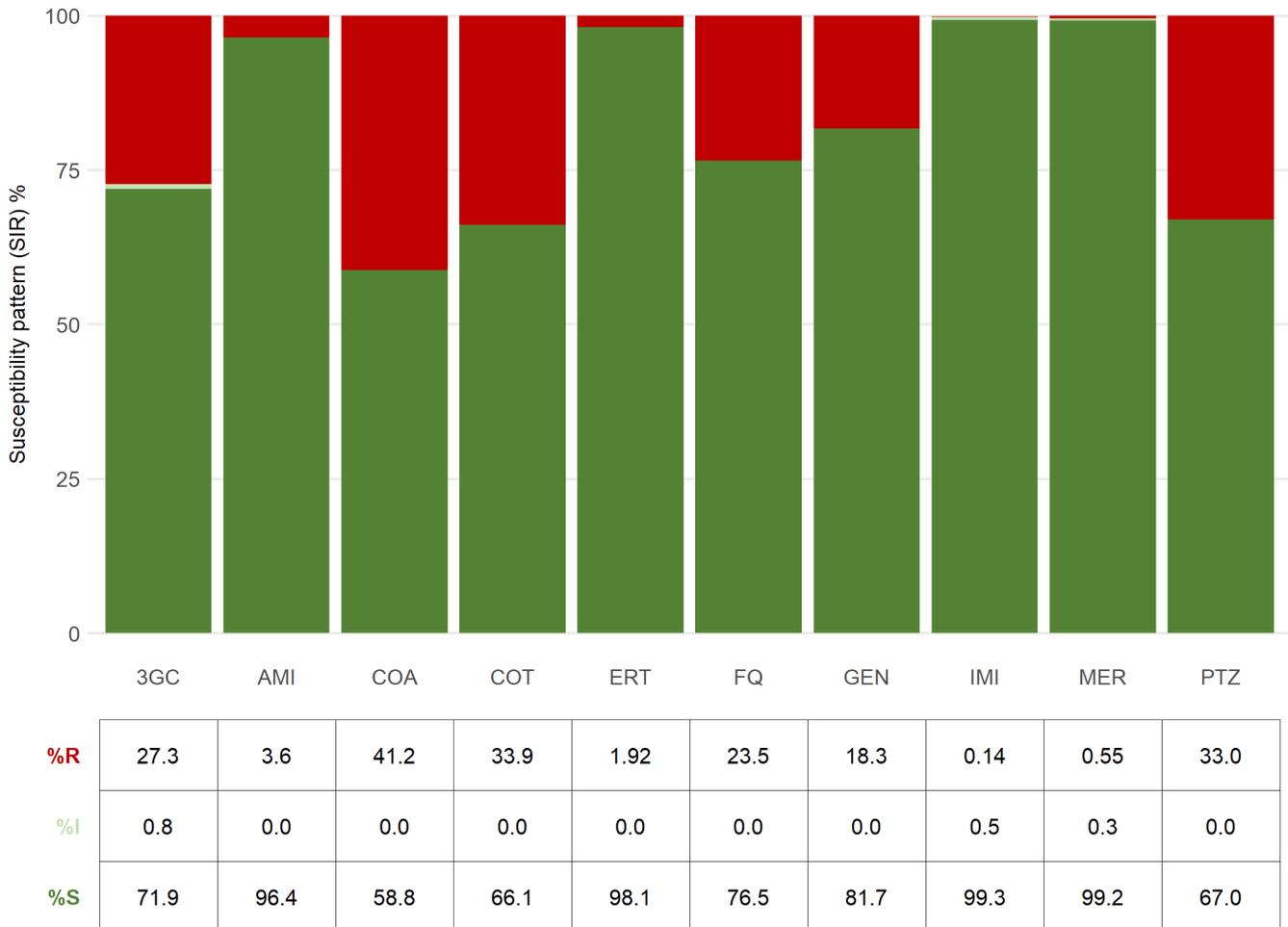
Figure 2: All-Wales antimicrobial resistance rates for *E. coli* bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *E. coli* bacteraemia with AST results from **2,107** isolates in 2022 to **2,352** in 2023 (duplicate cut-off ≤14 days).
- An increase in resistance to third generation cephalosporins to **14.6%** in 2023.
- A decrease in amikacin resistance to **2.5%** in 2023.
- An increase in co-amoxiclav resistance to **48.2%** in 2023.
*See notes on 'Changes in EUCAST methodology' on page 6.
- A general decrease in co-trimoxazole resistance from 2016-2022, with a small increase to **33.8%** in 2023.
- A general decrease in fluoroquinolone resistance, levelling off at **18.2%** in 2023.
- An increase in gentamicin resistance to **11.8%** in 2023.
- An increase in piperacillin/tazobactam resistance to **15.9%** in 2023.
*See notes on 'Changes in EUCAST methodology' on page 6.
- Imipenem and meropenem resistance was undetected in 2023.
- Ertapenem resistance was **<0.2%** in 2023.

Klebsiella spp. (n = 732 in 2023)

Klebsiella spp. are the second commonest group of gram-negative organisms grown from blood cultures. The All-Wales patterns of susceptibility (**S/I/R**) for *Klebsiella* spp. bacteraemia in 2023 are shown in **Figure 3**. Trends in the resistance rates for the period 2016-2023 are shown in **Figure 4**.

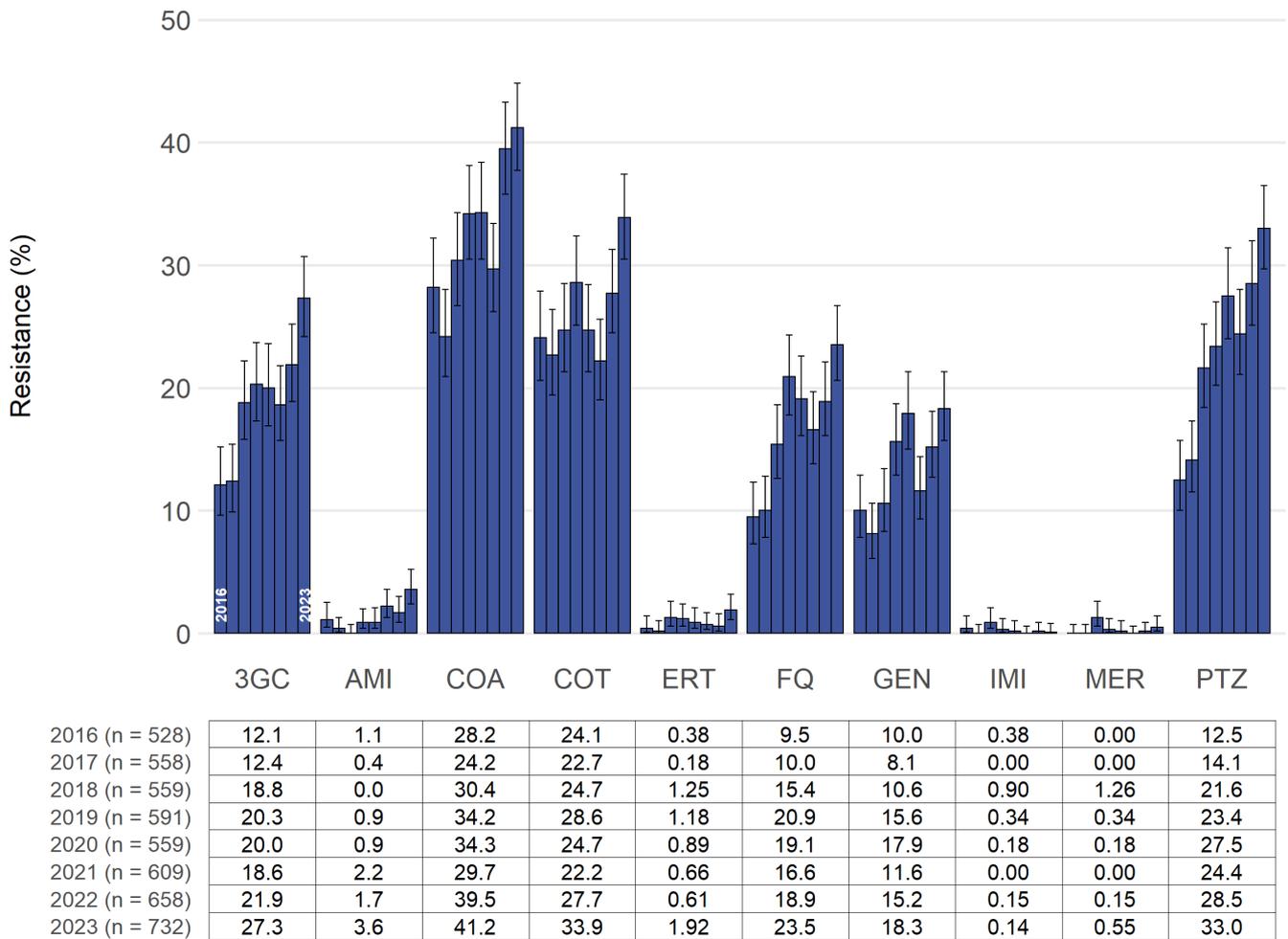


Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 3: All-Wales susceptibility patterns for *Klebsiella* spp. bacteraemia in 2023

What the data shows

- Third generation cephalosporin (3GC) resistance was **27.3%** [24.2, 30.7].
- Amikacin (AMI) resistance was **3.6%** [2.4, 5.2].
- Co-amoxiclav (COA) resistance was **41.2%** [37.7, 44.8].
- Co-trimoxazole (COT) resistance was **33.9%** [30.5, 37.4].
- Fluoroquinolone (FQ) resistance was **23.5%** [20.6, 26.7].
- Gentamicin (GEN) resistance was **18.3%** [15.7, 21.3].
- Piperacillin/tazobactam (PTZ) resistance was **33.0%** [29.7, 36.5].
- Resistance to imipenem (IMI), and meropenem (MER) was **<1.0%**.
- Ertapenem (ERT) resistance was **1.92%** [1.1, 3.2].



Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefepodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

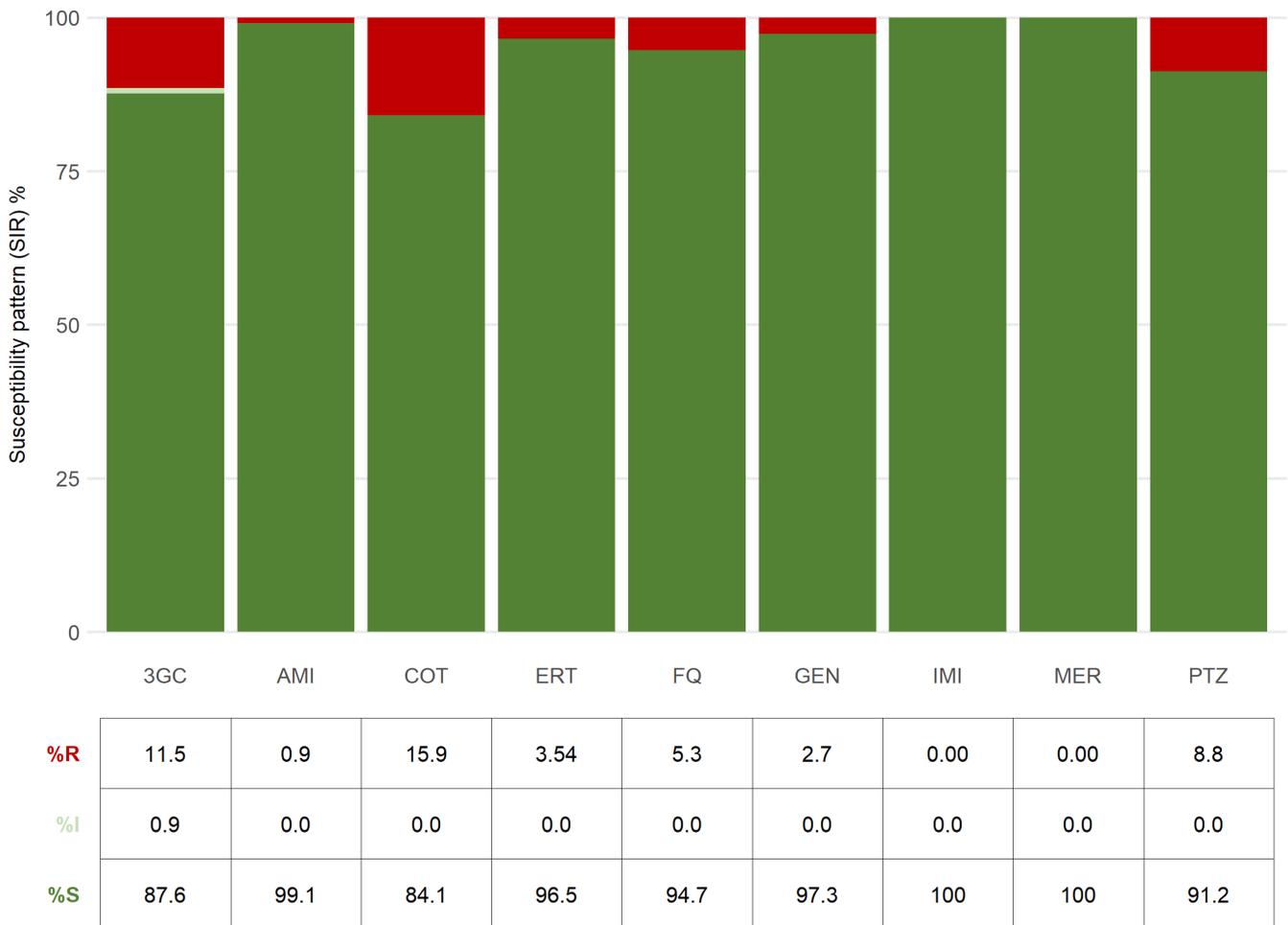
Figure 4: All-Wales antimicrobial resistance rates for *Klebsiella* spp. bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *Klebsiella* spp. bacteraemia with AST results from **658** isolates in 2022 to **732** in 2023 (duplicate cut-off ≤14 days).
- A significant increase in resistance to third generation cephalosporins to **27.3%** in 2023.
- An increase in amikacin resistance to **3.6%** in 2023.
- A significant increase in co-amoxiclav resistance to **41.2%** in 2023.
- A significant increase in co-trimoxazole resistance to **33.9%** in 2023.
- A significant increase in fluoroquinolone resistance to **23.5%** in 2023.
- A significant increase in gentamicin resistance to **18.3%** in 2023.
- A significant increase in piperacillin/tazobactam resistance to **33.0%** in 2023.
- Imipenem and meropenem resistance remain **<1%** across All-Wales.
- There has been an increase in ertapenem resistance to **1.92%** in 2023.

Enterobacter spp. (n = 113 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *Enterobacter* spp. bacteraemia in 2023 are shown in **Figure 5**. Trends in the resistance rates for the period 2016-2023 are shown in **Figure 6**.

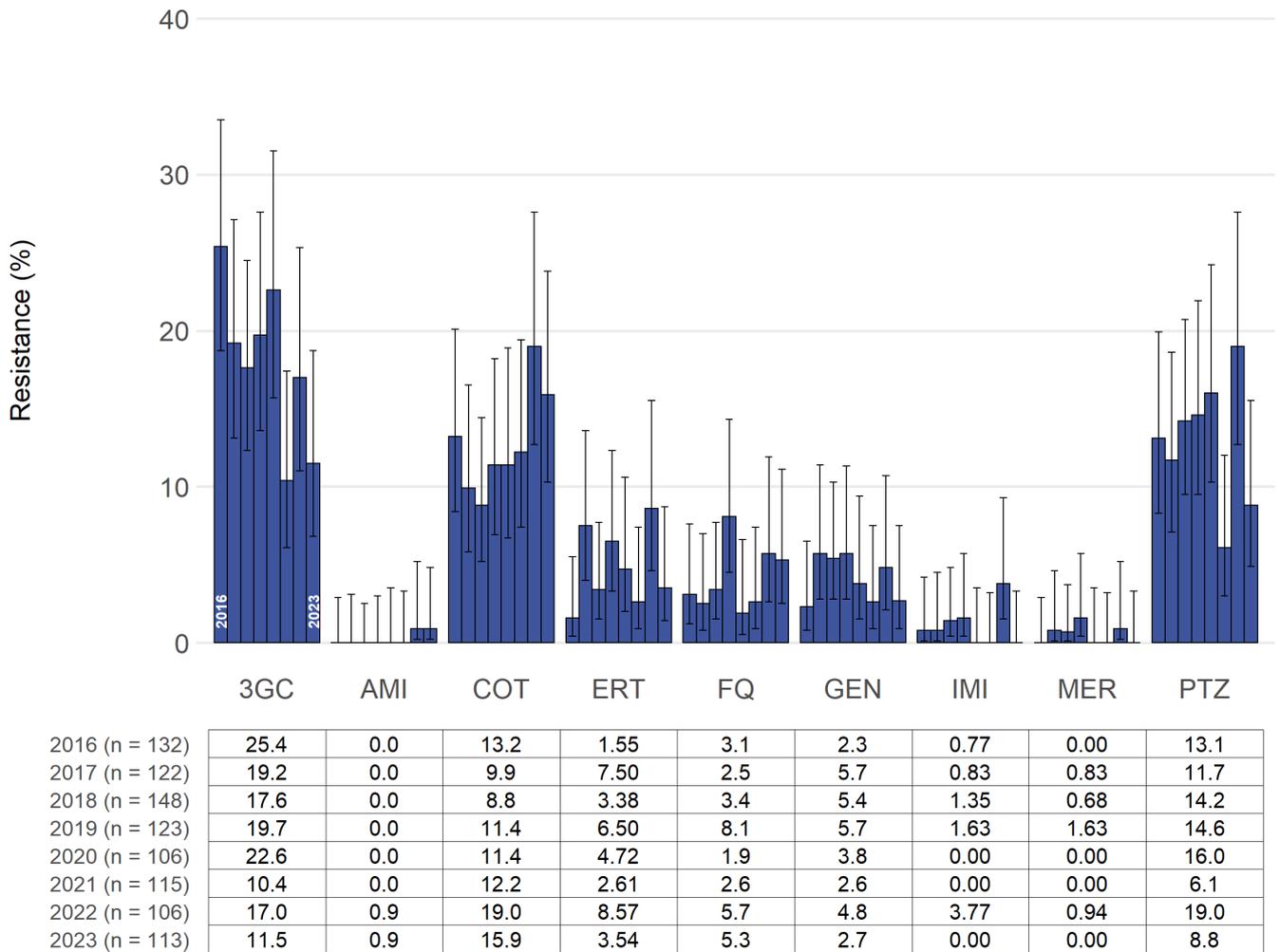


Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 5: All-Wales susceptibility patterns for *Enterobacter* spp. bacteraemia in 2023

What the data shows

- Third generation cephalosporin resistance (3GC) was **11.5%** [6.8, 18.7].
- Amikacin (AMI) resistance was **0.9%** [0.2, 4.8].
- Co-trimoxazole (COT) resistance was **15.9%** [10.3, 23.8].
- Fluoroquinolone (FQ) resistance was **5.3%** [2.5, 11.1].
- Gentamicin (GEN) resistance was **2.7%** [0.9, 7.5].
- Piperacillin/tazobactam (PTZ) resistance was **8.8%** [4.9, 15.5].
- Imipenem (IMI) and meropenem (MER) resistance was undetected.
- Ertapenem (ERT) resistance was **3.54%** [1.40, 8.70].



Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

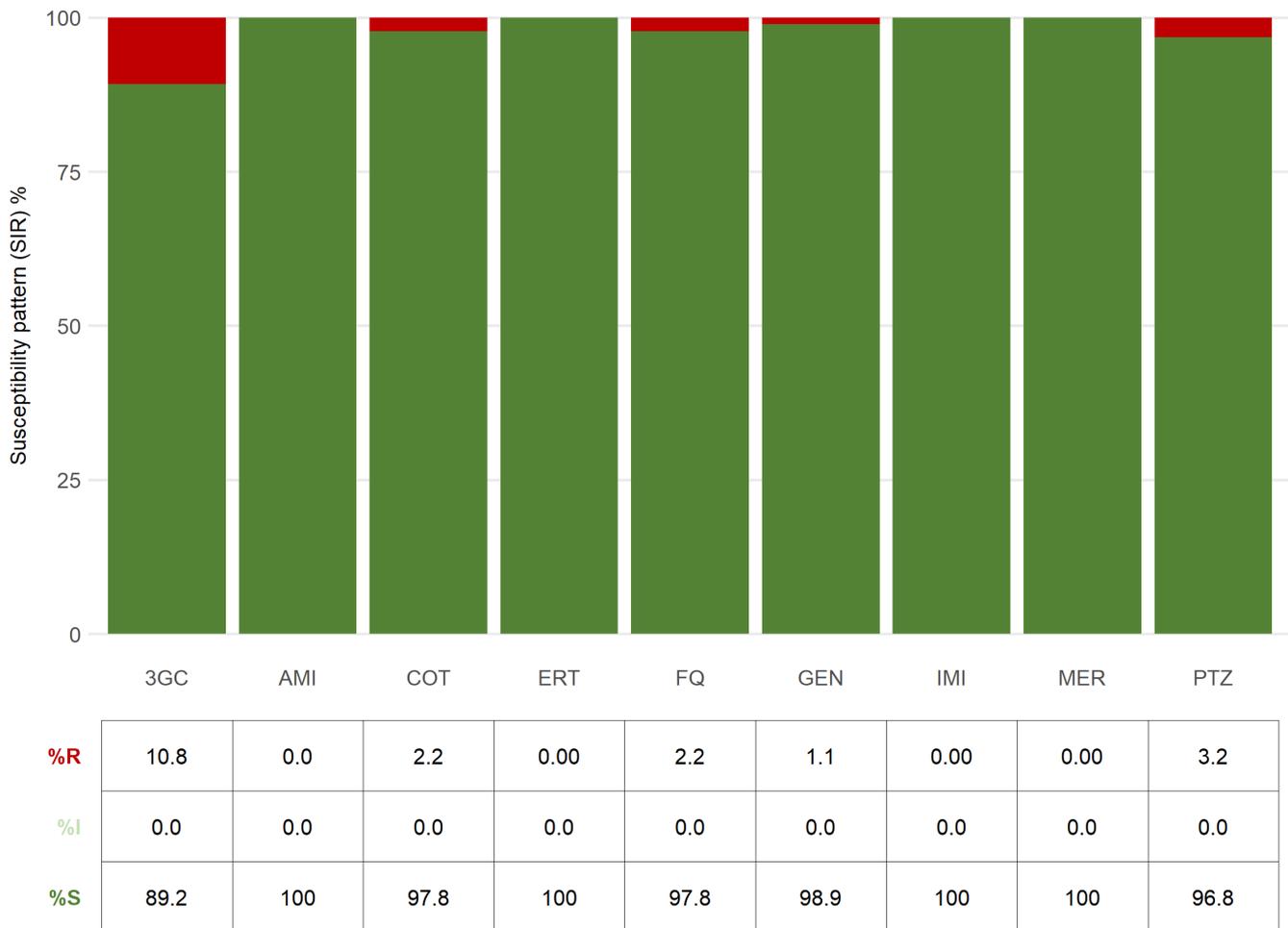
Figure 6: All-Wales antimicrobial resistance rates for *Enterobacter* spp. bacteraemia (2016 - 2023)

What the data shows

- There has been a general decrease in the number of *Enterobacter* spp. bacteraemia with AST results to **113** in 2023 (duplicate cut-off ≤ 14 days). This may be due in part to the reclassification of *Enterobacter aerogenes* to *Klebsiella aerogenes* in 2019.
- Due to small numbers in 2023, the 95% confidence intervals are large, and apart from the notable downward trend in third generation cephalosporin resistance, the other rates are changeable with no clear trend.

Serratia spp. (n = 93 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *Serratia* spp. bacteraemia in 2023 are shown in **Figure 7**. Trends in the resistance rates for the period 2016-2023 are shown in **Figure 8**.

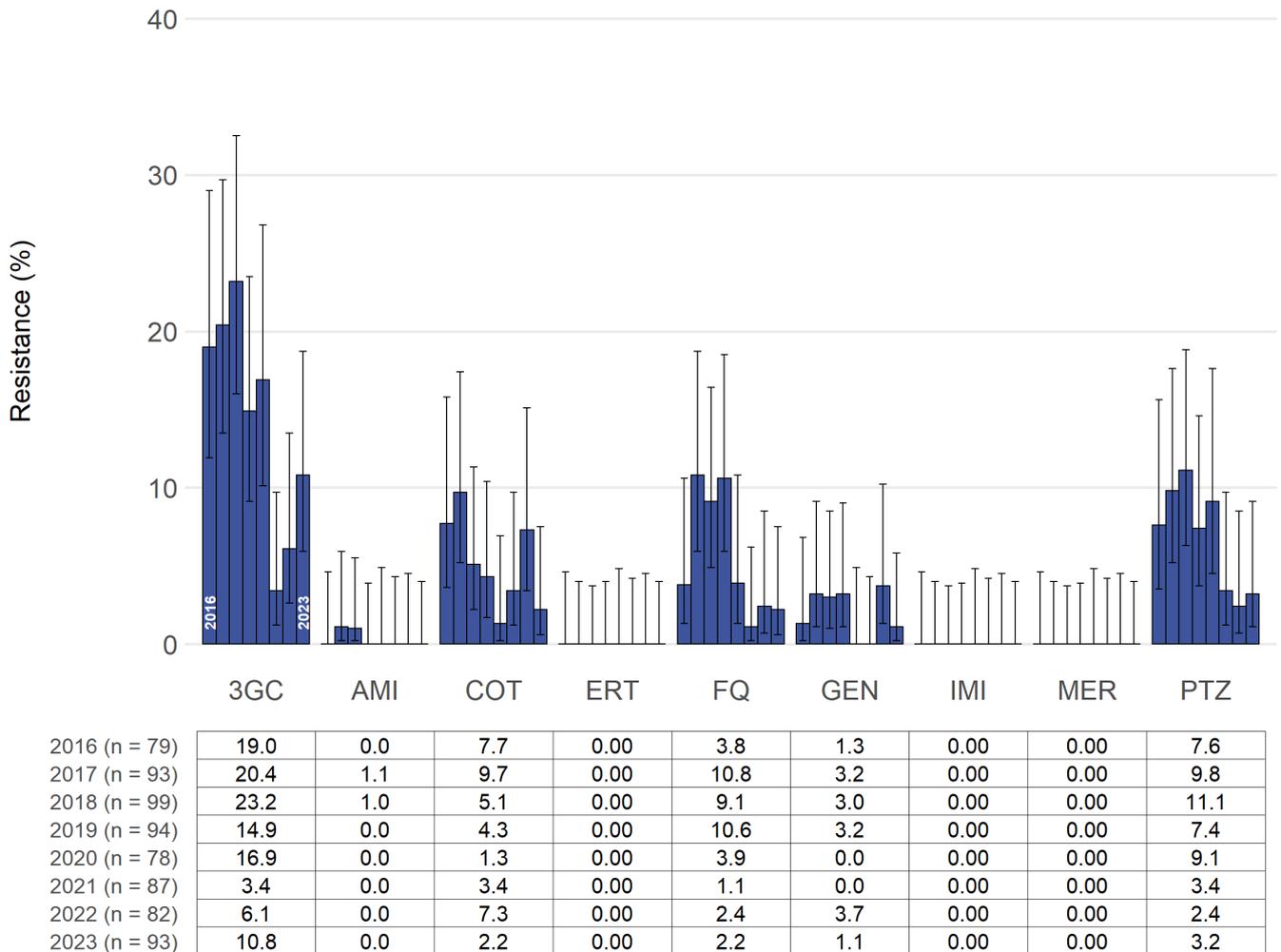


Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 7: All-Wales susceptibility patterns for *Serratia* spp. bacteraemia in 2023

What the data shows

- Third generation cephalosporin (3GC) resistance was **10.8%** [5.9, 18.7].
- Amikacin (AMI) resistance was undetected.
- Co-trimoxazole (COT) resistance was **2.2%** [0.6, 7.5].
- Fluoroquinolone (FQ) resistance was **2.2%** [0.6, 7.5].
- Gentamicin (GEN) resistance was **1.1%** [0.2, 5.8].
- Piperacillin/tazobactam (PTZ) resistance was **3.2%** [1.1, 9.1].
- Carbapenem (ertapenem, imipenem, meropenem) resistance was undetected.



Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

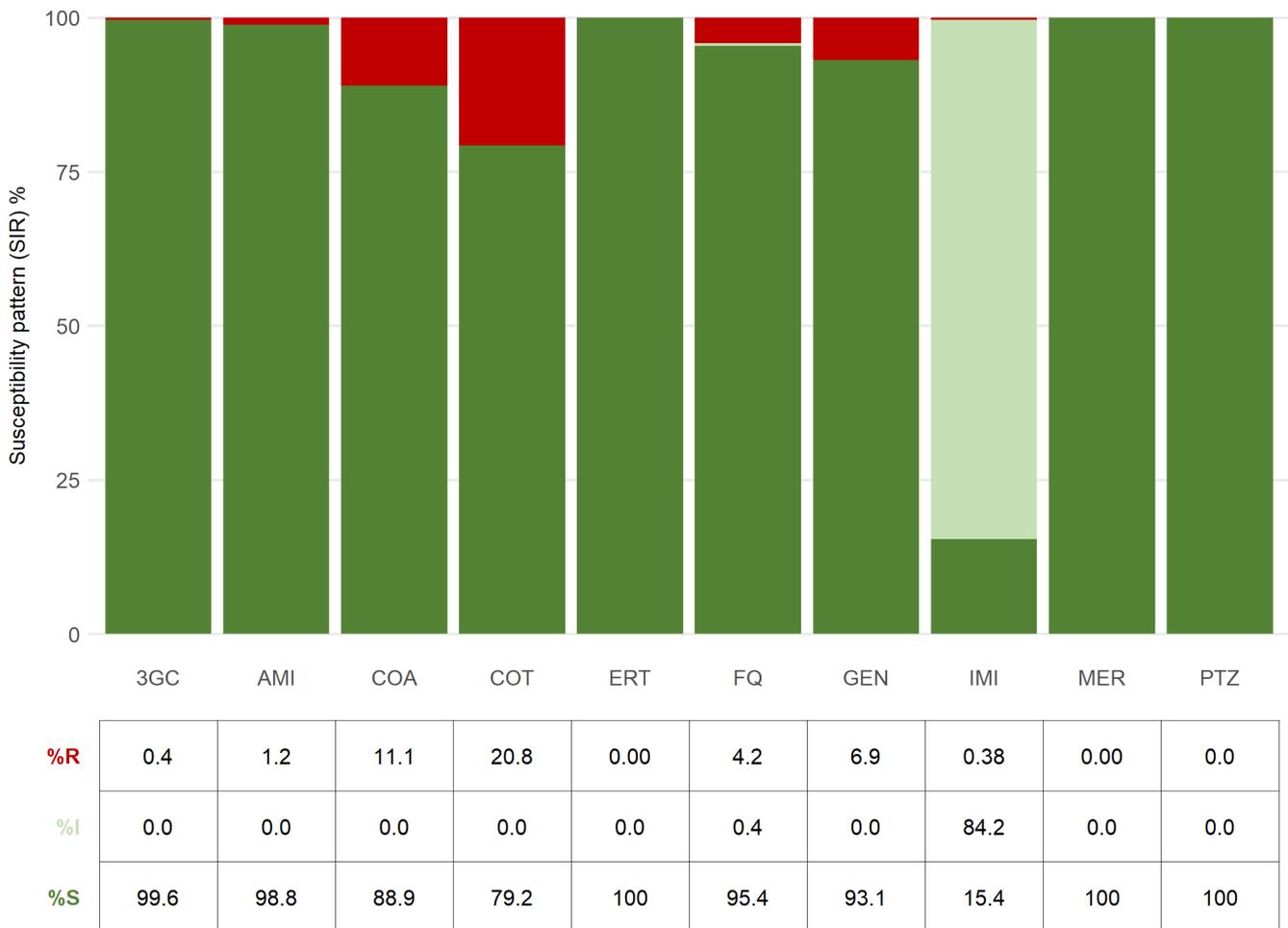
Figure 8: All-Wales antimicrobial resistance rates for *Serratia* spp. bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *Serratia* spp. bacteraemia with AST results from **82** isolates in 2022 and **93** in 2023 (duplicate cut-off ≤14 days).
- A general decrease in third generation cephalosporin resistance (3GC), with an increase in 2023 to **10.8%**.
- Amikacin (AMI) resistance was not reported in 2023.
- A general decrease in co-trimoxazole resistance to **2.2%** in 2023.
- Variability in fluoroquinolone resistance, with resistance at **2.2%** in 2023.
- No significant change in gentamicin resistance, with resistance at **1.1%** in 2023.
- A general decrease in piperacillin/tazobactam resistance to **3.2%** in 2023.
- Carbapenem (ertapenem, imipenem, meropenem) resistance was undetected.

Proteus spp. (n = 261 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *Proteus* spp. bacteraemia in 2023 are shown in **Figure 9**. Trends in the resistance rates for the period 2016-2023 period are shown in **Figure 10**.

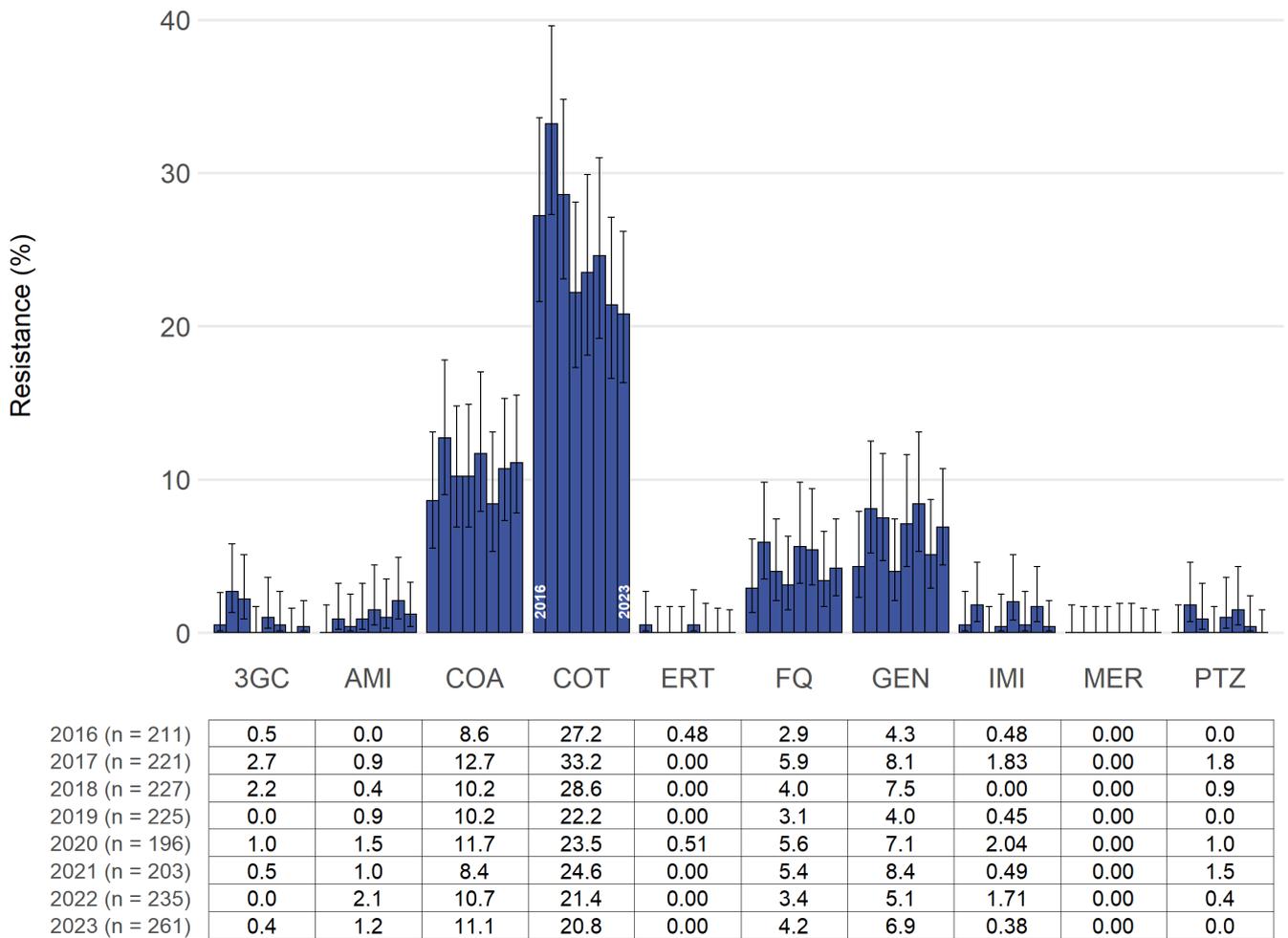


Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 9: All-Wales susceptibility patterns for *Proteus* spp. bacteraemia in 2023

What the data shows

- Third generation cephalosporin (3GC) resistance was **0.4%** [0.1, 2.1].
- Amikacin (AMI) resistance was **1.2%** [0.4, 3.3].
- Co-amoxiclav (COA) resistance was **11.1%** [7.8, 15.5].
- Co-trimoxazole (COT) resistance was **20.8%** [16.3, 26.2].
- Fluoroquinolone (FQ) resistance was **4.2%** [2.4, 7.4].
- Gentamicin (GEN) resistance was **6.9%** [4.4, 10.7].
- Piperacillin/tazobactam (PTZ) resistance was undetected.
- Imipenem (IMI) resistance was **<0.5%**.
- Ertapenem (ERT) and meropenem (MER)) resistance was undetected.



Key: 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, AMI = amikacin, COA = co-amoxiclav, COT = co-trimoxazole, ERT = ertapenem, FQ = ciprofloxacin &/or levofloxacin, or norfloxacin, GEN = gentamicin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

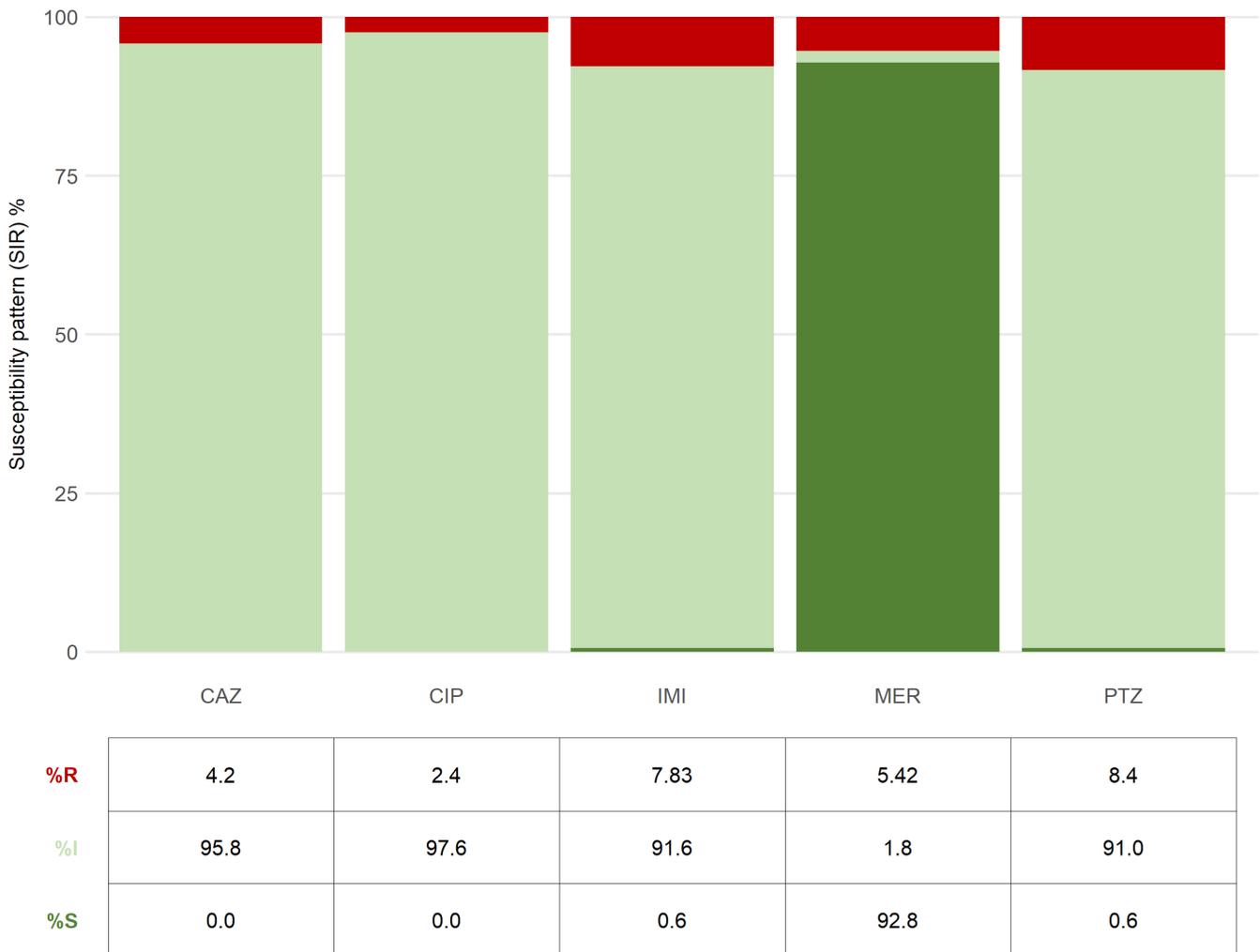
Figure 10: All-Wales antimicrobial resistance rates for *Proteus* spp. bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *Proteus* spp. bacteraemia with AST results from **235** isolates in 2022 to **261** in 2023 (duplicate cut-off ≤14 days).
- Variability in third generation cephalosporin resistance, with resistance at **0.4%** in 2023.
- Variability in amikacin resistance, with resistance at **1.2%** in 2023.
- No significant change in co-amoxiclav resistance, with resistance at **11.1%** in 2023.
- A general decrease in co-trimoxazole resistance, with resistance at **20.8%** in 2023.
- Variability in fluoroquinolone resistance, with resistance at **4.2%** in 2023.
- Variability in gentamicin resistance, with resistance at **6.9%** in 2023.
- Variability in piperacillin/tazobactam resistance, with no resistance detected in 2023.
- Ertapenem and meropenem resistance was undetected.
- Variability in imipenem resistance, with resistance at **0.38%** in 2023.

Pseudomonas aeruginosa (n = 166 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *Ps. aeruginosa* bacteraemia in 2023 are shown in **Figure 11**. Trends in the resistance rates for the period 2016-2023 are shown in **Figure 12**.



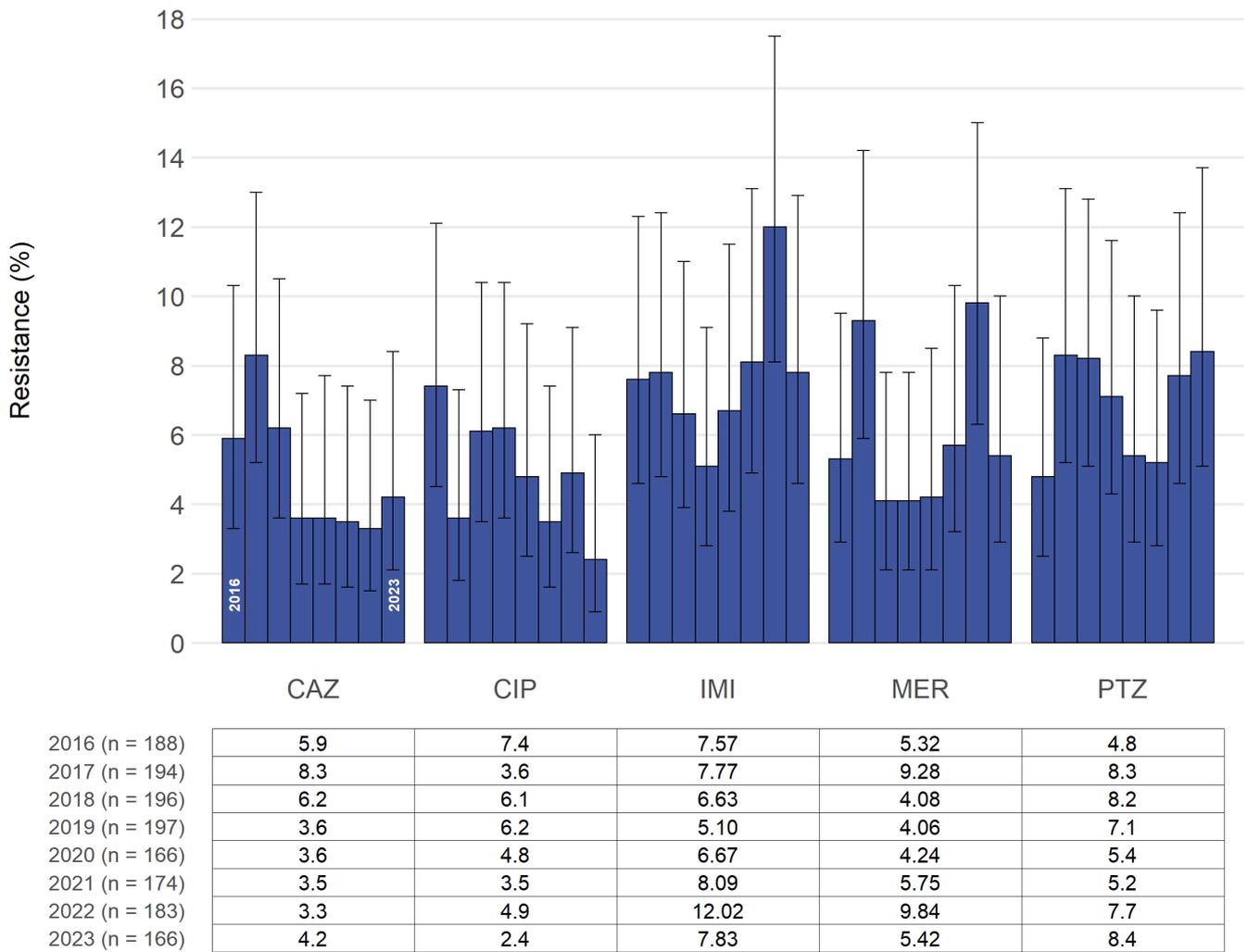
Key: CAZ = ceftazidime, CIP = ciprofloxacin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 11: All-Wales susceptibility patterns for *Ps. aeruginosa* bacteraemia in 2023

What the data shows

- Ceftazidime (CAZ) resistance was **4.2%** [2.1, 8.4].
- Ciprofloxacin (CIP) resistance was **2.4%** [0.9, 6.0].
- Imipenem (IMI) resistance was **7.83%** [4.6, 12.9].
- Meropenem (MER) resistance was **5.42%** [2.9, 10.0].
- Piperacillin/tazobactam (PTZ) resistance was **8.4%** [5.1, 13.7].

In 2021, reporting of AST results for *Pseudomonas aeruginosa* changed in line with EUCAST methodology, with several antibacterial agents reported as susceptible increased exposure (**I**), or resistant (**R**). There is no susceptible (S) category for these antibacterial agents, and any low levels of susceptibility reported are laboratory errors.



Key: CAZ = ceftazidime, CIP = ciprofloxacin, IMI = imipenem, MER = meropenem, PTZ = piperacillin/tazobactam

Figure 12: All-Wales antimicrobial resistance rates for *Ps. aeruginosa* bacteraemia (2016 - 2023)

What the data shows

- There has been a decrease in the number of *Ps. aeruginosa* bacteraemia with AST results from **183** isolates in 2022 to **166** in 2023 (duplicate cut-off ≤14 days).
- A general decrease in ceftazidime resistance, with resistance at **4.2%** in 2023.
- A decrease in ciprofloxacin resistance to **2.4%** in 2023.
- No significant change in imipenem resistance across time, with resistance at **7.83%** in 2023.
- No significant change in meropenem resistance, with resistance at **5.42%** in 2023.
- No significant change in piperacillin/tazobactam resistance, with resistance at **8.4%** in 2023.

Staphylococcus aureus (n = 937 in 2023)

Trends in the All-Wales resistance rates for *S. aureus* bacteraemias in the period 2016-2023 are shown in **Figure 13**.

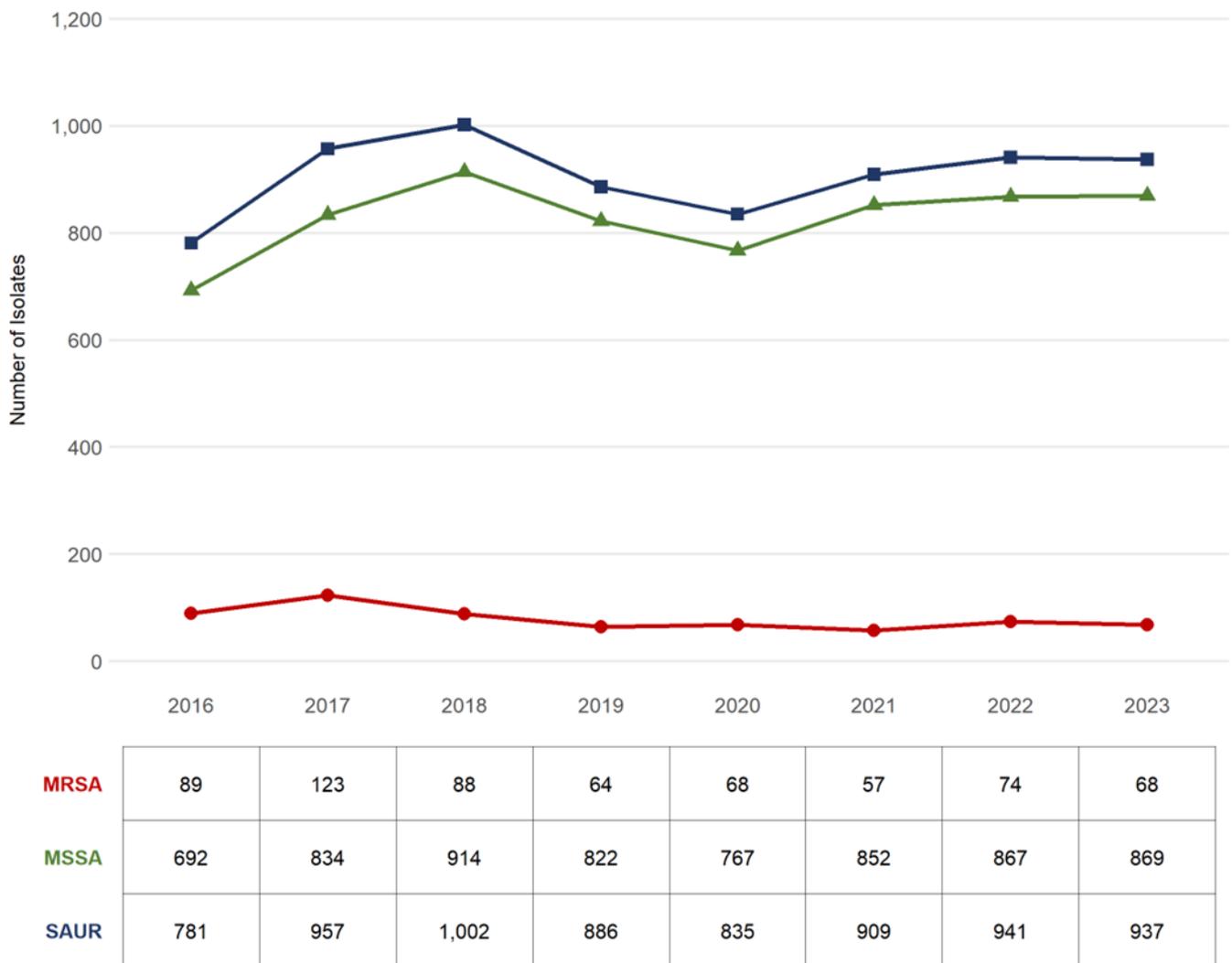


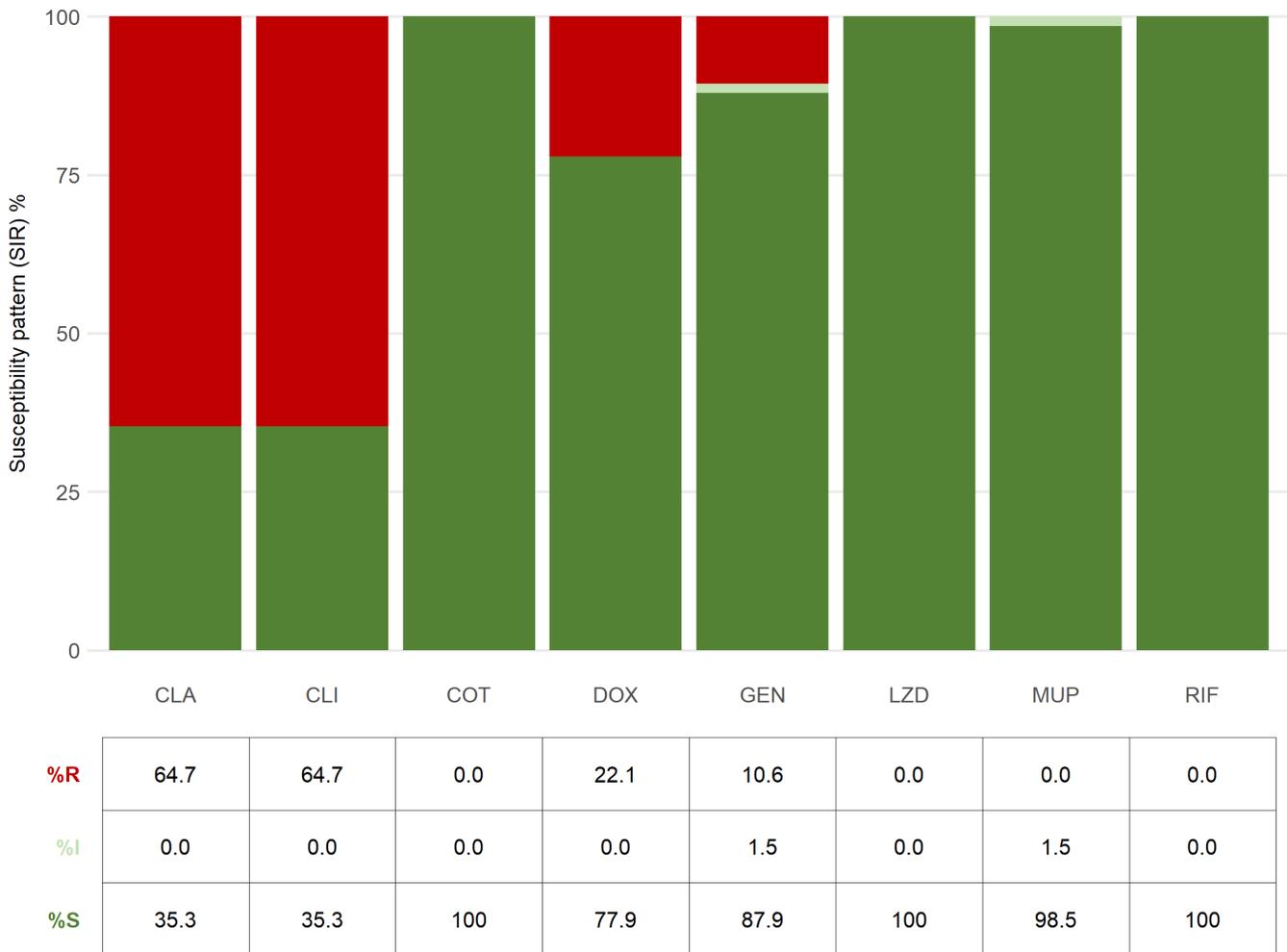
Figure 13: All-Wales *S. aureus* bacteraemia total number of isolates numbers (2016 - 2023)

What the data shows

- There has been no significant increase in the number of *Staphylococcus aureus* (SAUR) bacteraemia with AST results in the last year, with **941** isolates in 2022 and **937** in 2023 (duplicate cut-off ≤ 14 days).
- A general decrease in the number of methicillin resistant *S. aureus* (MRSA) to **68** in 2023 (duplicate cut-off ≤ 14 days).
- A general increase in the number of methicillin sensitive *S. aureus* (MSSA) to **869** in 2023.

Methicillin Resistant *Staphylococcus aureus* (n = 68 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for Methicillin Resistant *S. aureus* (MRSA) in 2023 are shown in **Figure 14**. Trends in the All-Wales resistance rates for the period 2016-2023 are shown in **Figure 15**.

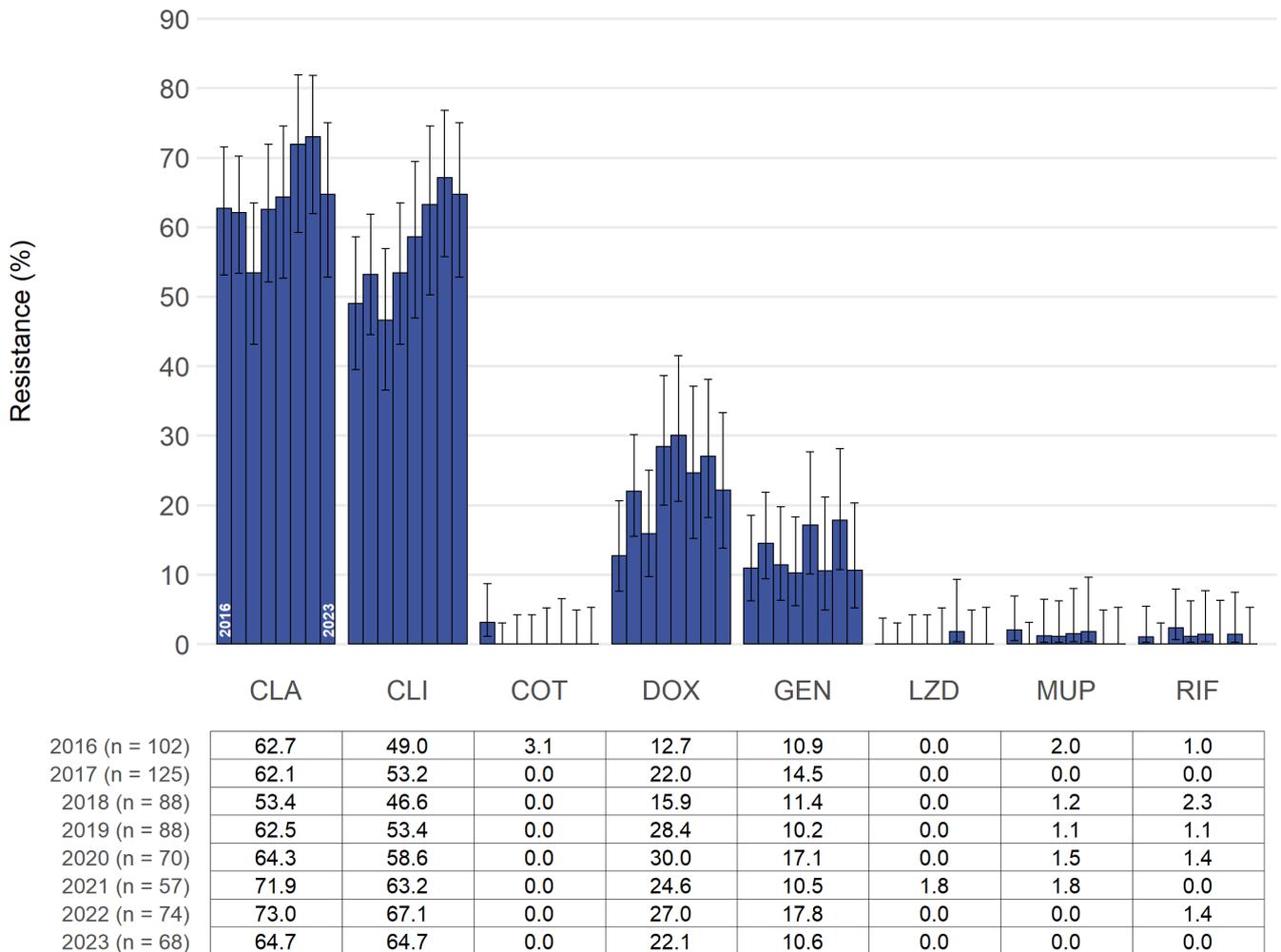


Key: CLA = clarithromycin, CLI = clindamycin, COT = co-trimoxazole, DOX = doxycycline, GEN = gentamicin, LZD = linezolid, MUP = mupirocin, RIF = rifampicin

Figure 14: All-Wales susceptibility patterns for MRSA bacteraemia in 2023

What the data shows

- Clarithromycin (CLA) resistance was **64.7%** [52.8, 75.0].
- Clindamycin (CLI) resistance was **64.7%** [52.8, 75.0].
- Co-trimoxazole (COT) resistance was undetected.
- Doxycycline (DOX) resistance was **22.1%** [13.8, 33.3].
- Gentamicin (GEN) resistance was **10.6%** [5.2, 20.3].
- Linezolid (LZD) resistance was undetected.
- Mupirocin (MUP) resistance was undetected.
- Rifampicin (RIF) resistance was undetected.



Key: CLA = clarithromycin, CLI = clindamycin, COT = co-trimoxazole, DOX = doxycycline, GEN = gentamicin, LZD = linezolid, MUP = mupirocin, RIF = rifampicin

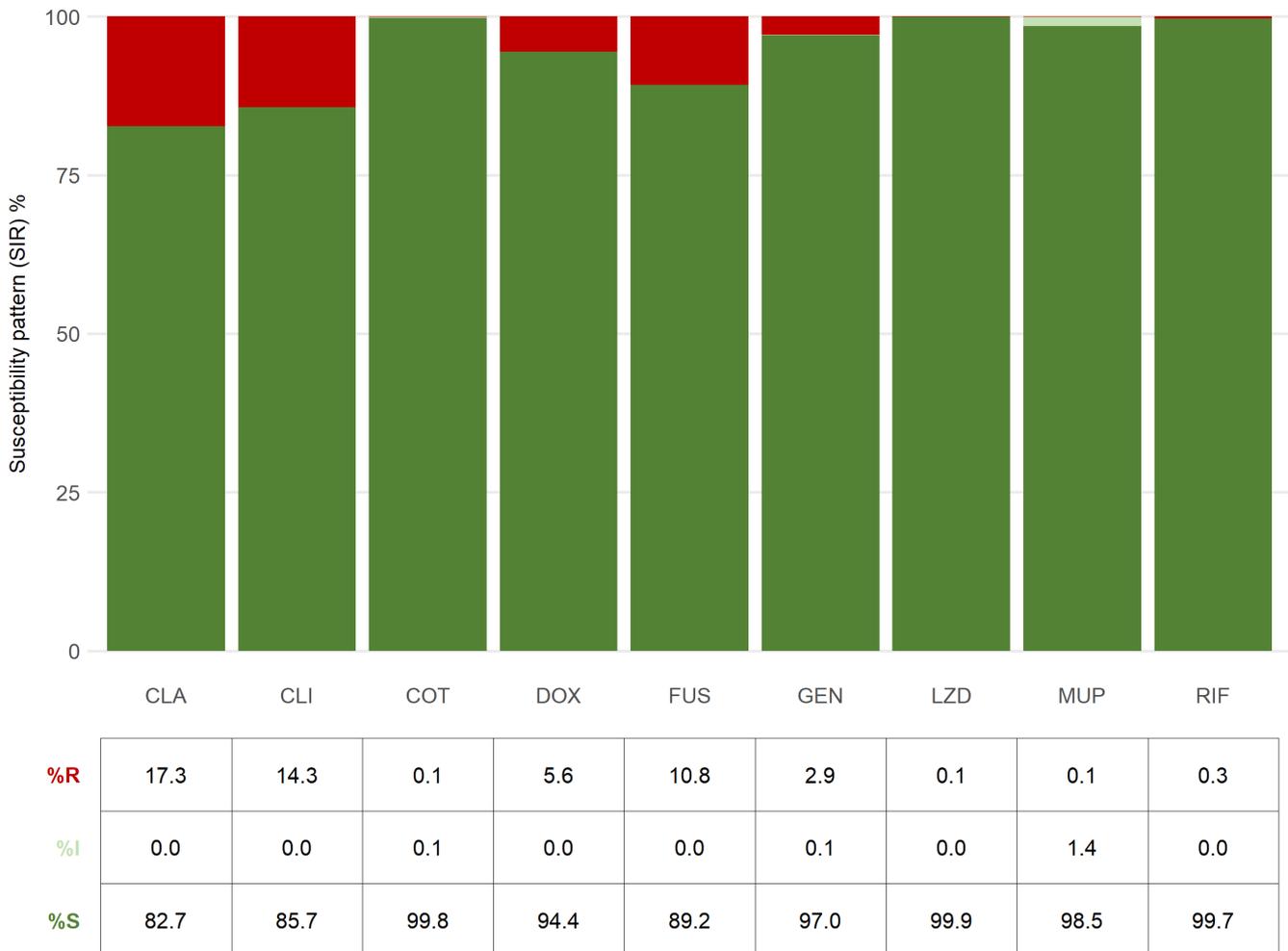
Figure 15: All-Wales antimicrobial resistance rates for MRSA bacteraemia (2016 - 2023)

What the data shows

- There has been a decrease in the number of MRSA bacteraemia with AST results, with **74** isolates in 2022 and **68** in 2023 (duplicate cut-off ≤14 days).
- No significant change in clarithromycin resistance, with resistance at **64.7%** in 2023.
- A general increase in clindamycin resistance, with resistance at **64.7%** in 2023.
- Resistance for co-trimoxazole was undetected in 2023.
- Variability in doxycycline resistance over time, with resistance at **22.1%** in 2023.
- No significant change in gentamicin resistance across time, with resistance at **10.6%** in 2023.
- Resistance rates for linezolid, mupirocin and rifampicin was undetected in 2023.

Methicillin Sensitive *Staphylococcus aureus* (n = 869 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for Methicillin Sensitive *Staphylococcus aureus* (MSSA) bacteraemia in 2023 are shown in **Figure 16**. Trends in the All-Wales resistance rates for the period 2016-2023 are shown in **Figure 17**.

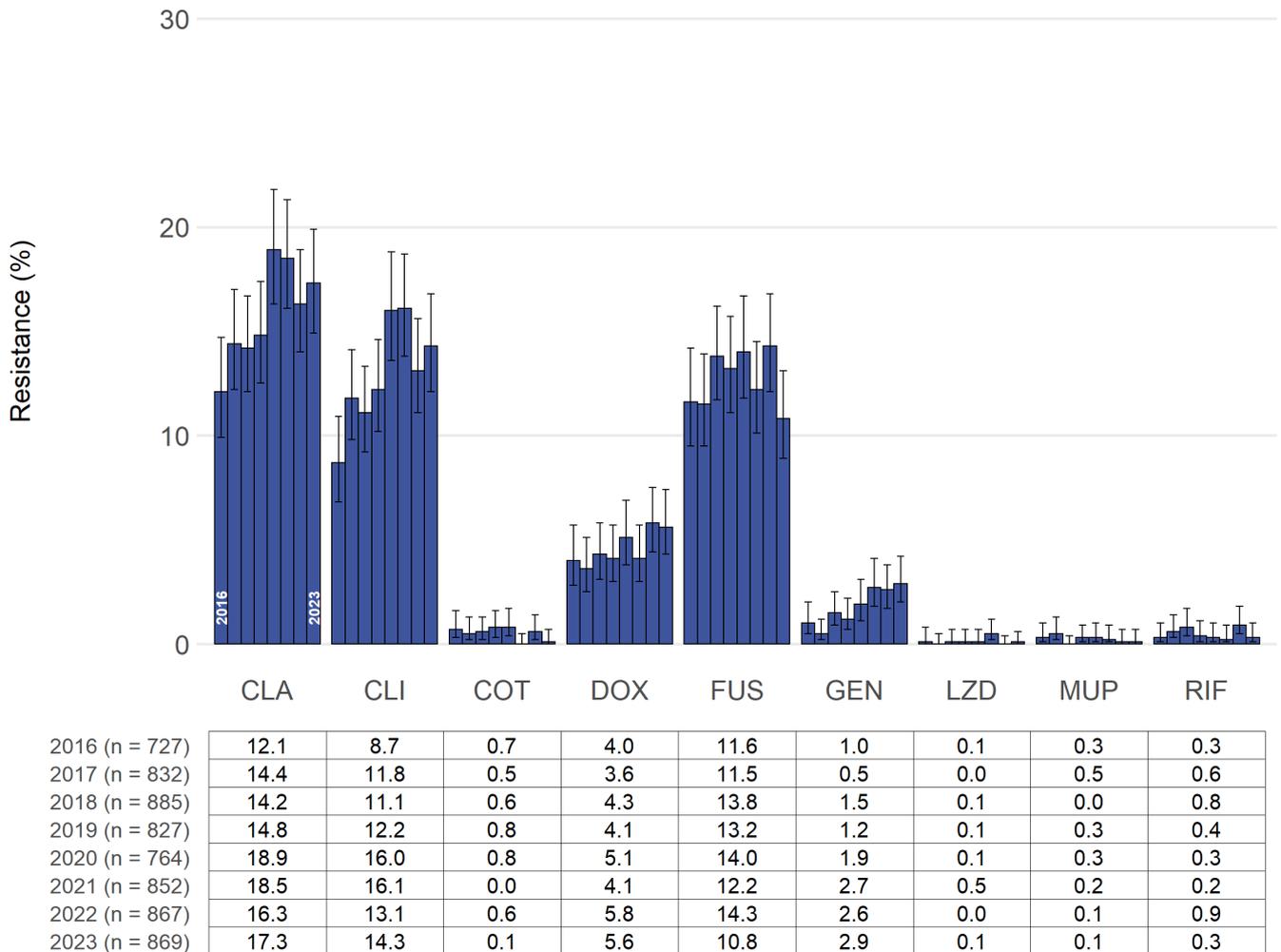


Key: CLA = clarithromycin, CLI = clindamycin, COT = co-trimoxazole, DOX = doxycycline, FUS = fusidic acid, GEN = gentamicin, LZD = linezolid, MUP = mupirocin, RIF = rifampicin

Figure 16: All-Wales susceptibility patterns for MSSA bacteraemia in 2023

What the data shows

- Clarithromycin (CLA) resistance was **17.3%** [14.9, 19.9].
- Clindamycin (CLI) resistance was **14.3%** [12.1, 16.8].
- Co-trimoxazole (COT) resistance was **<1%**.
- Doxycycline (DOX) resistance was **5.6%** [4.3, 7.4].
- Fusidic acid (FUS) resistance was **10.8%** [8.9, 13.1].
- Gentamicin (GEN) resistance was **2.9%** [2.0, 4.2].
- Linezolid (LZD) resistance was **<1%**.
- Mupirocin (MUP) resistance was **<1%**.
- Rifampicin (RIF) resistance was **<1%**.



Key: CLA = clarithromycin, CLI = clindamycin, COT = co-trimoxazole, DOX = doxycycline, FUS = fusidic acid, GEN = gentamicin, LZD = linezolid, MUP = mupirocin, RIF = rifampicin

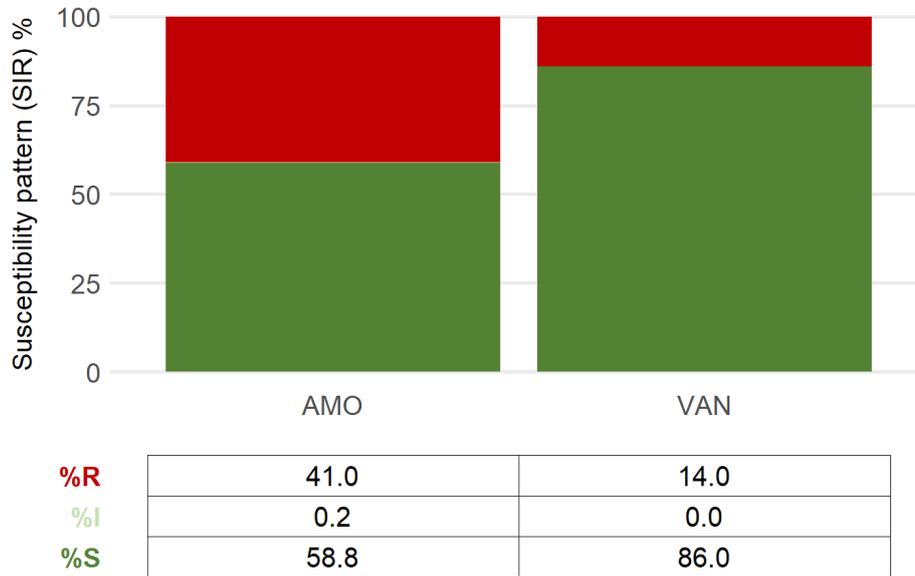
Figure 17: All-Wales antimicrobial resistance rates for MSSA bacteraemia (2016 - 2023)

What the data shows

- There has been no significant change in the number of MSSA bacteraemia with AST results recently - **867** isolates in 2022 and **869** in 2023 (duplicate cut-off ≤14 days).
- A general increase in clarithromycin resistance, with resistance at **17.3%** in 2023.
- A general increase in clindamycin resistance, with resistance at **14.3%** in 2023.
- Resistance rate for co-trimoxazole has remained **<1%**.
- A general increase in doxycycline resistance, with resistance at **5.6%** in 2023.
- No significant change in fusidic acid resistance, with resistance at **10.8%** in 2023.
- An increase in gentamicin resistance to **2.9%** in 2023.
- Resistance rates for linezolid, mupirocin and rifampicin have remained **<1%**.

Enterococcus spp. (n = 575 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *Enterococcus* spp. bacteraemia in 2023 are shown in **Figure 18**. Trends in the All-Wales resistance rates for the period 2016-2023 are shown in **Figure 19**.

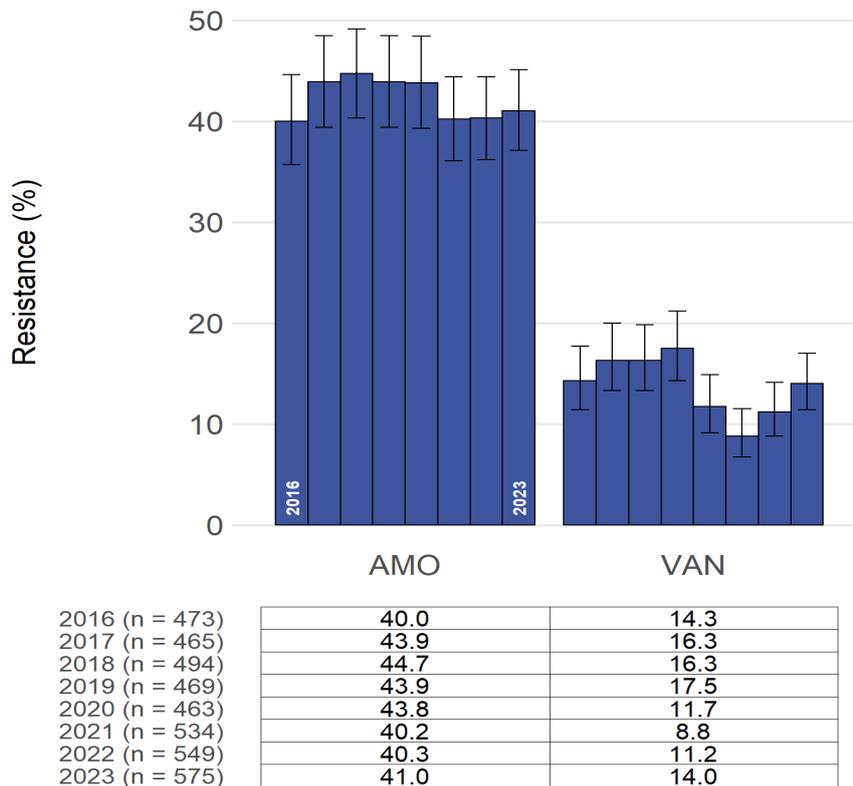


Key: AMO = amoxicillin, VAN = vancomycin

Figure 18: All-Wales susceptibility patterns for *Enterococcus* spp. bacteraemia in 2023

What the data shows

- Amoxicillin (AMO) resistance was **41.0%** [37.1, 45.1].
- Vancomycin (VAN) resistance was **14.0%** [11.4, 17.0].



Key: AMO = amoxicillin, VAN = vancomycin

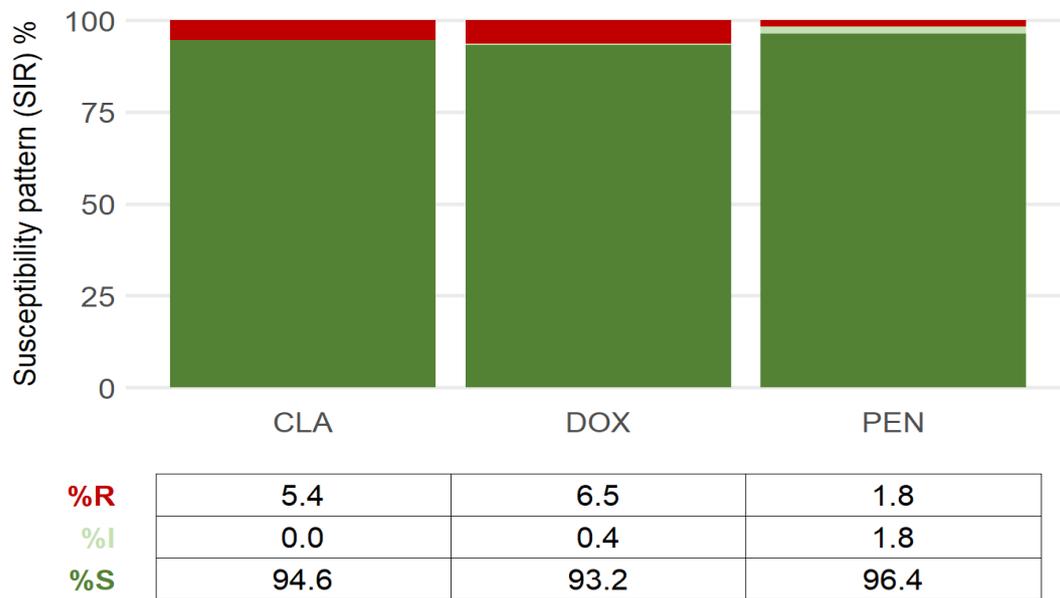
Figure 19: All-Wales antimicrobial resistance rates for *Enterococcus* spp. bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *Enterococcus* spp. bacteraemia with AST results from **549** isolates in 2022 to **575** in 2023 (duplicate cut-off ≤14 days).
- In 2023, the All-Wales resistance rate for amoxicillin in *Enterococcus* spp. was **41.0%**. Susceptibility to amoxicillin is a guide to speciation of the organism, *E. faecalis* being normally susceptible and *E. faecium* being normally resistant, and suggests that in 2023, **59.0%** of enterococcal bacteraemias were due to *E. faecalis*.
- There has been variability in resistance to vancomycin, with resistance at **14.0%** in 2023.

Streptococcus pneumoniae (n = 280 in 2023)

The All-Wales patterns of susceptibility (**S/I/R**) for *St. pneumoniae* bacteraemia in 2023 are shown in **Figure 20**. Trends in the All-Wales resistance rates for the period 2016-2023 are shown in **Figure 21**.

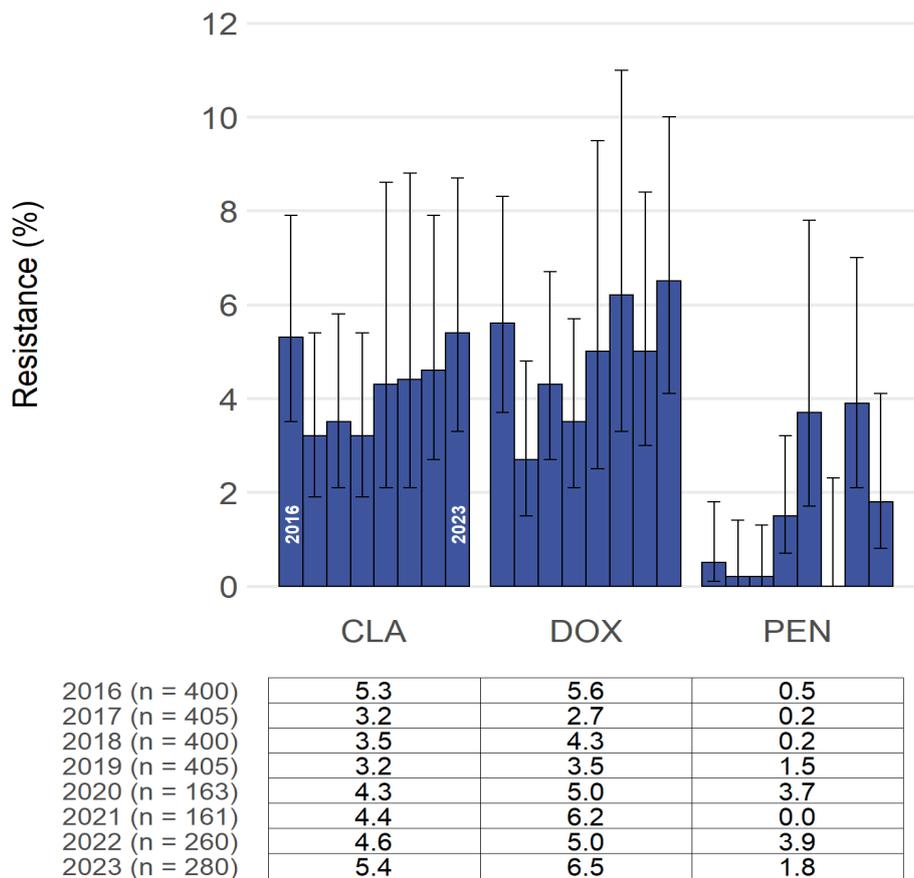


Key: CLA = clarithromycin, DOX = doxycycline, PEN = penicillin

Figure 20: All-Wales susceptibility patterns for *St. pneumoniae* bacteraemia in 2023

What the data shows

- Clarithromycin (CLA) resistance was **5.4%** [3.3, 8.7].
- Doxycycline (DOX) resistance was **6.5%** [4.1, 10.0].
- Penicillin (PEN) resistance was **1.8%** [0.8, 4.1].



Key: CLA = clarithromycin, DOX = doxycycline, PEN = penicillin

Figure 21: All-Wales antimicrobial resistance rates for *St. pneumoniae* bacteraemia (2016 - 2023)

What the data shows

- There has been an increase in the number of *St. pneumoniae* bacteraemia with AST results from **260** isolates in 2022 to **280** in 2023 (duplicate cut-off ≤14 days).
- No significant change in resistance over time for clarithromycin or doxycycline, with resistance at **5.4%**, and **6.5%** respectively in 2023.
- Variability in penicillin resistance, with resistance at **1.8%** in 2023.

Useful links:

Review on Antimicrobial Resistance May 2016

<https://amr-review.org/>

UK Antimicrobial Resistance Strategy 2013 – 18

<https://www.gov.uk/government/publications/uk-5-year-antimicrobial-resistance-strategy-2013-to-2018>

Antimicrobial Resistance Delivery Plan (Wales) 'Together for Health: Tackling antimicrobial resistance & improving antibiotic prescribing.

<http://www.wales.nhs.uk/sitesplus/documents/888/Antimicrobial%20Resistance%20Delivery%20Plan.pdf>

UK 20-year vision for antimicrobial resistance

<https://www.gov.uk/government/publications/uk-20-year-vision-for-antimicrobial-resistance>

Antimicrobial resistance: UK launches 5-year action plan and 20-year vision

<https://www.gov.uk/government/news/antimicrobial-resistance-uk-launches-5-year-action-plan-and-20-year-vision>



https://eucast.org/clinical_breakpoints/