Antimicrobial Resistance (EARS-Net) Data in Ireland

2023

Table of Contents

Abbreviations

3GC	Third Generation Cephalosporins
ac -	Acinetobacter species
AMR	Antimicrobial Resistance
BSI	Bloodstream Infection
CAI	Community Acquired Infection
CLSI	Clinical and Laboratory Standards Institute
CPE	Carbapenemase Producing Enterobacterales
EARS	European Antimicrobial Resistance Surveillance
ECDC	European Centre for Disease Prevention and Control
eco	Escherichia coli
EEA	European Economic Area
efa	Enterococcus faecalis
efm	Enterococcus faecium
EQA	External Quality Assessment
ESBL	Extended Spectrum Beta Lactamase
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
HAI	Healthcare Associated Infection
HPSC	Health Protection Surveillance Centre
iGAS	Invasive Group A Streptococcus
iGBS	Invasive Group B Streptococcus
KPC	Klebsiella pneumoniae carbapenemase
kpn	Klebsiella pneumoniae
MDR	Multi Drug Resistant
MIC	Minimum Inhibitory Concentration
MRSA	Meticillin Resistant Staphylococcus aureus
MSSA	Meticillin Susceptible Staphylococcus aureus

3GC	Third Generation Cephalosporins
NDM	New Delhi Metallo Beta Lactamase
NWT	Non Wild Type
OXA	Oxacillinase
pae	Pseudomonas aeruginosa
RIS	Resistance, Susceptible at Increased Exposure, Susceptible
sau	Staphylococcus aureus
spn	Streptococcus pneumoniae
VREfm	Vancomycin Resistant Enterococcus faecium
VSEfm	Vancomycin Susceptible Enterococcus faecium
WHO	World Health Organization
WT	Wild Type

Introduction

Antimicrobial Resistance Surveillance

Infectious disease surveillance is important in monitoring and evaluating emerging patterns and trends of disease. It provides information for action, thus timely data collection, validation, analysis, feedback and reporting is very important. Through surveillance we can: describe the current burden and epidemiology of a disease, monitor trends over time, investigate emergence and spread of new pathogens and variants, inform policy makers for action, and observe the effects of interventions.

Surveillance data provide a basis for taking action to control AMR and the importance of data is highlighted in the European One Health Action Plan against Antimicrobial Resistance. Surveillance of AMR is listed as a special health issue in the Regulation (EU) 2022/2371 of the European Parliament and of the Council of 23 November 2022 on serious cross-border threats to health.

In addition, surveillance data is used by WHO to prepare a list of 'priority pathogens' that have developed resistance to key antibiotics used to treat the infections they cause and for which new antibiotics are urgently required. The main international AMR surveillance system in the EU is the European Antimicrobial Resistance Surveillance Network (EARS-Net). Many of the pathogens (drug-bug combinations) that are under EARS-Net surveillance are listed among the "high" or "critical" group by WHO.

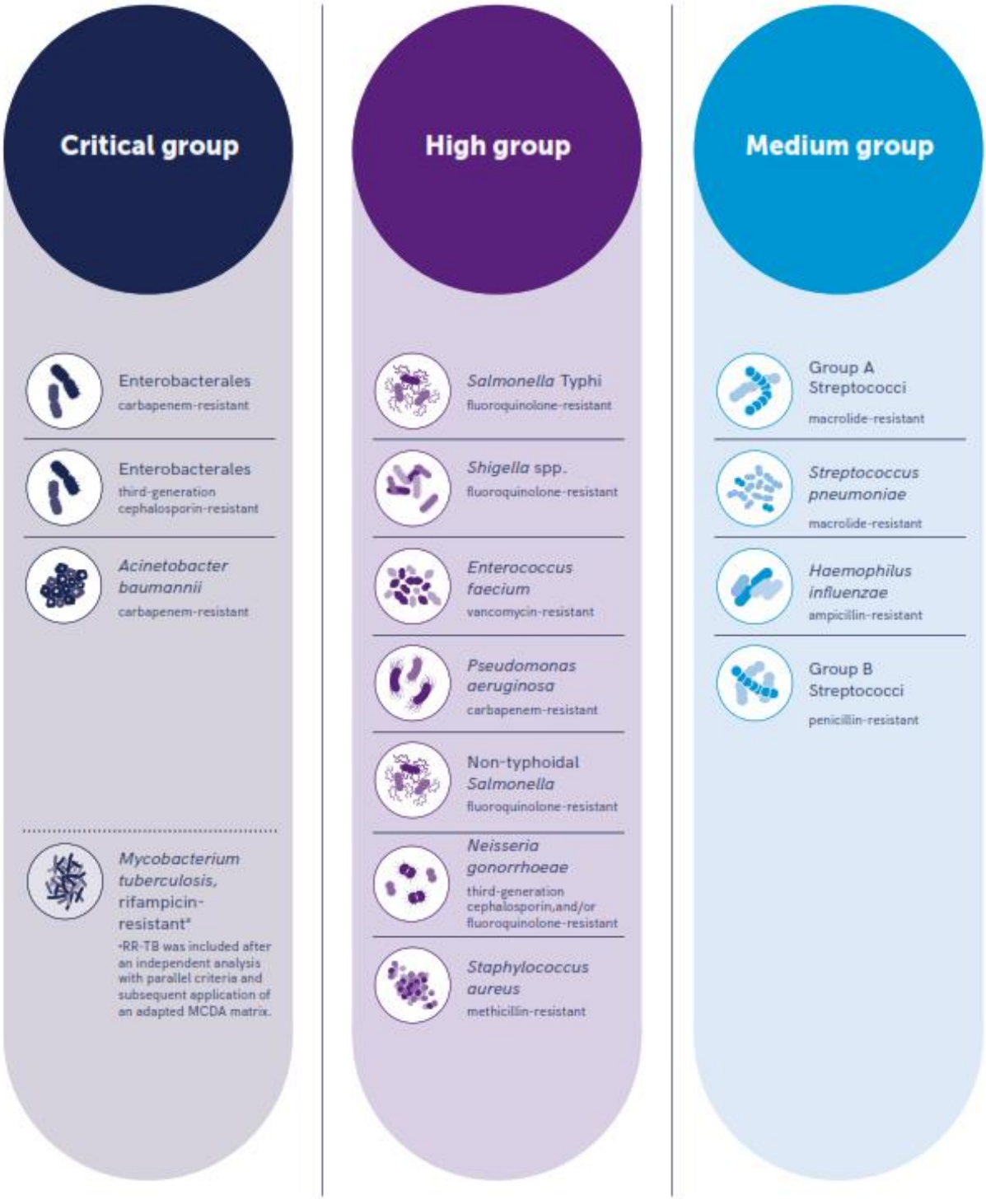


Figure 1: WHO Bacterial Priority Pathogens List, 2024

EARS-Net Background

The European Antimicrobial Resistance Surveillance System (EARSS), established in 1998, is the predecessor of EARS-Net. EARSS was initially funded by the European Commission's Directorate General for Health and Consumer Affairs and the Dutch Ministry of Health, Welfare and Sports. The network steadily grew and involved an increasing number of European countries. On 1 January 2010, the administration and coordination of EARSS was transferred to the European Centre for Disease Prevention and Control (ECDC). The network was renamed to 'European Antimicrobial Resistance Surveillance Network (EARS-Net)'. The European Antimicrobial Resistance Surveillance Network (EARS-Net) is the largest publicly funded system for antimicrobial resistance (AMR) surveillance in Europe.

The objectives of EARS-Net are to:

- collect comparable, representative and accurate AMR data;
- analyse temporal and spatial trends of AMR in Europe;
- provide timely AMR data for policy decisions;
- encourage the implementation, maintenance and improvement of national AMR surveillance programmes; and
- support national systems in their efforts to improve diagnostic accuracy by offering annual external quality assessments (EQA).

More information on EARS-Net can be found on ECDC's website.

Methodology

EARS-Net collects antimicrobial resistance data on **the first invasive isolate** (from blood or cerebrospinal fluid) for each of the **EARS-Net pathogens** listed below, **per patient, per year.** These EARS-Net pathogens are;

1. *Escherichia coli,*
2. *Klebsiella pneumoniae,*
3. *Pseudomonas aeruginosa,*
4. *Acinetobacter* species,
5. *Streptococcus pneumoniae,*
6. *Staphylococcus aureus,*
7. *Enterococcus faecalis*
8. *Enterococcus faecium.*

Routinely-generated qualitative (RIS) and quantitative (MIC) data from laboratories on key antibiotics for eight pathogens under surveillance data is sent to HPSC. In addition, HPSC collects data on 3 non-EARS-Net pathogens. These are invasive isolates of Group A Streptococcus, Group B Streptococcus and *Candida* species.

Nationally, data are stored in WHONET format (a free software from WHO, which is versatile for collecting, storing and analysing AMR data) and in an Access Database at HPSC. Data analyses and reporting is done through RStudio which is a programming software for statistical computing and graphics.

EARS-Net requires that countries submit data only from laboratories using EUCAST guidelines. In 2023, three laboratories in Ireland were still using CLSI guidelines (with one of these switching to EUCAST in Q4). Data from these three laboratories are included in the national data for this report but are not submitted to ECDC. Therefore, the numbers, proportions, and rates in this report will differ from those produced by ECDC later this year. ECDC will publish its 2023 Annual Epidemiological Report in November 2024, in advance of European Antibiotic Awareness Day.

Over the past 5 years, the estimated coverage of the Irish population has consistently been over 95%. In 2023, there was an estimated 96% coverage of the population: three laboratories did not participate due to resource issues. Meanwhile the coverage varies considerably in other EU/EEA countries from <20% to 100%.

EARS-Net laboratories are also required to participate in the annual EARS-Net EQA exercise: In 2020, this exercise was cancelled throughout Europe due to the pandemic. In 2021, Ireland didn't participate due to resource issues. In 2022, participation in Ireland recommenced; however, 6 of 37 labs did not participate.

National Results

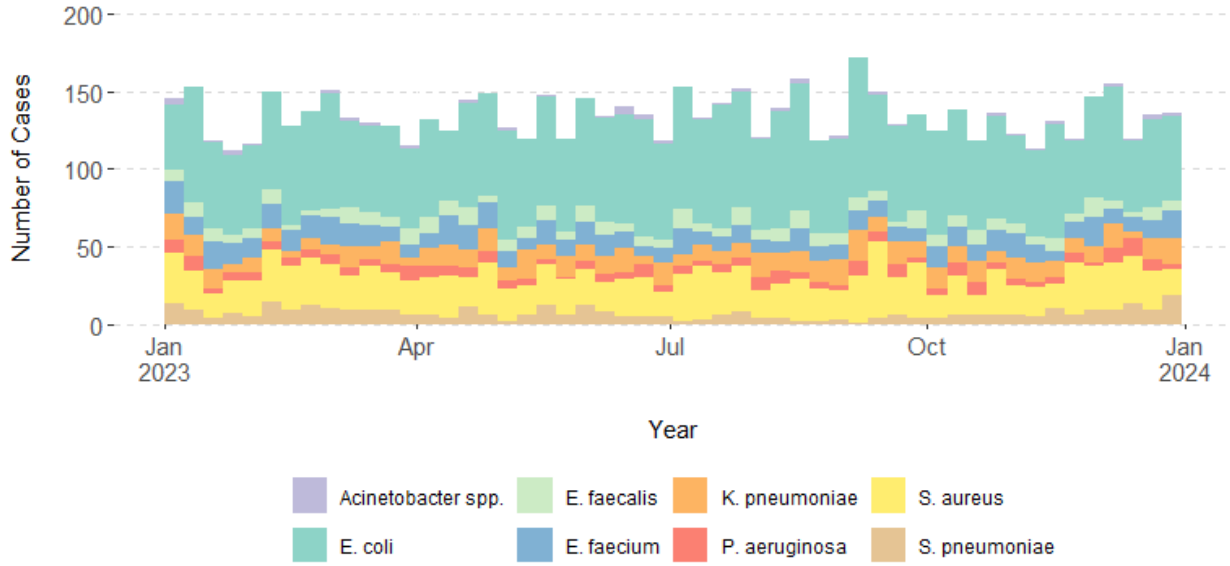
Key Points

- In 2023, 33 of 36 microbiology laboratories in Ireland submitted data on invasive infections (predominantly bloodstream infections) for 8 key pathogens, including *E. coli* and *S. aureus*.
- Three laboratories did not submit data. Two laboratory had lost surveillance staff and so were unable to submit data; while another one had technical issues getting the data. The estimated population coverage by EARS-Net Ireland in 2023 was 96%.
- Data were received on 7641 isolates in 2023 compared with 7130 in 2022. Of the 7641 isolates in 2023, 6961 were EARS-Net pathogens and the rest were invasive Group A streptococcus, invasive Group B streptococcus and *Candida* species.
- For most pathogens, there was an increase in the number of cases reported in 2023 compared to 2022, with the biggest increase seen for Group A streptococcus (coinciding with the upsurge in iGAS infections at the end of 2022 and continued in 2023), *K. pneumoniae* and *S. pneumoniae* whereas *P. aeruginosa*, *Acinetobacter* spp. and Group B streptococcus infections decreased in 2023.
- In 2023, the proportion of meticillin-resistant *S. aureus* (%MRSA) decreased to 9.7%. This is the lowest recorded level to date. Furthermore, the MRSA incidence rate slightly decreased to 0.029 per 1,000 Patient Days from 0.031 per 1,000 Patient Days in 2022. However, the overall *S. aureus* incidence and MSSA incidence slightly increased in 2023 compared to the previous year.
- Vancomycin-resistance among *E. faecium* (VREfm) decreased to 21.4% in 2023. This is also the lowest recorded level to date. Overall, the 5-year trend indicates that the % VREfm is decreasing. Furthermore, there has been a decrease in overall *E. faecium* and VREfm incidence rates, while the VSEfm incidence increased slightly between 2022 and 2023.

Table 1: Number of Laboratories Participated in the Last 5 Years and Population Coverage

	2019	2020	2021	2022	2023
Total Number of Laboratories	38	38	37	36	36
Number of Participating Laboratories	38	38	37	35	33
Population Coverage (%)	100	100	100	97	96

Figure 1: Epi Curve of BSI in Ireland In the Latest Year by Organism and Weeks



E. coli was responsible for almost half of the bloodstream infections among EARS-Net pathogens in 2023 (47%), followed by *S. aureus* (18%). The proportions of *E. faecium* and *K. pneumoniae* infections were very close, at 9% and 8%, respectively. *Acinetobacter* spp. accounted for only 1% of the infections.

Among EARS-Net pathogens, there was an increase in the number of cases reported in 2023 for *K. pneumoniae*, *S. pneumoniae*, *E. coli*, *E. faecium*, *E. faecalis*, and *S. aureus*. In contrast, *P. aeruginosa* and *Acinetobacter* spp. infections decreased in 2023 compared to the previous year.

Figure 2: Number of BSI in Ireland In the Last 5 Years by Organism and Year

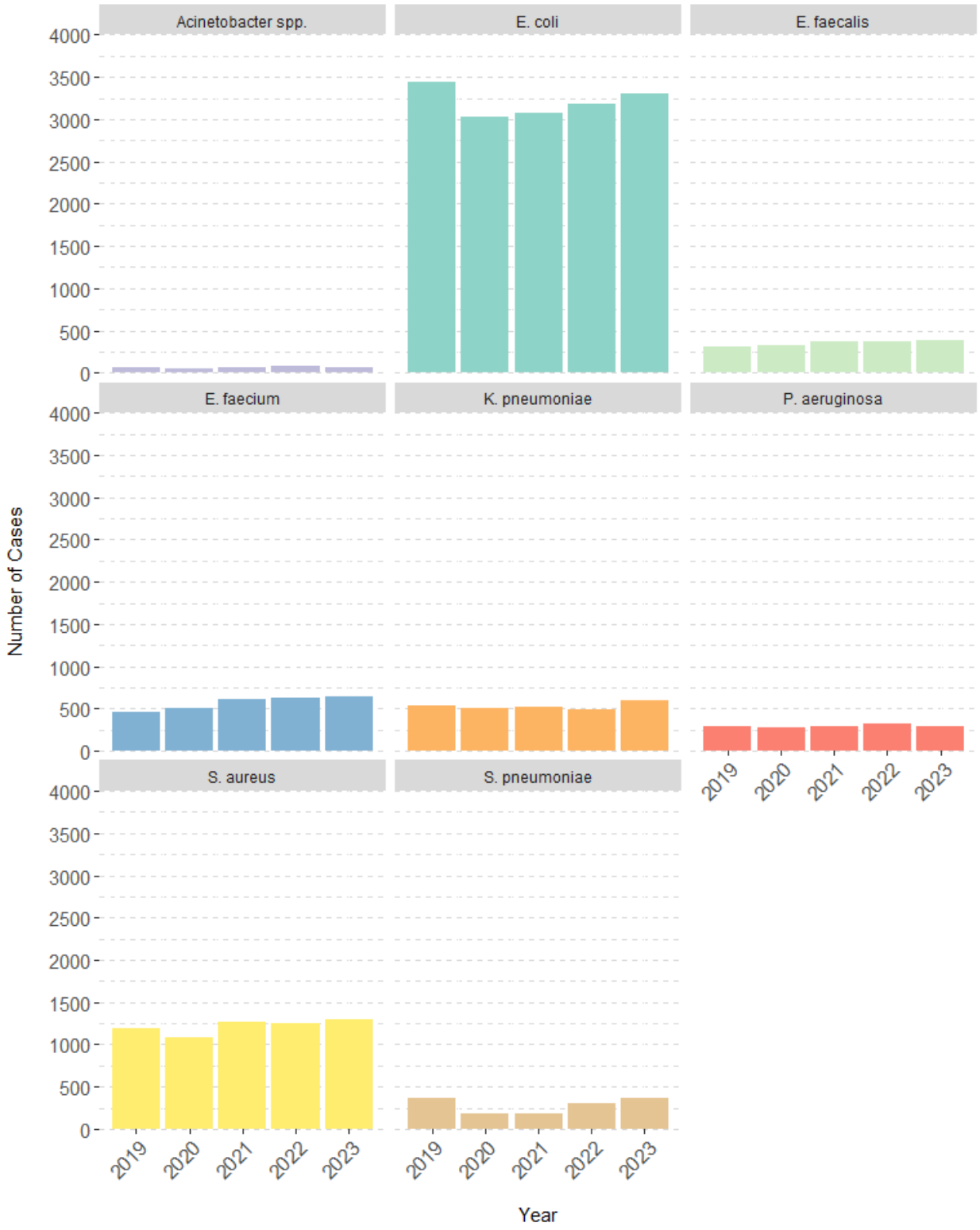
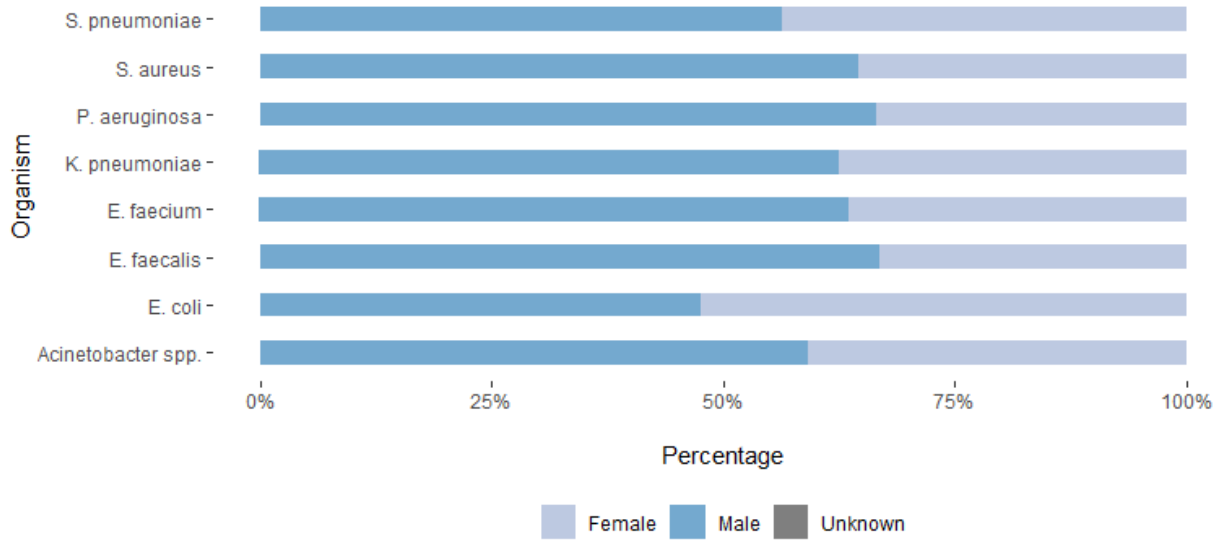


Figure 3: Gender Distribution of Cases In the Latest Year by Organism in Ireland



The majority of bloodstream infections occurred in male patients. The only exception was *E. coli* infections, where just over 50% of the infections occurred in females. Regarding age groups, the burden was highest among the older population (>65 years old) for nearly all pathogens. The only exception was *Acinetobacter* infections, where the majority of infections occurred in adults aged 18 to 64 year old.

Figure 4: Age Distribution of Cases In the Latest Year by Organism in Ireland

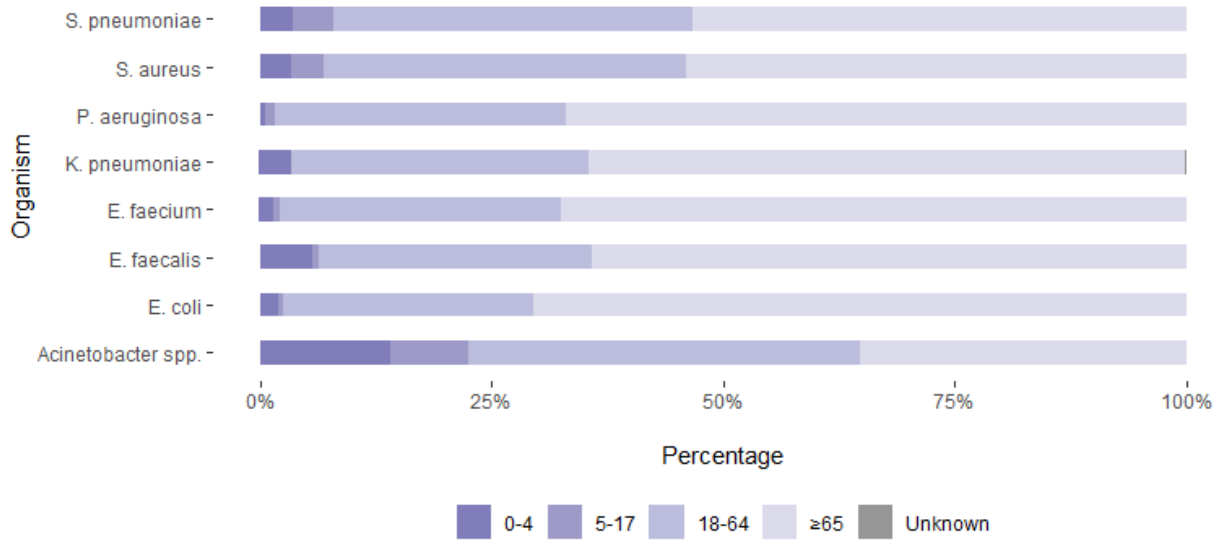
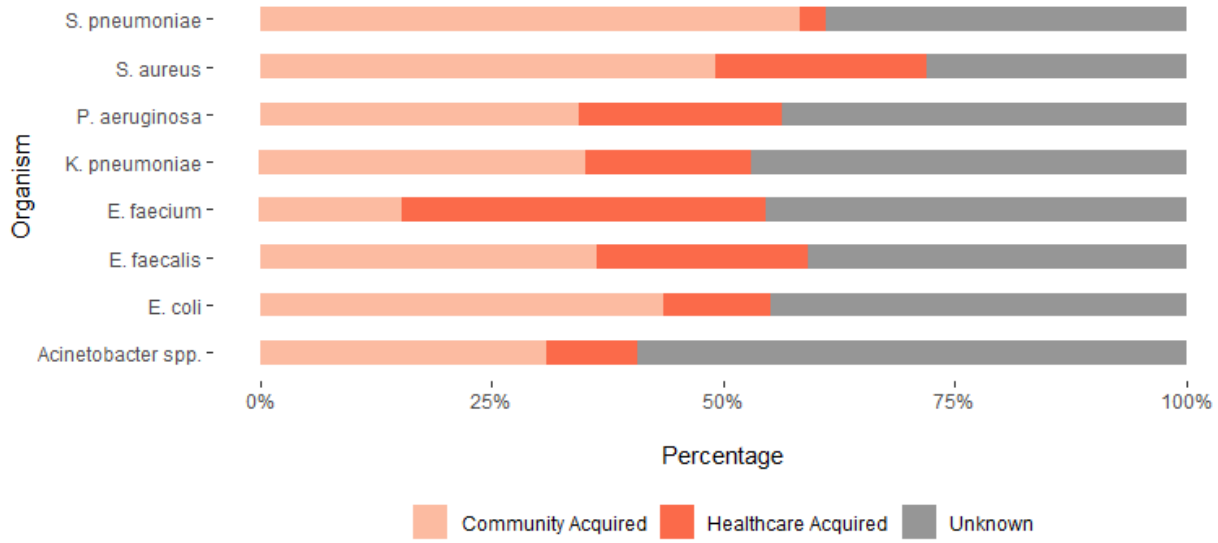


Figure 5: HAI Status of Cases In the Latest Year by Organism in Ireland



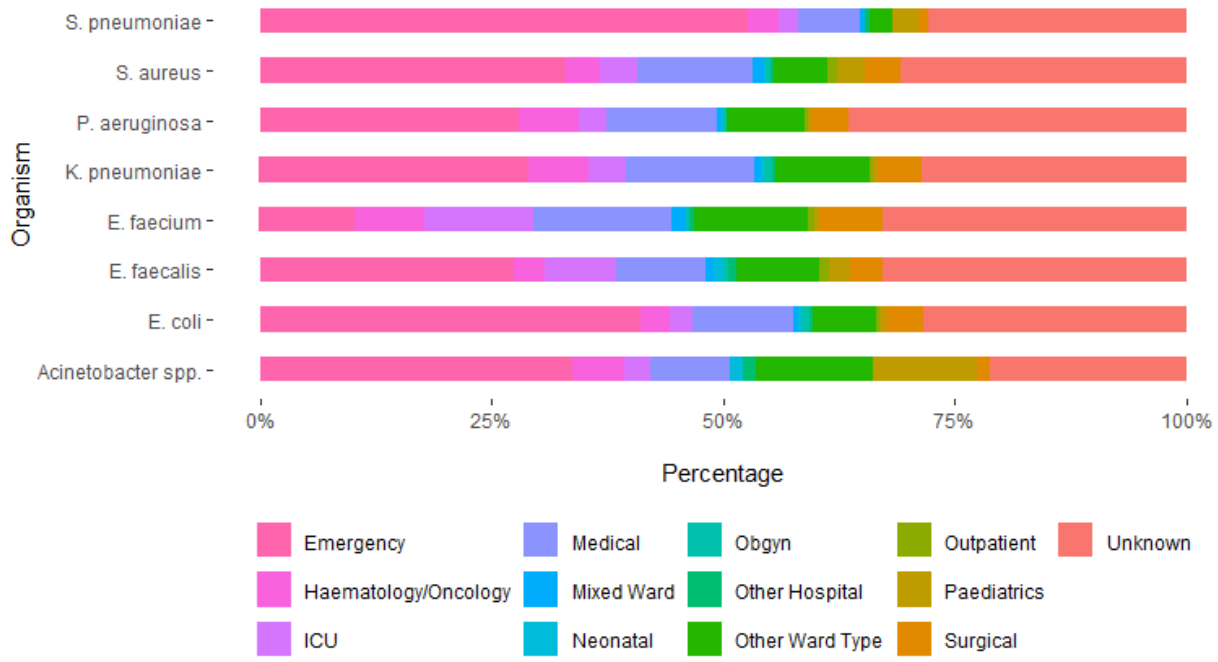
Healthcare-Associated Infection (HAI) was defined as an infection where the specimen date was more than two days after the admission date (i.e., more than 48 hours after admission). Community-Acquired Infection (CAI) was defined as an infection where the specimen date was less than or equal to two days before the admission date (i.e., within 48 hours of admission). Unfortunately, the admission date was missing for many patients (40%), preventing their categorization as either CAI or HAI.

When isolates with missing admission dates are excluded, CAIs were most common in *S. pneumoniae*, *E. coli*, and *Acinetobacter* spp. infections. In contrast, *E. faecium*, *P.aeruginosa* and *E. facealis* infections had the highest proportions of HAIs.

Table 2: HAI Status of Cases In the Latest Year by Organism in Ireland

	ac-	eco	efa	efm	kpn	pae	sau	spn
CAI	75.9%	79.1%	61.6%	28.2%	66.2%	61.1%	68.4%	95.5%
HAI	24.1%	20.9%	38.4%	71.8%	33.8%	38.9%	31.6%	4.5%

Figure 6: Ward Type of Cases In the Latest Year by Organism in Ireland



Just over 70% of the patients had their department information completed. The majority of specimens were taken when the patients were in the emergency wards (35%), followed by medical wards (11.5%), other ward types (7.5%), and surgical wards (4%). The breakdown of departments by pathogens can be found in the figure above.

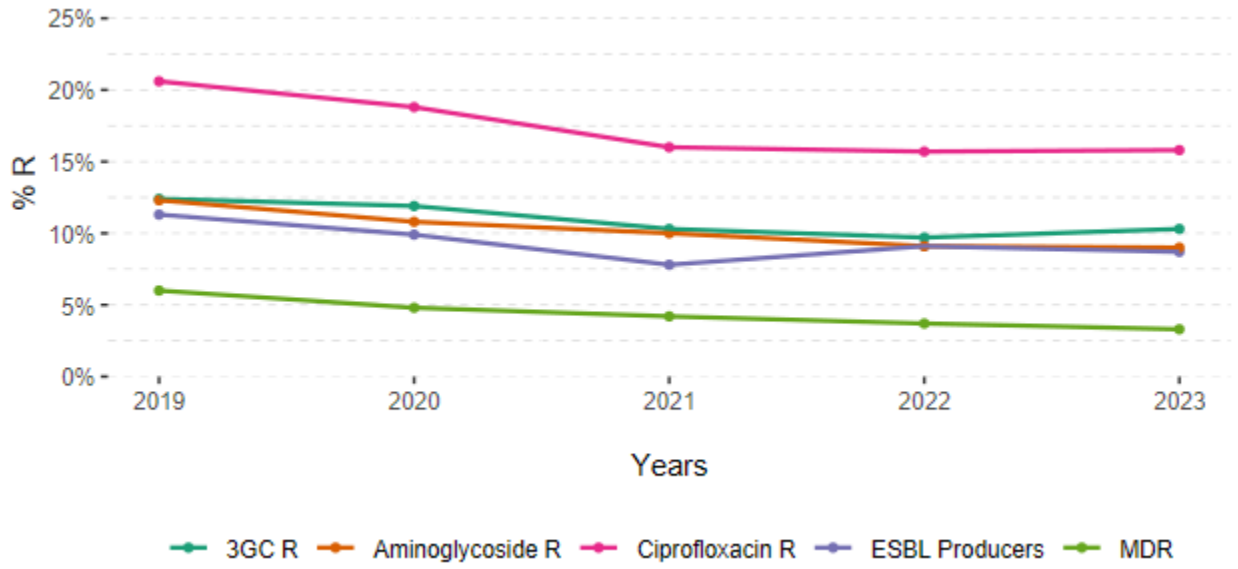
1. Escherichia coli

- From 2022 to 2023, *E. coli* bloodstream infections exhibited stable or slightly declining trends in antibiotic resistance.
- Resistance to third-generation cephalosporins (3GC) remained stable at 10%. Similarly, the proportion of extended-spectrum beta-lactamase (ESBL) producers stayed constant at approximately 9%.
- Multi-drug resistance (MDR) saw a further drop from 4% to 3% between 2022 and 2023. These patterns indicate a plateau in resistance levels for *E. coli* in 2023 compared to 2022, suggesting that while earlier declines have slowed, resistance is not increasing.
- However the number of *E. coli* bloodstream infections has been increasing steadily since 2020, with the number of infections almost back to pre-pandemic levels.
- The 5-year trend indicates that the % carbapenem-resistant *E. coli* is stable and the numbers are low; Only 3 *E. coli* isolates were found to be carbapenemase-producers (CPE) in 2023.

Table 3: Antimicrobial Resistance in Invasive *E. coli* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	3439	3032	3073	3181	3304
Ampicillin R	68.1%	65.2%	63.0%	62.1%	63.0%
Amoxicillin/Clavulanic Acid R	51.1%	49.1%	48.7%	45.1%	47.8%
Piperacillin/Tazobactam R	13.2%	13.2%	12.5%	11.6%	12.7%
Cefoxitin R	7.4%	6.5%	4.6%	4.8%	4.8%
Cefotaxime/Ceftriaxone R	12.2%	11.2%	9.1%	10.0%	9.9%
Ceftazidime R	10.0%	10.8%	10.0%	8.3%	8.8%
3GC R	12.4%	11.9%	10.3%	9.7%	10.3%
ESBL Producers	11.3%	9.9%	7.8%	9.1%	8.7%
Ciprofloxacin R	20.6%	18.8%	16.0%	15.7%	15.8%
Gentamicin R	10.7%	9.3%	8.8%	7.7%	7.7%
Aminoglycoside R	12.3%	10.8%	10.0%	9.1%	9.0%
MDR	6.0%	4.8%	4.2%	3.7%	3.3%
Carbapenem R	0.0%	0.3%	0.1%	0.3%	0.1%
CPE (n)	0	3	0	4	3

Figure 7: Key Resistance Indicators in Invasive *E. coli* Infections in Ireland



Third Generation Cephalosporin Resistance and Extended Spectrum Beta-Lactamase Positivity

Table 4: 3rd Generation Cephalosporin Resistance in Invasive *E. coli* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	3,439	426	62	2,948	12.4%
2020	3,032	361	5	2,665	11.9%
2021	3,073	315	10	2,744	10.3%
2022	3,181	310	9	2,861	9.7%
2023	3,304	340	13	2,947	10.3%

Figure 8: 3rd Generation Cephalosporin Resistance in Invasive *E. coli* Infections in the EU/EEA Member States in 2022

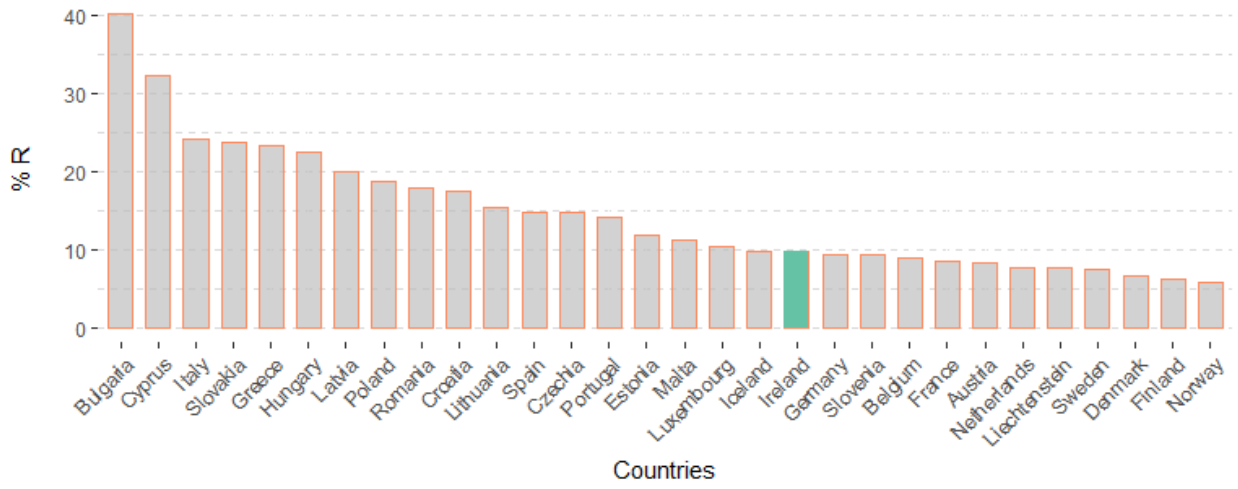


Table 5: ESBL Positivity in Invasive *E. coli* Infections in Ireland

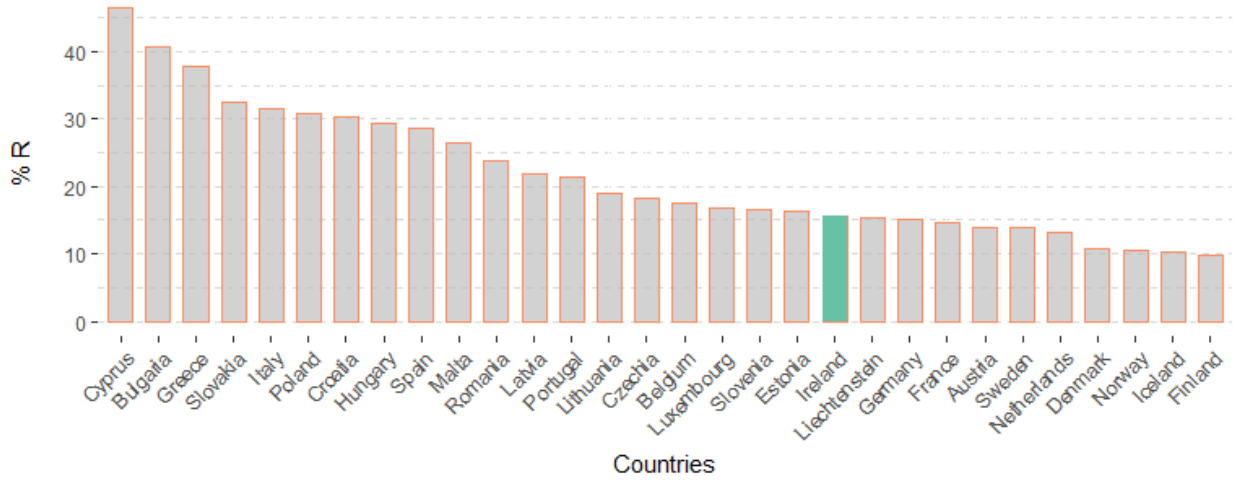
Year	Total Cases	Pos	Neg	ESBL Positivity
2019	3,439	383	3,011	11.3%
2020	3,032	264	2,399	9.9%
2021	3,073	226	2,656	7.8%
2022	3,181	271	2,694	9.1%
2023	3,304	285	2,988	8.7%

Fluoroquinolone Resistance

Table 6: Fluoroquinolone Resistance in Invasive *E. coli* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	3,439	708	60	2,661	20.6%
2020	3,032	568	63	2,393	18.8%
2021	3,073	492	41	2,530	16.1%
2022	3,181	498	42	2,632	15.7%
2023	3,304	513	39	2,692	15.8%

Figure 9: Fluoroquinolone Resistance in Invasive *E. coli* Infections in the EU/EEA Member States in 2022

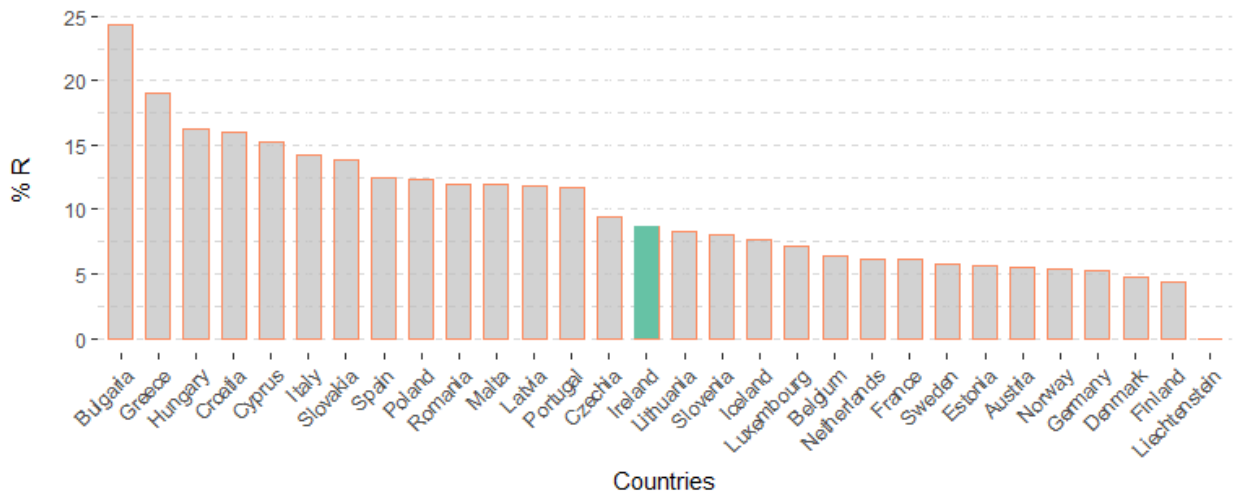


Aminoglycoside Resistance

Table 7: Aminoglycoside Resistance in Invasive *E. coli* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	3,439	423	23	2,992	12.3%
2020	3,032	326	2	2,702	10.8%
2021	3,073	307	0	2,764	10.0%
2022	3,181	289	1	2,887	9.1%
2023	3,304	295	0	2,998	9.0%

Figure 10: Aminoglycoside Resistance in Invasive *E. coli* Infections in the EU/EEA Member States in 2022



Carbapenem Resistance

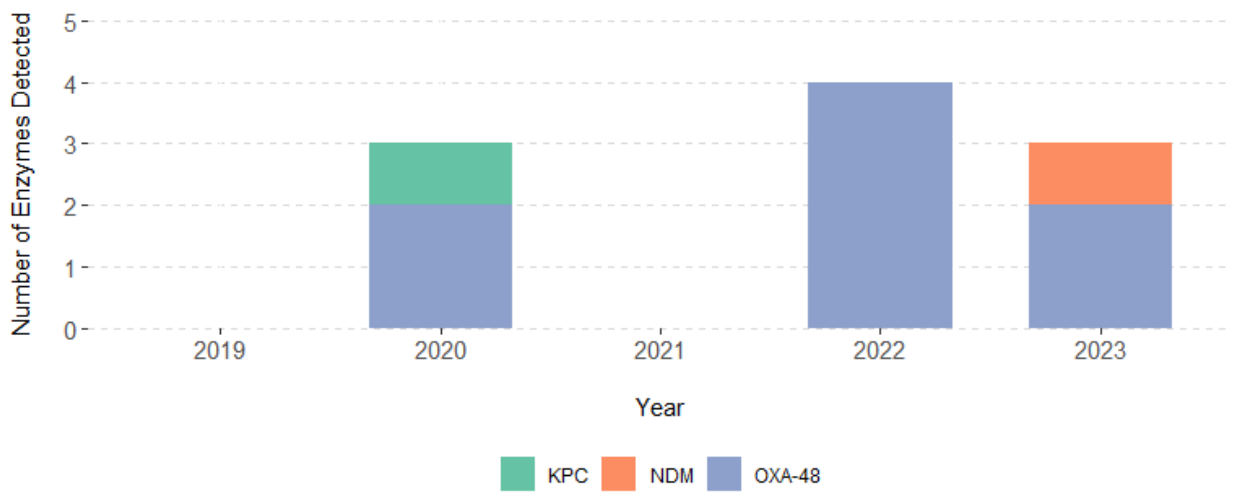
Table 8: Carbapenem Resistance in Invasive *E. coli* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	3,439	1	0	3,434	0.0%
2020	3,032	9	0	2,992	0.3%
2021	3,073	4	0	3,054	0.1%
2022	3,181	10	0	3,168	0.3%
2023	3,304	4	1	3,294	0.1%

Table 9: Carbapenemase Producing *E. coli* Infections by Enzyme Type in Ireland

Year	KPC	NDM	OXA-48	Total
2019	0	0	0	0
2020	1	0	2	3
2021	0	0	0	0
2022	0	0	4	4
2023	0	1	2	3

Figure 11: Carbapenemase Producing *E. coli* Infections by Enzyme Type in Ireland



Multi Drug Resistance

Table 10: Multi Drug Resistance in Invasive *E. coli* Infections in Ireland

Year	Total Cases	MDR	Incomplete	Non-MDR	% MDR
2019	3,439	207	12	3,220	6.0%
2020	3,032	145	11	2,876	4.8%
2021	3,073	130	13	2,930	4.2%
2022	3,181	116	14	3,051	3.7%
2023	3,304	108	70	3,126	3.3%

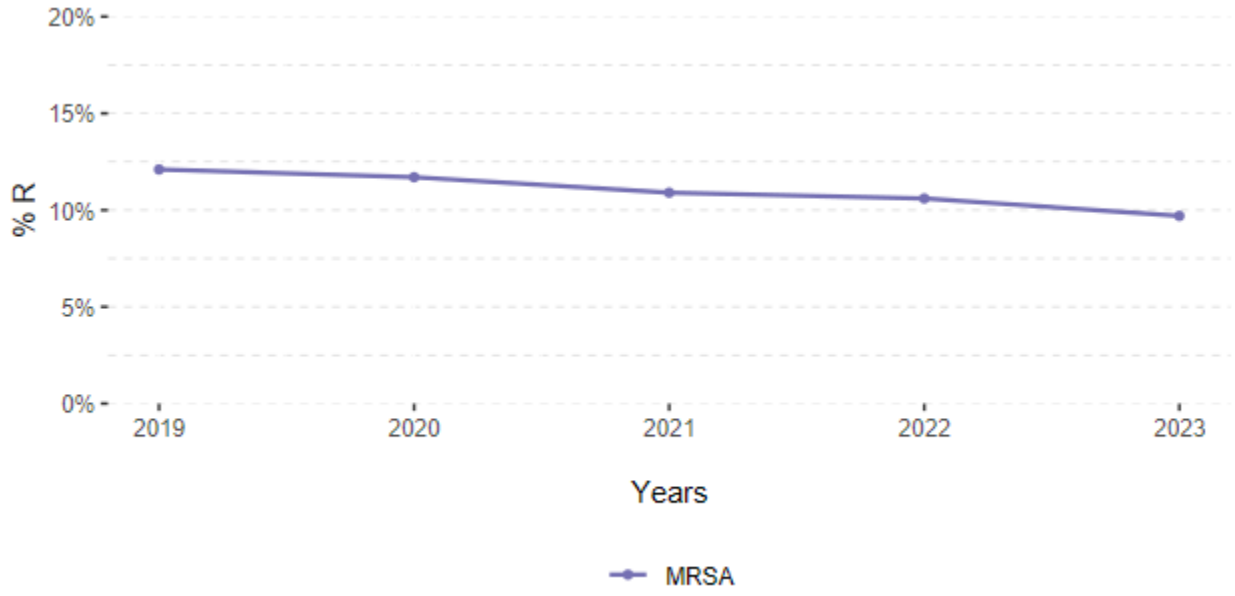
2. Staphylococcus aureus

- The number of invasive *S. aureus* infections remained relatively stable between 2022 and 2023.
- In 2023, the proportion of meticillin-resistant *S. aureus* (%MRSA) decreased to 9.7%. The % MRSA is the lowest recorded level to date. This marks a change in the EU/EEA map from orange (10-15%) to yellow (<10%).
- In addition, the MRSA incidence rate slightly decreased to 0.029 per 1,000 Patient Days from 0.031 per 1,000 Patient Days in 2022.
- However, there was an increase in the incidence rate of meticillin-susceptible *S. aureus* (MSSA) and the rate increased slightly to 0.268 per 1,000 Patient Days from 0.266 per 1,000 Patient Days in 2022.
- Overall, the *S. aureus* infection incidence rate has remained stable in the last year (0.297 per 1,000 Patient Days in both 2022 and 2023).

Table 11: Antimicrobial Resistance in Invasive *S. aureus* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	1186	1081	1262	1250	1301
MRSA	12.1%	11.7%	10.9%	10.6%	9.7%
Ciprofloxacin R	14.6%	12.7%	9.8%	11.7%	10.0%
Linezolid R	0.0%	0.0%	0.0%	0.1%	0.2%
Rifampicin R	0.7%	0.5%	0.6%	1.0%	0.7%
Vancomycin R	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 12: Key Resistance Indicators in Invasive *S. aureus* Infections in Ireland

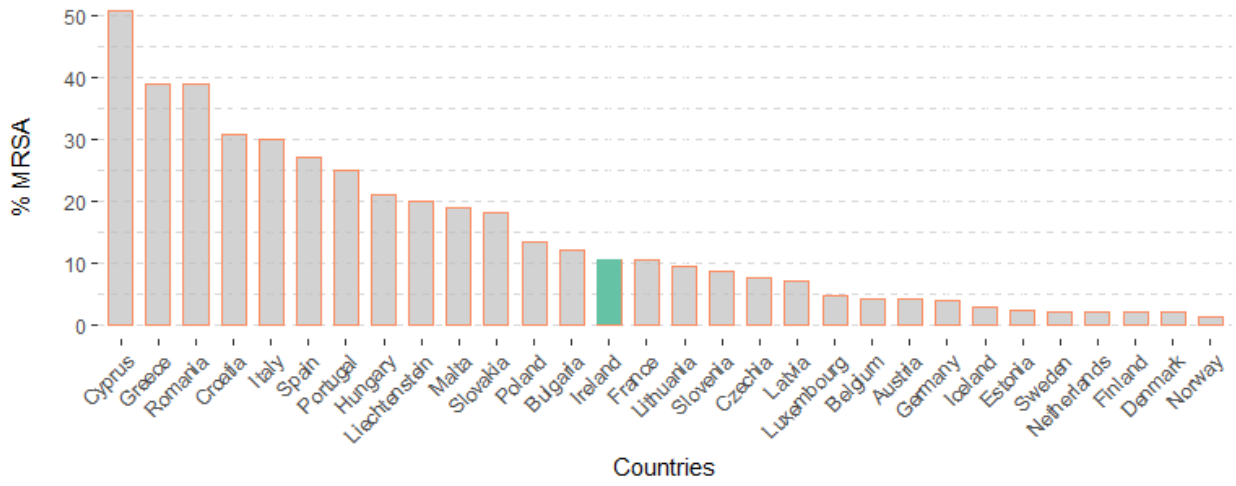


Meticillin-resistant Staphylococcus aureus Proportion

Table 12: Meticillin Resistance in Invasive *S. aureus* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	1,186	144	0	1,042	12.1%
2020	1,081	126	0	954	11.7%
2021	1,262	138	0	1,124	10.9%
2022	1,250	132	0	1,118	10.6%
2023	1,301	126	0	1,175	9.7%

Figure 13: Meticillin Resistance in Invasive *S. aureus* Infections in the EU/EEA Member States in 2022

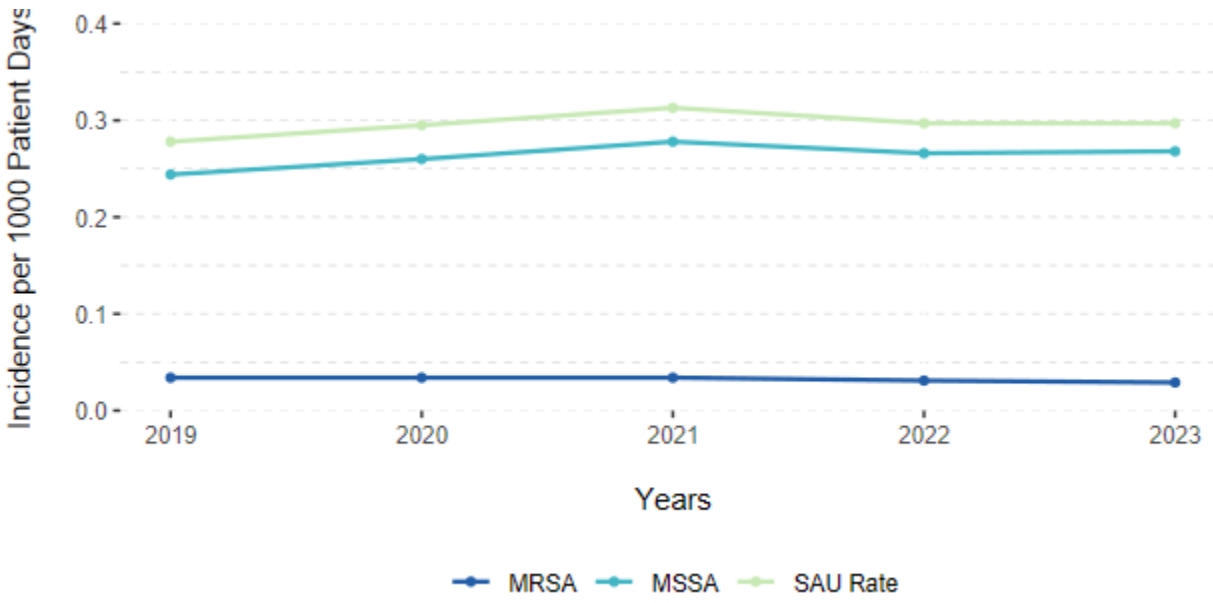


Meticillin-resistant Staphylococcus aureus Incidence

Table 13: Invasive *S. aureus* Incidence in Ireland

Year	Bed Days Used	SAU Rate per 1000 Patient Days	MRSA Rate per 1000 Patient Days	MSSA Rate per 1000 Patient Days
2019	4,265,555	0.278	0.034	0.244
2020	3,667,687	0.295	0.034	0.260
2021	4,038,076	0.313	0.034	0.278
2022	4,209,051	0.297	0.031	0.266
2023	4,384,954	0.297	0.029	0.268

Figure 14: Invasive *S. aureus* Incidence Rates in Ireland



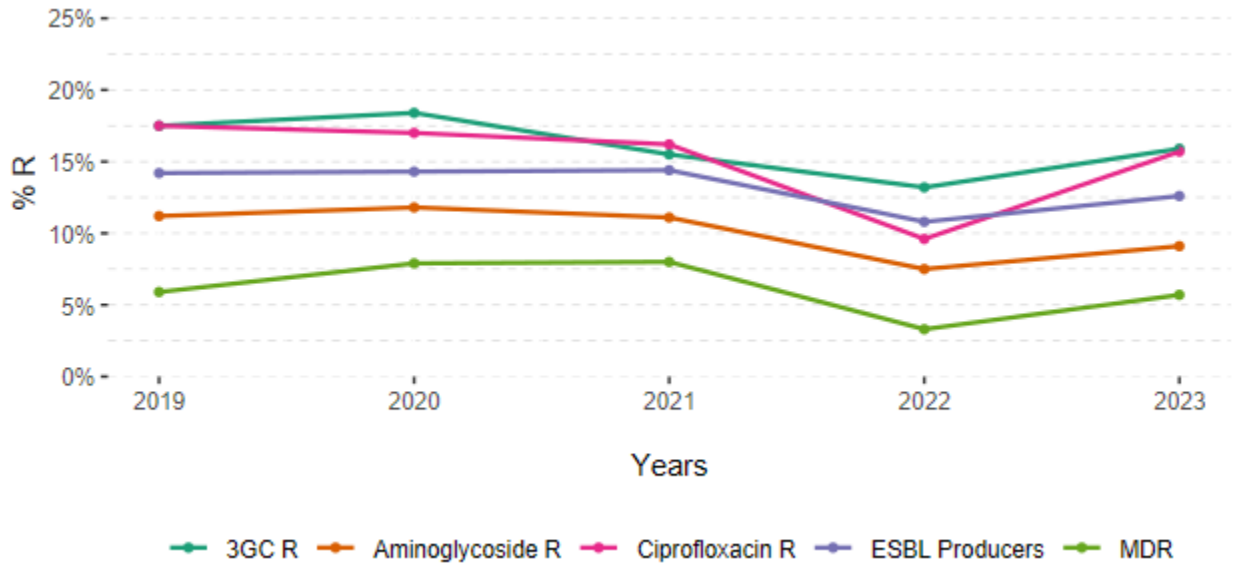
3. Klebsiella pneumoniae

- The number of invasive K. pneumoniae infections increased significantly between 2022 and 2023, from 492 in to 604 in 2023.
- Additionally, resistance to most of key antibiotics also increased between 2022 and 2023. Third generation cephalosporin resistance increased from 13.2% to 15.9%, while ESBL positivity increased from 10.8% to 12.6%.
- Multi-drug resistance (MDR) accounted for 5.6 % of isolates in 2023, an increase from 3.3% in 2022. But this is still lower than pre-2022. A marginal increase was also noted for carbapenem resistance: the proportion of resistant isolates was 1.5% in 2023 compared to 1.2% in 2022. Ten K. pneumoniae isolates were found to be carbapenemase-producers (CPE) in 2023, up from five in 2022.
- Resistance to these key antibiotic groups is still relatively stable and with no significant trend. Compared to other EU/EEA countries, Ireland has relatively low levels of resistance among K. pneumoniae isolates.

Table 14: Antimicrobial Resistance in Invasive *K. pneumoniae* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	543	512	515	492	604
Ampicillin R	99.1%	99.2%	99.8%	100.0%	99.7%
Amoxicillin/Clavulanic Acid R	27.6%	32.2%	32.5%	29.3%	34.2%
Piperacillin/Tazobactam R	22.3%	20.5%	21.3%	21.9%	25.3%
Cefoxitin R	5.2%	6.5%	5.8%	5.7%	8.3%
Cefotaxime/Ceftriaxone R	15.5%	16.9%	14.9%	11.2%	14.3%
Ceftazidime R	14.0%	18.4%	16.1%	12.8%	15.2%
3GC R	17.5%	18.4%	15.5%	13.2%	15.9%
ESBL Producers	14.2%	14.3%	14.4%	10.8%	12.6%
Ciprofloxacin R	17.5%	17.0%	16.2%	9.6%	15.7%
Gentamicin R	10.3%	9.1%	9.3%	7.3%	8.6%
Aminoglycoside R	11.2%	11.8%	11.1%	7.5%	9.1%
MDR	5.9%	7.9%	8.0%	3.3%	5.7%
Carbapenem R	1.1%	1.8%	2.0%	1.2%	1.5%
CPE (n)	6	5	8	5	10

Figure 15: Key Resistance Indicators in Invasive *K. pneumoniae* Infections in Ireland



Third Generation Cephalosporin Resistance and Extended Spectrum Beta-Lactamase Positivity

Table 15: 3rd Generation Cephalosporin Resistance in Invasive *K. pneumoniae* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	543	95	9	439	17.5%
2020	512	94	4	414	18.4%
2021	515	80	1	434	15.5%
2022	492	65	1	426	13.2%
2023	604	96	3	503	15.9%

Figure 16: 3rd Generation Cephalosporin Resistance in Invasive *K. pneumoniae* Infections in the EU/EEA Member States in 2022

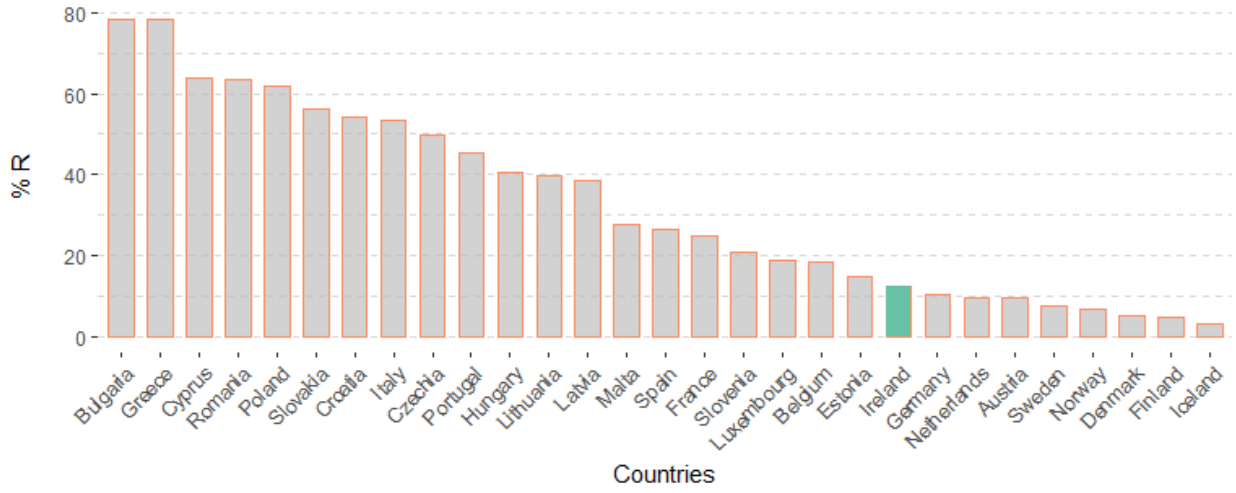


Table 16: ESBL Positivity in Invasive *K. pneumoniae* Infections in Ireland

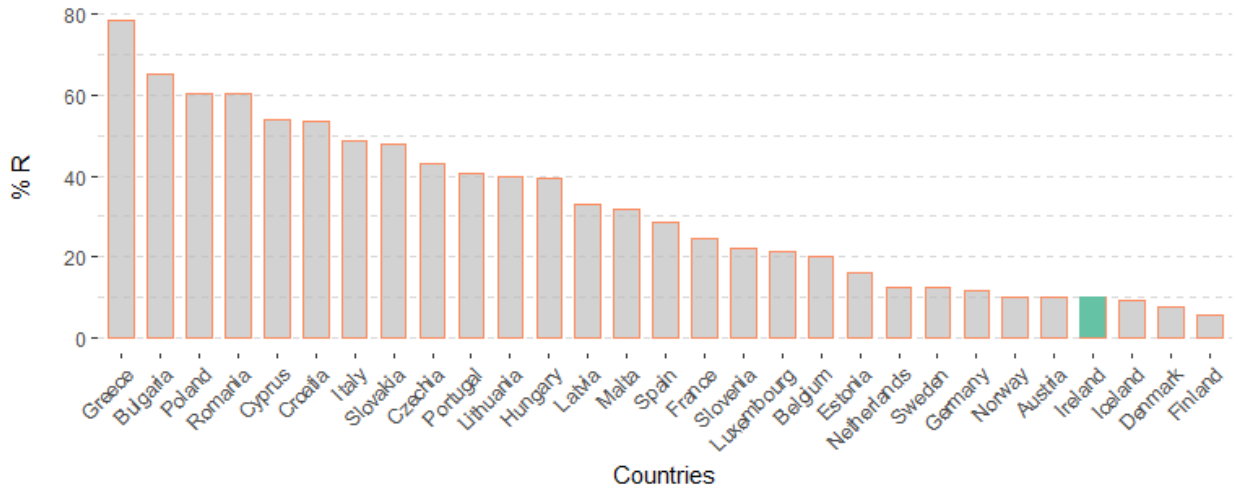
Year	Total Cases	Pos	Neg	ESBL Positivity
2019	543	76	459	14.2%
2020	512	65	391	14.3%
2021	515	70	415	14.4%
2022	492	47	390	10.8%
2023	604	74	515	12.6%

Fluoroquinolone Resistance

Table 17: Fluoroquinolone Resistance in Invasive *K. pneumoniae* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	543	95	18	429	17.5%
2020	512	87	15	409	17.0%
2021	515	83	12	418	16.2%
2022	492	47	8	434	9.6%
2023	604	93	10	490	15.7%

Figure 17: Fluoroquinolone Resistance in Invasive *K. pneumoniae* Infections in the EU/EEA Member States in 2022



Aminoglycoside Resistance

Table 18: Aminoglycoside Resistance in Invasive *K. pneumoniae* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	543	61	5	477	11.2%
2020	512	60	1	449	11.8%
2021	515	57	0	458	11.1%
2022	492	37	0	455	7.5%
2023	604	55	0	548	9.1%

Carbapenem Resistance

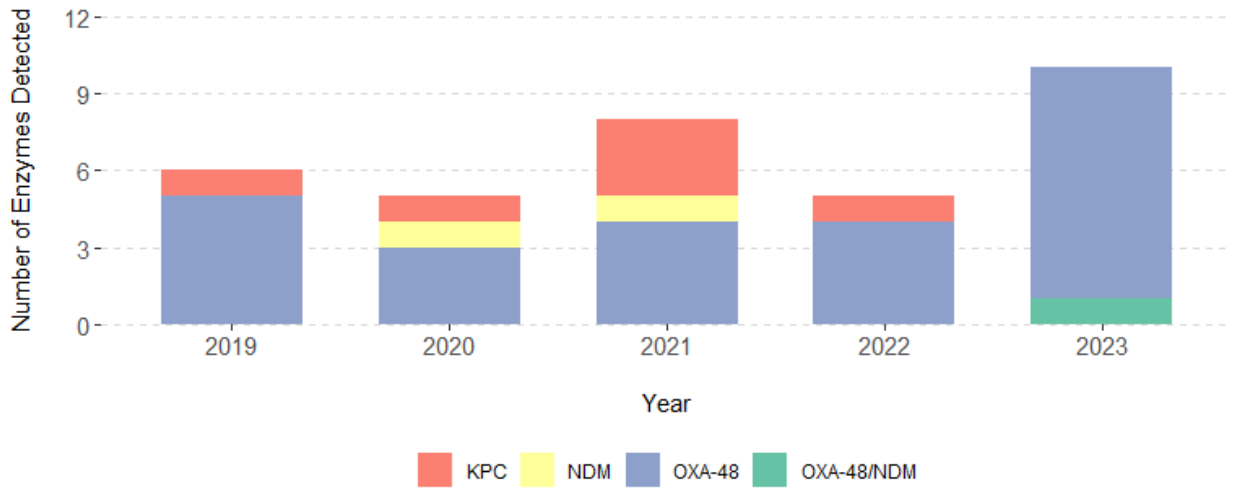
Table 19: Carbapenem Resistance in Invasive *K. pneumoniae* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	543	6	0	537	1.1%
2020	512	9	1	495	1.8%
2021	515	10	0	501	2.0%
2022	492	6	0	485	1.2%
2023	604	9	1	593	1.5%

Table 20: Carbapenemase Producing *K. pneumoniae* Infections in Ireland

Year	KPC	NDM	OXA-48	OXA-48/NDM	Total
2019	1	0	5	0	6
2020	1	1	3	0	5
2021	3	1	4	0	8
2022	1	0	4	0	5
2023	0	0	9	1	10

Figure 18: Carbapenemase Producing *K. pneumoniae* Infections by Enzyme Type in Ireland

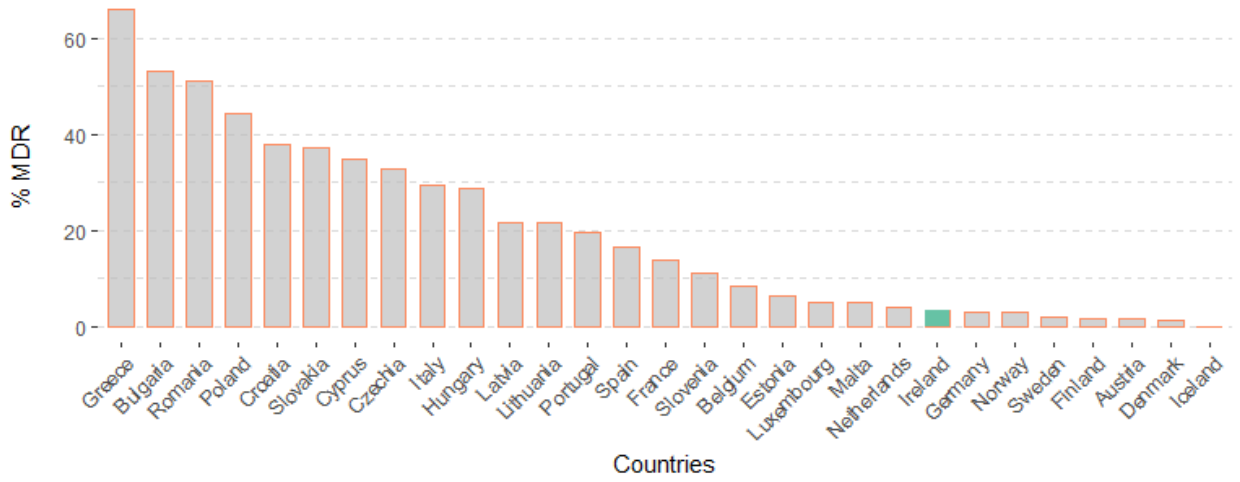


Multi Drug Resistance

Table 21: Multi Drug Resistance in Invasive *K. pneumoniae* Infections in Ireland

Year	Total Cases	MDR	Incomplete	Non-MDR	% MDR
2019	543	32	1	510	5.9%
2020	512	40	3	469	7.9%
2021	515	41	2	472	8.0%
2022	492	16	3	473	3.3%
2023	604	34	12	558	5.7%

Figure 19: Multi Drug Resistance in Invasive *K. pneumoniae* Infections in the EU/EEA Member States in 2022



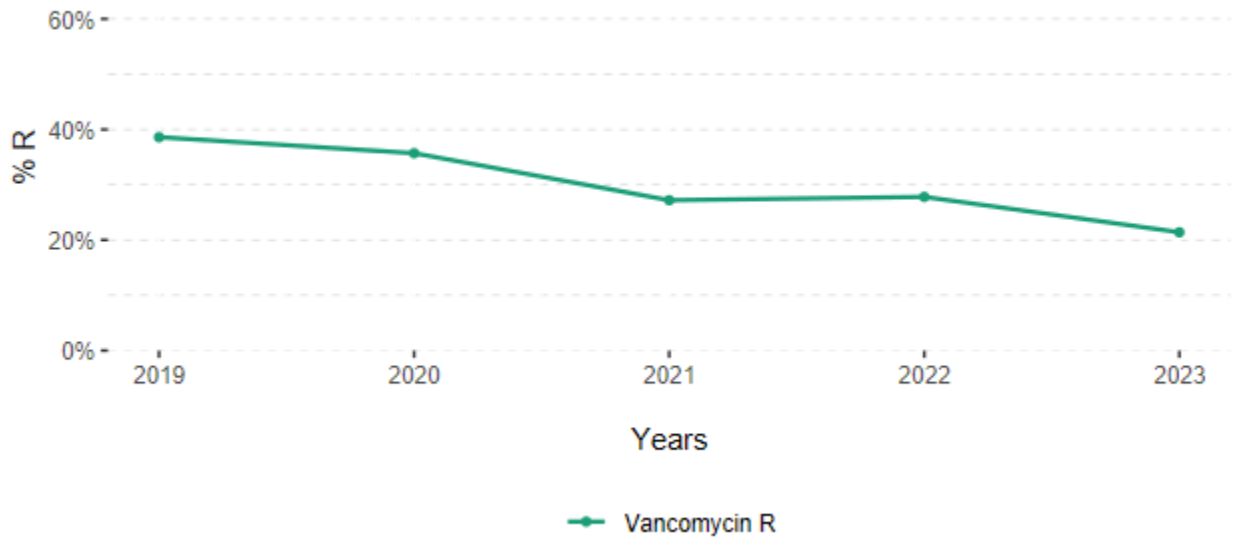
5. Enterococcus faecium

- The number of invasive *E. faecium* infections remained stable between 2022 and 2023.
- Vancomycin-resistance among *E. faecium* (VREfm) has decreased to 21.4% in 2023. Overall, the 5-year trend indicates that the % VREfm is decreasing.
- VRE, especially among *E. faecium* (or VREfm), is a growing problem throughout the EU/EEA area; Ireland is one of a few countries where there has been a decreasing trend in the % VREfm in recent years.
- The VREfm incidence also decreased between 2022 and 2023 from 0.042 infections per 1000 Patient Days to 0.031 infections per 1000 Patient Days. Similarly, overall *E. faecium* incidence decreased between 2022 and 2023.
- However, the VSEfm incidence increased slightly in the last year, from 0.108 infections per 1000 Patient Days to 0.114 infections per 1000 Patient Days.

Table 22: Antimicrobial Resistance in Invasive *E. faecium* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	459	499	619	634	638
Vancomycin R	38.6%	35.7%	27.2%	27.8%	21.4%
Ampicillin R	94.5%	95.4%	94.8%	96.6%	96.2%
High Level Gentamicin R	63.8%	59.2%	60.2%	60.8%	62.2%
Linezolid R	0.4%	1.1%	0.3%	0.6%	0.2%
MDR	27.9%	25.3%	18.1%	17.2%	16.9%

Figure 20: Key Resistance Indicators in Invasive *E. faecium* Infections in Ireland

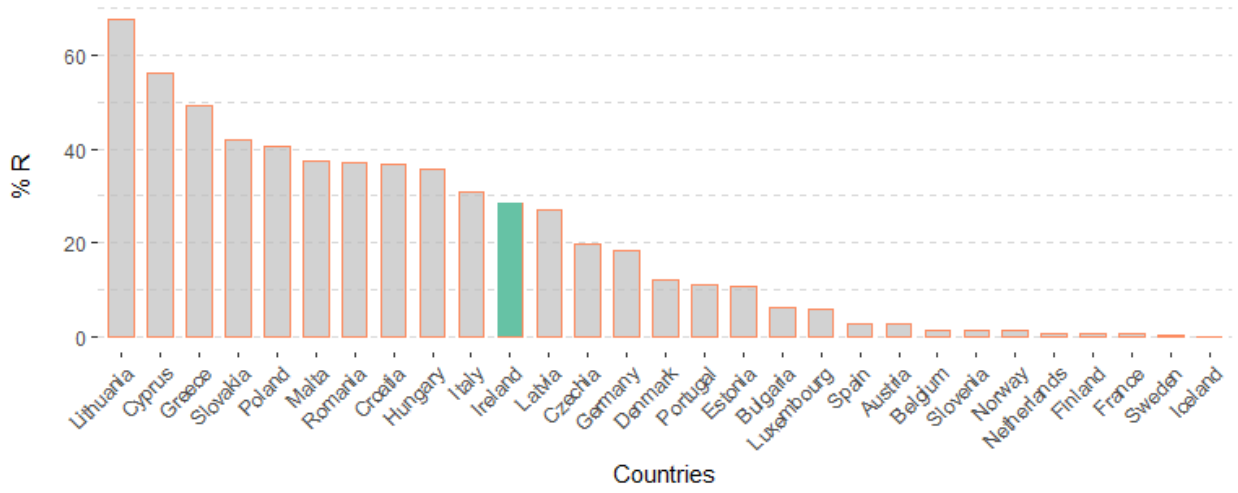


Vancomycin-resistant Enterococcus faecium Proportion

Table 23: Vancomycin Resistance in Invasive *E. faecium* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	459	177	0	282	38.6%
2020	499	178	0	320	35.7%
2021	619	168	0	450	27.2%
2022	634	176	0	456	27.8%
2023	638	136	0	499	21.4%

Figure 21: Vancomycin Drug Resistance in Invasive *E. faecium* Infections in the EU/EEA Member States in 2022

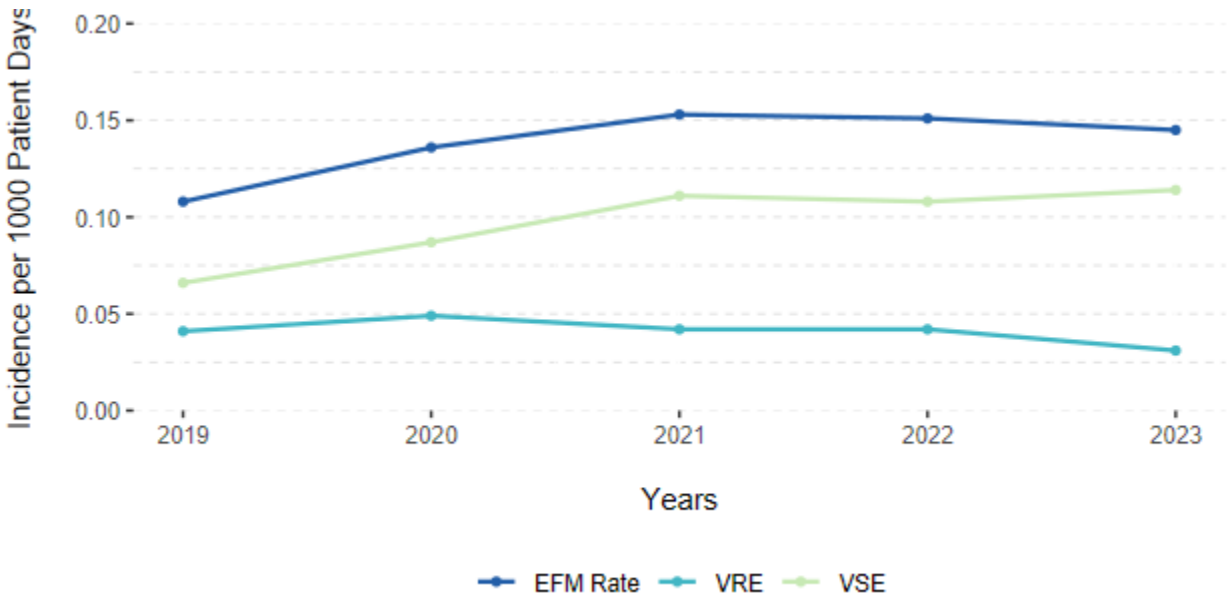


Vancomycin-resistant Enterococcus faecium Incidence

Table 24: Invasive *E. faecium* Incidence in Ireland

Year	Bed Days Used	EFM Rate per 1000 Patient Days	VRE Rate per 1000 Patient Days	VSE Rate per 1000 Patient Days
2019	4,265,555	0.108	0.041	0.066
2020	3,667,687	0.136	0.049	0.087
2021	4,038,076	0.153	0.042	0.111
2022	4,209,051	0.151	0.042	0.108
2023	4,384,954	0.145	0.031	0.114

Figure 22: Invasive *E. faecium* Incidence Rates in Ireland



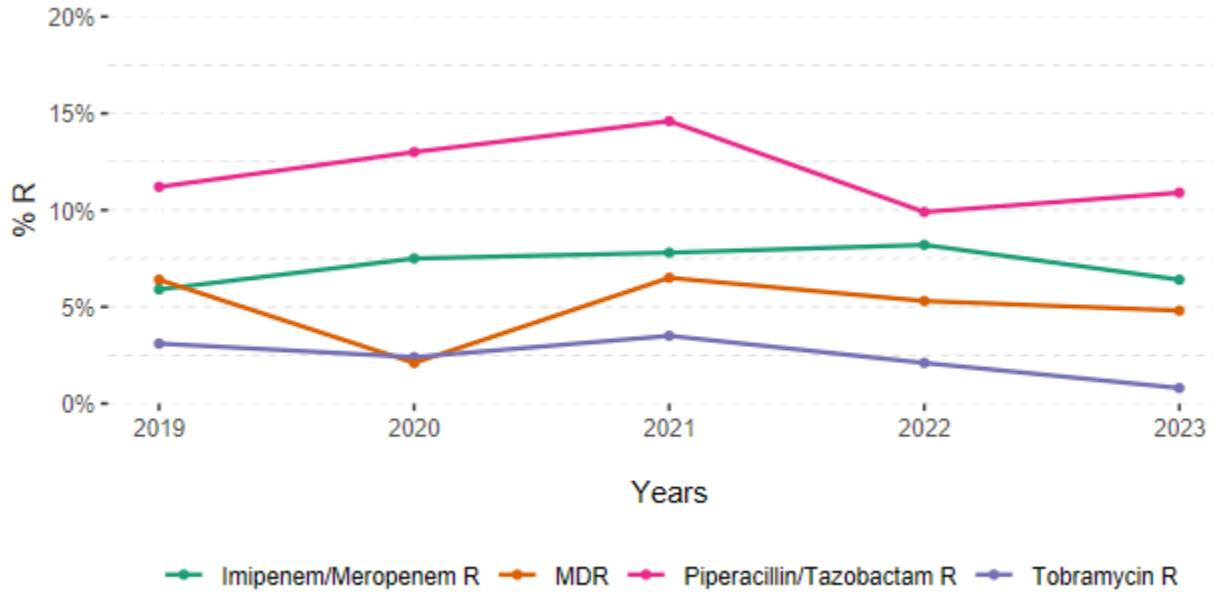
5. Pseudomonas aeruginosa

- The number of invasive *P. aeruginosa* infections slightly decreased between 2022 and 2023. There has been a decreasing trend in resistance to the key antibiotics between 2022 and 2023 with the exception of Piperacillin/Tazobactam.
- The case definition for *P. aeruginosa* in 2020 was amended from 2020 onwards with gentamicin no longer being included among the aminoglycosides for testing against this pathogen following the removal of the breakpoints in EUCAST for this drug-bug combination. In 2023, 4.8% of isolates were MDR, representing a decrease from 5.3% in 2022.

Table 25: Antimicrobial Resistance in Invasive *P. aeruginosa* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	289	271	294	319	296
Piperacillin/Tazobactam R	11.2%	13.0%	14.6%	9.9%	10.9%
Ceftazidime R	9.1%	10.5%	10.7%	9.1%	6.6%
Imipenem/Meropenem R	5.9%	7.5%	7.8%	8.2%	6.4%
Ciprofloxacin R	10.1%	14.7%	9.6%	8.6%	8.0%
Tobramycin R	3.1%	2.4%	3.5%	2.1%	0.8%
MDR	6.4%	2.1%	6.5%	5.3%	4.8%

Figure 23: Key Resistance Indicators in Invasive *P. aeruginosa* Infections in Ireland



Multi Drug Resistance

Table 26: Multi Drug Resistance in Invasive *P. aeruginosa* Infections in Ireland

Year	Total Cases	MDR	Incomplete	Non-MDR	% MDR
2019	289	11	117	161	6.4%
2020	271	3	130	138	2.1%
2021	294	15	62	217	6.5%
2022	319	10	127	179	5.3%
2023	296	8	131	157	4.8%

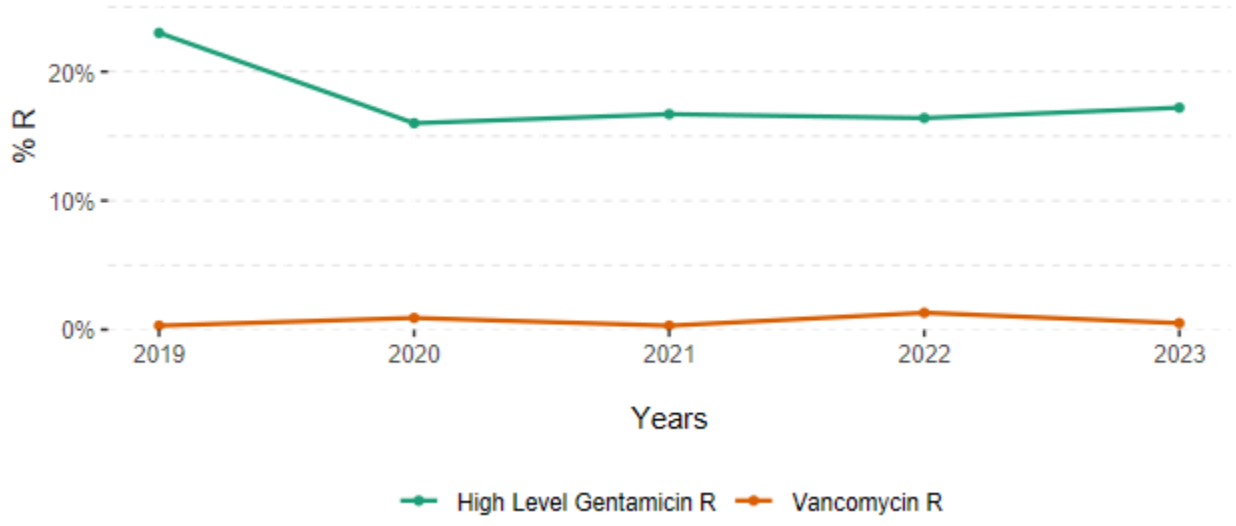
6. Enterococcus faecalis

- The number of invasive *E. faecalis* infections increased slightly between 2022 and 2023, from 375 to 387 respectively.
- Only two isolates were vancomycin-resistant in 2023 (0.5 %).
- High-level gentamicin resistance among *E. faecalis* has remained stable in the last 4 years and it was recorded as 17.2% in 2023.
- Only one linezolid-resistant *E. faecalis* was reported in 2023.

Table 27: Antimicrobial Resistance in Invasive *E. faecalis* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	310	330	365	375	387
Vancomycin R	0.3%	0.9%	0.3%	1.3%	0.5%
Ampicillin R	0.0%	0.9%	0.8%	1.1%	0.5%
High Level Gentamicin R	23.0%	16.0%	16.7%	16.4%	17.2%
Linezolid R	0.0%	0.0%	0.6%	0.0%	0.3%
MDR	0.0%	0.0%	0.0%	0.7%	0.0%

Figure 24: Key Resistance Indicators in Invasive *E. faecalis* Infections in Ireland

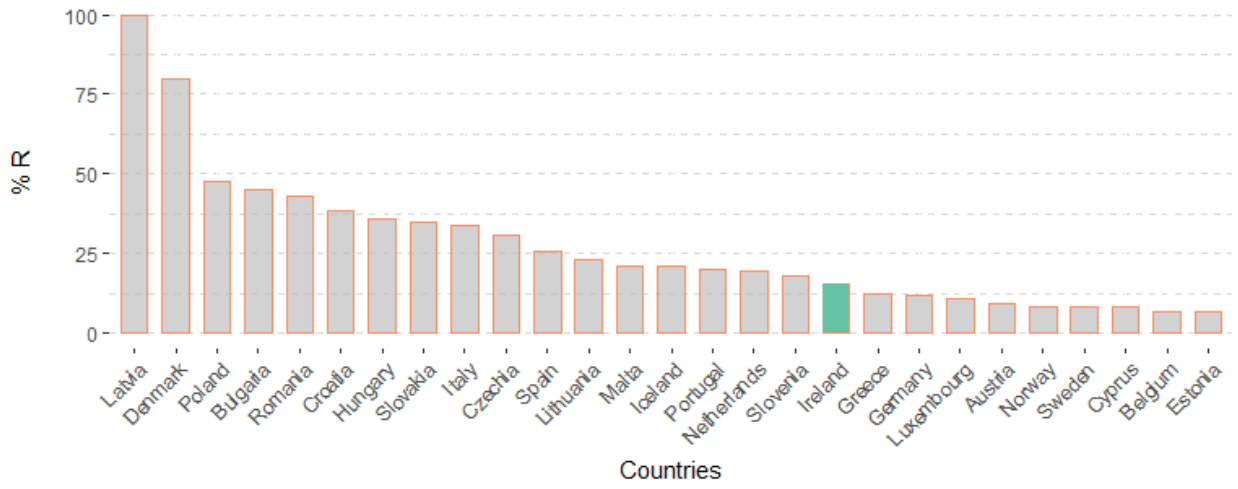


High Level Gentamicin Resistance

Table 28: High Level Gentamicin Resistance in Invasive *E. faecalis* Infections in Ireland

Year	Total Cases	R	I	S	% R
2019	310	56	0	188	23.0%
2020	330	30	0	158	16.0%
2021	365	46	0	229	16.7%
2022	375	45	0	230	16.4%
2023	387	55	1	264	17.2%

Figure 25: High Level Gentamicin Resistance in Invasive *E. faecalis* Infections in the EU/EEA Member States in 2022



7. Acinetobacter species

- The number of invasive *Acinetobacter* spp. infections decreased from 80 in 2022 to 71 in 2023.
- Resistance to all key antibiotics, including carbapenems, remains at low levels (<3%).
- No multi-drug resistance (MDR) or carbapenem resistance among invasive *Acinetobacter* spp. infections was reported in Ireland in 2023.
- MDR and carbapenem resistant *Acinetobacter* spp. is a major problem in Southern and Eastern European countries, with 16 countries reporting proportions in excess of 75% in 2022.

Table 29: Antimicrobial Resistance in Invasive *Acinetobacter* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	67	53	72	80	71
Fluoroquinolone R	9.1%	7.3%	3.1%	1.4%	1.4%
Gentamicin R	1.7%	2.2%	3.1%	1.6%	0.0%
Aminoglycoside R	3.4%	2.2%	3.0%	1.5%	1.5%
Imipenem/Meropenem R	1.6%	0.0%	1.5%	2.5%	0.0%
MDR	1.9%	0.0%	0.0%	0.0%	0.0%

Figure 26: Key Resistance Indicators in Invasive *Acinetobacter* Infections in Ireland

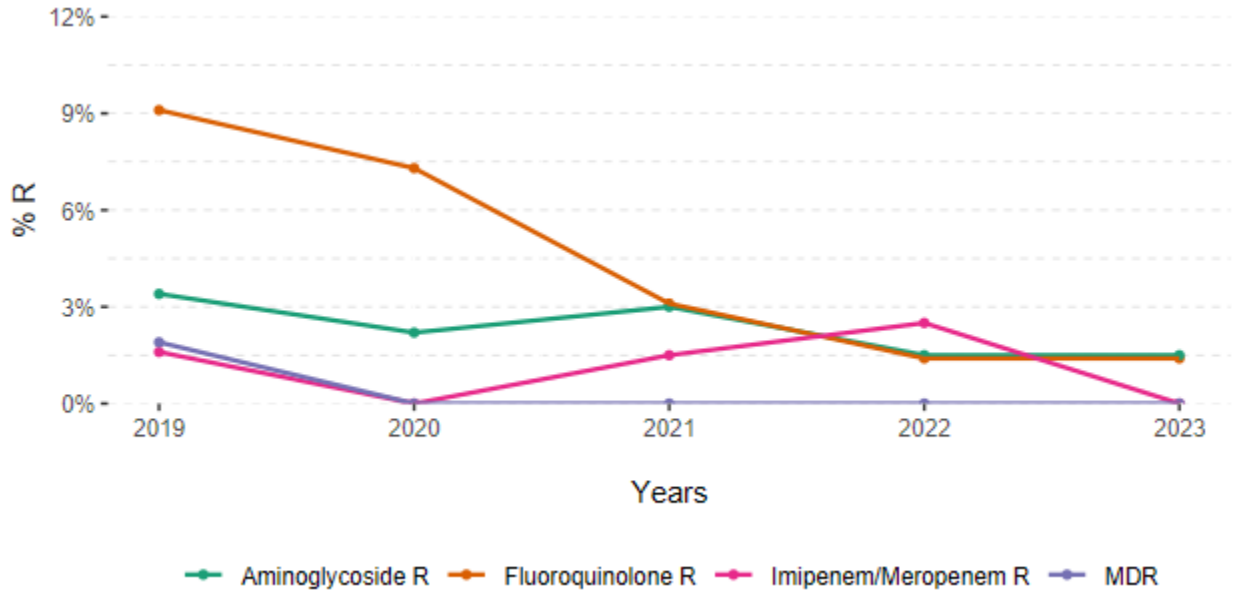
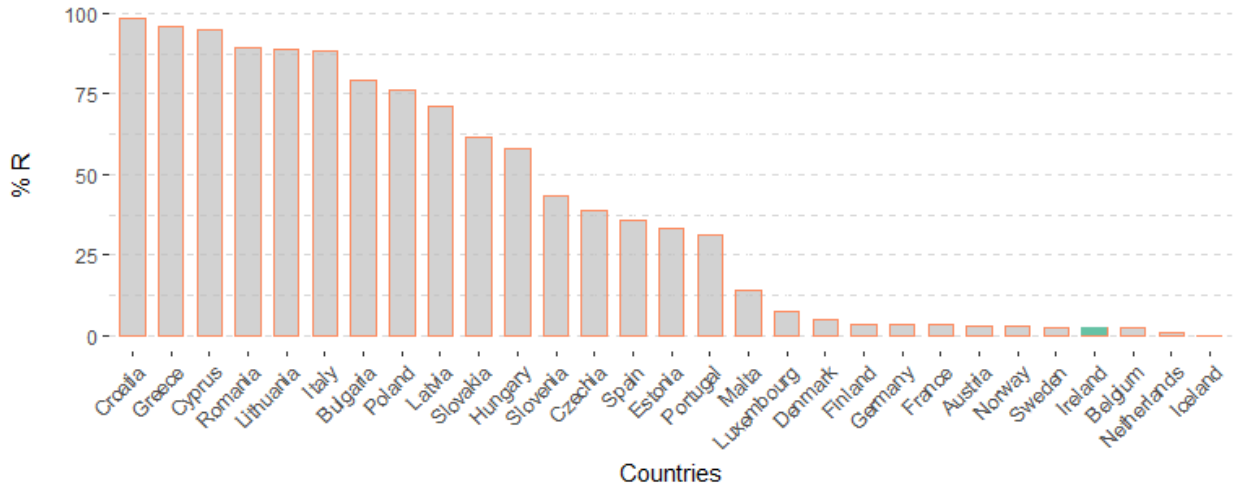


Figure 27: Carbapenem Resistance in Invasive *Acinetobacter* Infections in the EU/EEA Member States in 2022



8. Streptococcus pneumoniae

- The number of invasive *S. pneumoniae* infections increased by 69% between 2021 and 2022. The increase wasnt as dramatic between 2022 and 2023. However, the number of infections have now returned to pre-pandemic levels.
- Penicillin non-wild type (Pen-NWT) refers to *S. pneumoniae* isolates reported as either "susceptible, increased exposure"(I) or resistant (R); with MICs above those of the wild type isolates (>0.06mg/L). Wild type (WT) organisms are those with no phenotypically detectable resistance mechanisms (acquired or by mutation) to a particular antimicrobial. Penicillin-WT strains of *S. pneumoniae* are typically susceptible to penicillin.
- In 2023, 17.5% of all invasive *S. pneumoniae* isolates were penicillin non-wild type (Pen-NWT) representing a decrease from 23.6% in 2022.

Table 30: Antimicrobial Resistance in Invasive *Streptococcus pneumoniae* Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	372	189	179	305	360
Typed Isolates (n)	349	170	154	276	335
Typed Isolates (%)	93.8%	89.9%	86.0%	90.5%	93.1%
Pen Non-WT (n)	52	32	34	72	61
Pen Non-WT (%)	14.0%	16.9%	19.0%	23.6%	17.5%
Pen R (Pen-Non-WT)	0.8%	0.0%	1.1%	2.0%	1.7%
Pen I (Pen-Non-WT)	13.2%	16.9%	17.9%	21.6%	15.3%
Erythromycin R	12.5%	13.2%	12.2%	16.5%	14.1%

Figure 28: Key Resistance Indicators in Invasive *Streptococcus pneumoniae* Infections in Ireland

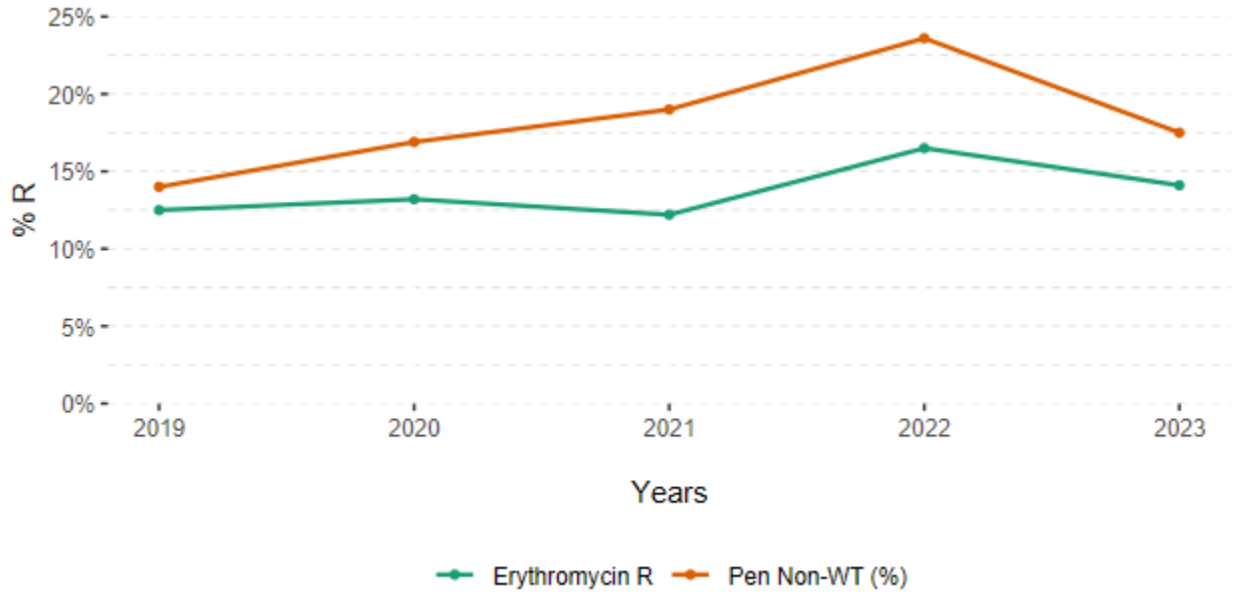
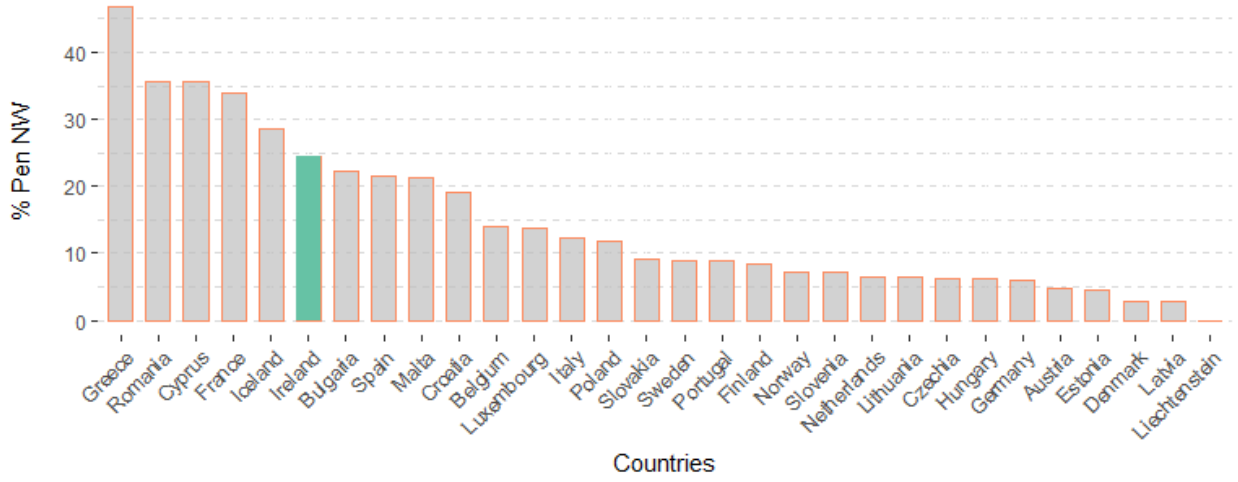


Figure 29: Penicillin resistance in Invasive *Streptococcus pneumoniae* Infections in the EU/EEA Member States in 2022



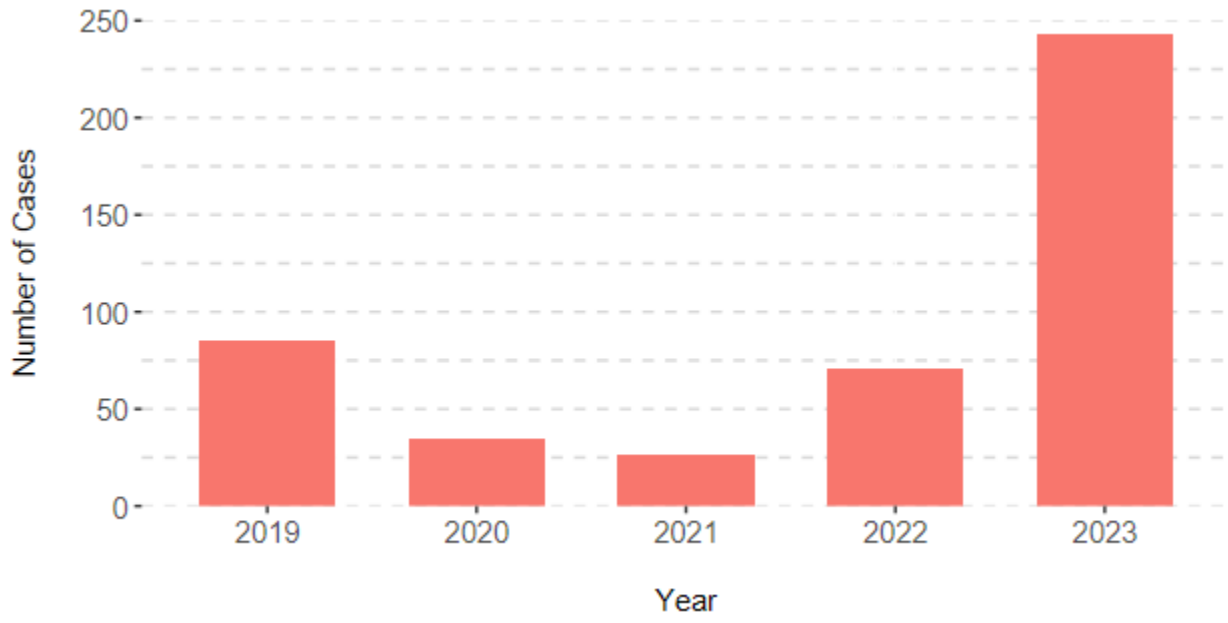
9. Invasive Group A Streptococcus (iGAS)

- iGAS infections decreased significantly during the COVID-19 pandemic but an unusual upsurge in cases was observed at the end of 2022. For more details, see the iGAS section on HPSC's website.
- Erythromycin resistance among iGAS isolates was low during the pre-pandemic years (2019, approx. 5%). During the pandemic years (2020-2021), resistance increased to 17% coinciding with very low numbers of iGAS cases being reported (with EARS-Net data mirroring iGAS notifications on CIDR). Since 2022, resistance has decreased to pre-pandemic levels (2023, 3.5%).

Table 31: Antimicrobial Resistance in iGAS Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	85	35	26	71	243
Typed Isolates (n)	77	28	22	62	220
Typed Isolates (%)	90.6%	80.0%	84.6%	87.3%	90.5%
Erythromycin R	4.9%	17.1%	16.7%	9.2%	3.5%

Figure 30: Number of iGAS Infections in Ireland in the Last 5 Years



10. Invasive Group B Streptococcus (iGBS)

- The number of iGBS infections remained relatively stable in the last three years. Erythromycin resistance decreased in the first year of COVID-19 pandemic to 26.7%. However, it increased back to 42% in 2021 and has remained stable at around 40 % over the last three years.

Table 32: Antimicrobial Resistance in iGBS Infections in Ireland

	2019	2020	2021	2022	2023
Total Isolates	176	119	139	138	125
Typed Isolates (n)	88	49	44	20	68
Typed Isolates (%)	50.0%	41.2%	31.7%	14.5%	54.4%
Erythromycin R	41.9%	26.7%	41.9%	40.9%	41.4%

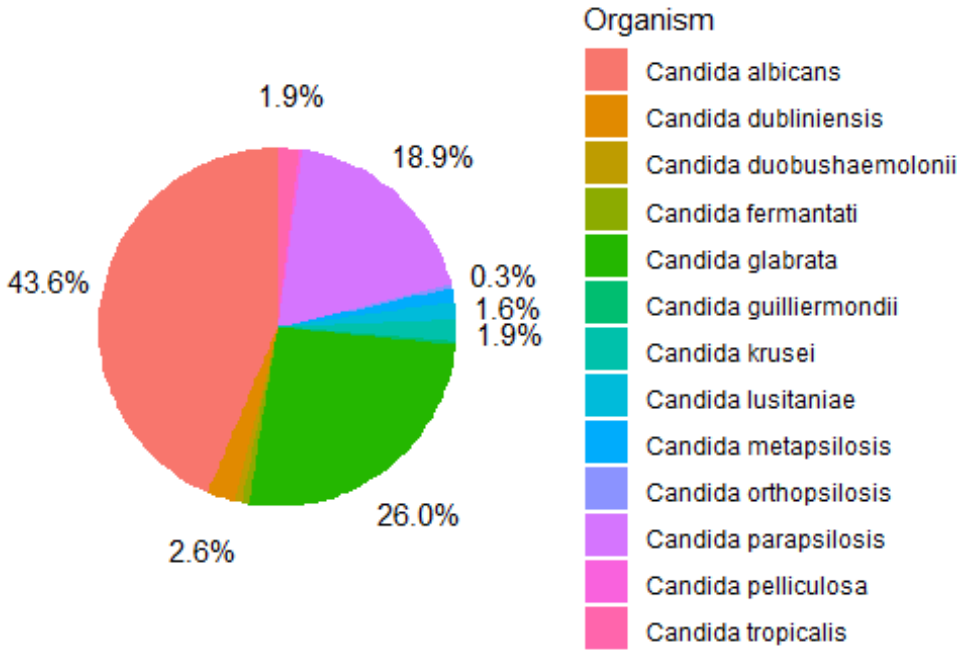
11. Candida species

- The number of Candida infections has been relatively stable in the last three years. In 2023, 26 laboratories reported 312 cases of invasive *Candida spp.* infections. No cases were reported from 7 laboratories.
- *C. auris* is a recently emerged pathogen causing severe hospital-acquired systemic infections. It is very important to speciate *Candida* isolates to exclude *C. auris* from the diagnosis.
- In 2023, all *Candida* isolates were speciated. Since the surveillance started in 2017, no *C. auris* from invasive infections have been reported.

Table 33: Antimicrobial Resistance in Invasive *Candida* Infections in Ireland

Organism	2019	2020	2021	2022	2023
Candida albicans	118	85	124	129	136
Candida glabrata	70	53	77	84	81
Candida parapsilosis	44	57	51	49	59
Candida dubliniensis	6	5	10	4	8
Candida krusei	2	0	6	1	6
Candida tropicalis	9	4	17	9	6
Candida lusitaniae	5	5	2	4	5
Candida metapsilosis	0	0	0	1	4
Candida duobushaemolonii	0	0	0	0	2
Candida fermentati	0	0	0	0	2
Candida guilliermondii	3	1	1	3	1
Candida pelliculosa	1	0	0	0	1
Candida orthopsilosis	0	0	1	0	1
Candida spp.	4	11	0	1	0
Candida lipolyticas	1	0	1	0	0
Candida auris	0	0	0	0	0
Total	263	221	290	285	312

Figure 31: Invasive *Candida* Infections In the Latest Year by Species in Ireland



Acknowledgements

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