

# AUSTRIA

Participating institutions:

Federal Ministry of Social Affairs, Health, Care and Consumer Protection, [www.sozialministerium.at](http://www.sozialministerium.at)

Medical University Vienna, [www.meduniwien.ac.at](http://www.meduniwien.ac.at)

Ordensklinikum Linz, Elisabethinen, [www.ordensklinikum.at](http://www.ordensklinikum.at)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Austria, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	ND	ND	ND	ND	90
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	24.2	ND	ND	ND	ND

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Austria, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	97	95	NA	100	97

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Austria, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	38	5 686	9	38	6 305	8	37	5 394	8	37	5 579	7	35	5 122	9
<i>K. pneumoniae</i>	38	1 228	14	38	1 333	14	36	1 133	17	36	1 326	15	34	1 256	13
<i>P. aeruginosa</i>	38	737	16	38	808	13	36	727	18	36	788	16	34	726	15
<i>Acinetobacter</i> spp.	28	95	12	23	82	13	22	69	12	25	80	16	21	101	7
<i>S. aureus</i>	38	3 310	13	38	3 419	12	36	2 934	14	36	3 444	14	36	3 124	12
<i>S. pneumoniae</i>	38	567	18	37	550	18	34	301	10	33	347	16	34	476	15
<i>E. faecalis</i>	38	837	17	37	792	16	35	840	21	36	898	23	35	918	15
<i>E. faecium</i>	35	524	28	34	537	33	32	509	30	31	701	36	30	668	31

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Austria

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	2.66	<b>2.17</b>	1.56	1.22	1.51	↓	<b>-30.4</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	7.29	<b>7.14</b>	6.35	5.71	5.25	↓	<b>-26.5</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.15	<b>0.20</b>	0.12	0.15	0.14	-	<b>-32.2</b>

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime, or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Austria, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	5 456	50.7	6 042	46.3	4 798	46.0	4 805	45.1	4 669	45.9	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5 672	10.2	6 106	9.3	5 376	9.5	5 537	8.3	5 096	8.3	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	5 564	0.1	5 935	0.0	5 141	0.1	5 206	0.0	4 973	0.1	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 679	21.9	6 111	18.2	5 373	17.3	5 539	15.1	4 788	13.9	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	5 616	8.2	6 102	6.9	5 219	6.2	5 320	5.8	4 653	5.5	9.7 (4.4-24.3)	↓*
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	5 598	3.6	6 072	2.7	5 192	2.8	5 286	1.7	4 307	2.0	5.1 (1.5-14.2)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 221	8.4	1 326	10.3	1 124	7.8	1 305	9.8	1 233	9.6	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 184	1.0	1 296	1.2	1 055	0.9	1 229	1.0	1 247	0.9	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 221	13.2	1 327	15.7	1 129	12.0	1 303	12.0	1 183	10.0	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 214	4.8	1 319	5.5	1 085	3.7	1 235	3.4	1 157	2.9	22.5 (0.0-67.9)	↓*
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 203	3.1	1 312	3.0	1 076	2.8	1 227	2.2	1 066	1.6	20.0 (0.0-66.2)	↓
	Piperacillin-tazobactam resistance	650	10.6	665	9.5	624	9.0	643	10.1	607	11.4	19.3 (3.8-50.5)	-
	Ceftazidime resistance	729	10.3	781	8.5	688	9.4	741	13.0	664	11.4	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	736	12.8	786	13.4	683	15.1	737	15.9	677	16.4	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	736	14.0	805	10.7	676	14.3	722	16.6	659	15.8	18.6 (2.8-49.2)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	729	6.3	784	3.8	426	2.6	438	4.1	436	3.7	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	639	5.3	633	5.1	355	3.9	279	4.3	255	9.0	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	91	4.4	81	7.4	69	7.2	70	10.0	94	3.2	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	91	7.7	82	9.8	69	10.1	80	13.8	94	1.1	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	92	8.7	82	7.3	66	7.6	75	10.7	74	0.0	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	88	4.5	81	6.2	66	6.1	70	10.0	67	0.0	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	3 307	6.4	3 323	5.2	2 843	4.4	3 159	3.1	3 108	3.9	15.2 (1.1-50.8)	↓*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	523	6.3	458	6.8	258	3.9	324	5.2	460	4.8	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	562	11.6	547	12.4	295	11.5	335	14.3	468	10.9	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	519	3.3	455	3.5	252	2.4	315	2.5	452	2.0	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	417	28.3	285	22.8	258	14.3	255	14.5	299	9.4	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	524	2.1	537	3.2	507	3.6	697	2.0	666	2.7	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# BELGIUM

Participating institutions:

Sciensano, [www.sciensano.be](http://www.sciensano.be)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Belgium, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)					
Laboratories collecting <i>S. pneumoniae</i>	91	87	91	91	91
Laboratories collecting other species	36	26	36	43	42
Geographical representativeness					
Laboratories collecting <i>S. pneumoniae</i>	High	High	High	High	High
Laboratories collecting other species	Medium	Medium	High	High	High
Hospital representativeness	High	High	High	High	Medium
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	99.1 <sup>a</sup>	87.5 <sup>a</sup>	129.6 <sup>a</sup>	100.8 <sup>a</sup>	115.8 <sup>a</sup>

<sup>a</sup> Not including *S. pneumoniae* network

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Belgium, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	91	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	82	91	NA	94	94

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Belgium, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	32	4 675	NA	27	3 940	NA	28	4 320	NA	31	4 722	NA	31	4 540	NA
<i>K. pneumoniae</i>	31	956	NA	26	759	NA	27	912	NA	30	926	NA	29	888	NA
<i>P. aeruginosa</i>	30	490	NA	27	441	NA	28	504	NA	30	479	NA	29	456	NA
<i>Acinetobacter</i> spp.	26	134	NA	23	94	NA	23	161	NA	28	169	NA	27	170	NA
<i>S. aureus</i>	31	1 750	NA	27	1 169	NA	28	1 455	NA	30	1 615	NA	30	1 501	NA
<i>S. pneumoniae</i>	88	1 526	NA	89	1 548	NA	89	858	27	82	843	24	80	1 457	24
<i>E. faecalis</i>	31	615	NA	26	496	NA	29	669	NA	31	712	NA	31	642	NA
<i>E. faecium</i>	30	441	NA	25	343	NA	26	494	NA	29	502	NA	29	424	NA

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Belgium

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	3.83	2.62	2.43	1.33	1.27	↓	-51.5
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	10.21	13.19	10.29	7.84	8.07	↓	-38.9
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.32	0.27	0.24	0.26	0.25	-	-8.5

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Belgium, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018–2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	4 445	55.8	3 601	56.5	4 009	56.5	4 389	55.2	4 205	56.6	53.4 (32.5–68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4 644	9.0	3 937	10.0	4 320	9.9	4 721	8.3	4 500	8.8	14.3 (5.8–40.2)	-
	Carbapenem (imipenem/meropenem) resistance	4 641	0.1	3 926	0.1	4 126	0.0	4 722	0.0	4 296	0.1	0.2 (0.0–1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	4 211	21.8	3 925	19.1	4 320	18.1	4 721	18.5	4 536	17.5	22.0 (9.9–46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	3 822	7.4	3 922	6.9	4 312	7.5	4 267	6.1	3 733	6.4	9.7 (4.4–24.3)	↓
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	3 809	3.1	3 920	3.0	4 312	2.9	4 265	1.7	3 694	2.1	5.1 (1.5–14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	935	21.4	759	19.5	912	19.7	926	18.9	879	18.3	32.7 (3.1–78.5)	-
	Carbapenem (imipenem/meropenem) resistance	935	1.4	757	1.1	881	1.1	926	1.4	835	1.4	10.9 (0.0–72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	932	22.6	757	19.8	911	22.8	926	19.0	887	20.2	32.0 (5.7–78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	747	12.4	755	11.4	910	13.1	858	9.7	726	10.6	22.5 (0.0–67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	742	9.8	755	8.7	909	10.3	858	7.9	716	8.5	20.0 (0.0–66.2)	-
	Piperacillin-tazobactam resistance	430	10.0	439	12.1	503	11.1	478	10.0	438	11.9	19.3 (3.8–50.5)	-
	Ceftazidime resistance	441	7.5	427	8.2	489	9.0	464	8.0	421	9.5	16.2 (2.1–56.6)	-
	Carbapenem (imipenem/meropenem) resistance	487	7.4	440	10.7	474	12.4	479	10.6	452	14.8	18.6 (2.4–53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	451	14.0	440	14.3	503	14.7	479	14.0	456	14.7	18.6 (2.8–49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	406	8.4	438	7.1	304	6.3	257	7.0	190	6.8	8.9 (0.0–42.2)	NA
<i>Acinetobacter</i> species	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	366	5.5	423	6.1	289	8.0	243	8.2	166	13.3	13.4 (0.0–47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	132	3.8	94	0.0	160	1.3	167	1.2	168	2.4	36.3 (1.0–98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	134	12.7	93	8.6	141	15.6	146	12.3	156	8.3	38.8 (0.0–98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	122	7.4	85	3.5	148	2.7	153	5.2	143	1.4	34.1 (0.0–96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	120	3.3	84	0.0	127	0.8	130	1.5	129	0.0	31.8 (0.0–96.2)	-
	MRSA <sup>f</sup>	1 735	9.0	1 168	6.7	1 455	6.9	1 614	4.1	1 492	4.2	15.2 (1.1–50.8)	↓*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	1 526	0.1	1 548	9.7	858	14.5	843	18.0	1 457	14.1	16.3 (2.8–46.7)	↑*
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 526	15.2	1 548	15.7	858	19.1	843	16.5	1 457	14.6	17.9 (3.4–36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	1 526	0.1	1 548	5.7	858	8.7	843	9.8	1 457	8.0	9.7 (0.8–33.3)	↑*
<i>E. faecalis</i>	High-level gentamicin resistance	390	12.3	363	16.8	296	13.2	351	8.5	325	6.8	25.3 (6.7–100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	436	1.8	343	0.6	491	2.9	502	2.8	423	1.4	17.6 (0.0–67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# BULGARIA

Participating institutions:

National Center of Infectious and Parasitic Diseases,

[https://ncipd.org/index.php?option=com\\_content&view=featured&Itemid=730&lang=en](https://ncipd.org/index.php?option=com_content&view=featured&Itemid=730&lang=en)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Bulgaria, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	46	45	45	45	45
Geographical representativeness	Medium	Medium	Medium	Medium	Medium
Hospital representativeness	Low	Medium	Medium	Medium	Medium
Isolate representativeness	Medium	Medium	Medium	Medium	Medium
Blood culture sets/1 000 patient-days	8.5	8.6	10.4	11.4	11.3

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Bulgaria, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	96	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Bulgaria, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	22	292	22	23	352	23	23	261	19	22	263	15	18	239	21
<i>K. pneumoniae</i>	21	193	47	20	267	53	19	249	48	19	242	47	20	260	43
<i>P. aeruginosa</i>	18	90	36	16	107	40	17	70	51	15	83	45	14	76	54
<i>Acinetobacter</i> spp.	19	110	66	15	132	60	14	129	60	18	217	70	15	160	66
<i>S. aureus</i>	22	313	29	23	324	23	23	220	22	19	211	15	20	233	22
<i>S. pneumoniae</i>	14	42	17	14	46	35	9	28	21 <sup>c</sup>	6	11	NA	10	27	30 <sup>c</sup>
<i>E. faecalis</i>	20	150	34	20	150	35	19	165	41	21	190	37	20	145	30
<i>E. faecium</i>	20	91	49	17	99	31	16	77	57	13	148	62	15	145	54

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Bulgaria

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	1.63	1.43	0.78	0.96	0.85	↓	-40.3
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3.73	4.05	3.24	2.95	2.92	↓	-27.7
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	1.24	2.24	2.19	3.52	3.91	↑	+74.9

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Bulgaria, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	287	66.6	352	63.4	261	66.7	263	61.2	239	68.6	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	292	38.7	352	38.6	261	41.4	263	37.3	239	40.2	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	292	1.4	352	0.0	261	0.8	263	0.4	239	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	292	41.8	352	38.6	261	42.9	263	33.5	239	40.6	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	275	28.4	352	24.4	219	34.2	263	27.0	239	24.3	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	275	19.6	352	19.0	219	18.7	263	14.8	239	14.2	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	193	77.7	267	75.7	249	79.1	242	81.4	260	78.5	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	193	21.2	267	27.0	249	28.1	242	46.3	260	47.3	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	193	62.7	267	60.7	249	67.1	242	71.1	260	65.4	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	191	59.2	267	57.3	230	67.0	242	69.0	260	61.9	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	191	47.6	267	44.9	230	57.4	242	59.9	260	53.1	20.0 (0.0-66.2)	↑*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	89	32.6	107	31.8	70	64.3	83	43.4	76	48.7	19.3 (3.8-50.5)	↑*
	Ceftazidime resistance	90	20.0	107	30.8	70	54.3	83	45.8	76	56.6	16.2 (2.1-56.6)	↑*
	Carbapenem (imipenem/meropenem) resistance	90	25.6	107	25.2	70	42.9	83	32.5	76	40.8	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	90	30.0	107	29.9	70	52.9	83	31.3	76	39.5	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	90	24.4	107	31.8	50	32.0	83	25.3	55	36.4	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	89	25.8	107	30.8	50	50.0	83	31.3	55	45.5	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	110	74.5	132	72.0	129	82.9	217	77.9	160	79.4	36.3 (1.0-98.6)	-
<i>Acinetobacter species</i>	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	110	78.2	132	74.2	129	82.9	217	80.2	160	80.6	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	110	73.6	132	78.0	129	76.0	217	81.6	160	81.3	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	110	66.4	132	69.7	129	72.9	217	71.9	160	75.0	31.8 (0.0-96.2)	-
	Carbapenem (imipenem/meropenem) resistance	110	74.5	132	72.0	129	82.9	217	77.9	160	79.4	36.3 (1.0-98.6)	-
<i>S. aureus</i>	MRSA <sup>f</sup>	313	17.6	324	14.8	220	11.8	211	15.2	233	12.0	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	42	9.5	46	8.7	28	7.1 <sup>h</sup>	11	NA	27	22.2 <sup>h</sup>	16.3 (2.8-46.7)	NA
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	42	16.7	46	30.4	28	10.7 <sup>h</sup>	11	NA	27	22.2 <sup>h</sup>	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	42	2.4	46	8.7	28	3.6 <sup>h</sup>	11	NA	27	11.1 <sup>h</sup>	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	150	39.3	150	37.3	165	47.9	190	48.4	145	44.8	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	91	9.9	99	12.1	77	7.8	148	10.1	145	6.2	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cofoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# CROATIA

Participating institutions:

Reference Center for Antimicrobial Resistance Surveillance, <https://bfm.hr/referentni-centar-za-pracenje-rezistencije-bakterija-na-antibiotike/>

Ministry of Health Zagreb University Hospital for Infectious Diseases (Dr. Fran Mihaljević), <https://bfm.hr/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Croatia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	80	ND	80	100	90
Geographical representativeness	High	ND	High	High	High
Hospital representativeness	High	ND	High	High	High
Isolate representativeness	High	ND	High	High	High
Blood culture sets/1 000 patient-days	ND	ND	109.0	38.3	34.0

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Croatia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	87	97

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Croatia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	19	1 216	5	19	1 123	8	19	828	7	19	729	12	23	989	13
<i>K. pneumoniae</i>	19	332	14	17	328	14	16	270	20	18	361	32	22	369	30
<i>P. aeruginosa</i>	17	200	16	15	185	15	18	165	32	15	214	45	20	263	37
<i>Acinetobacter</i> spp.	14	155	26	16	143	31	14	225	73	18	408	75	21	291	60
<i>S. aureus</i>	18	458	11	15	360	11	19	424	16	18	600	30	21	618	21
<i>S. pneumoniae</i>	17	146	9	16	156	20	12	55	17	14	80	23	20	83	18
<i>E. faecalis</i>	16	145	12	14	127	16	16	162	23	17	199	38	20	215	25
<i>E. faecium</i>	11	71	13	11	74	19	16	88	28	14	113	50	18	133	37

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Croatia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	3.68	2.73	3.82	5.18	5.44	↑	+99.4
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5.27	5.31	4.22	3.34	4.93	-	-7.1
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.21	1.20	1.57	2.87	2.52	↑	+110.8

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Croatia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	1 214	57.7	1 108	57.1	827	57.7	728	55.8	981	55.8	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 168	14.8	1 085	15.9	827	16.6	726	18.6	987	17.4	14.3 (5.8-40.2)	↑
	Carbapenem (imipenem/meropenem) resistance	1 190	0.0	1 090	0.2	820	0.0	686	0.0	980	0.1	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 199	30.0	1 108	27.3	826	29.7	721	29.0	975	30.3	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 210	14.9	1 112	14.8	828	14.9	725	11.7	985	16.0	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 150	9.2	1 064	9.2	825	8.7	714	7.3	973	7.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	318	44.3	317	53.0	270	52.2	361	62.0	369	54.2	32.7 (3.1-78.5)	↑*
	Carbapenem (imipenem/meropenem) resistance	325	2.2	325	12.0	267	19.1	353	32.9	367	24.0	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	327	48.6	318	57.9	268	54.1	360	63.9	363	53.7	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	330	36.4	325	42.8	270	38.1	356	46.6	366	41.5	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	312	28.2	312	38.1	268	35.8	355	43.4	362	38.1	20.0 (0.0-66.2)	↑*
	Piperacillin-tazobactam resistance	196	11.2	182	14.3	164	10.4	209	10.5	260	12.7	19.3 (3.8-50.5)	-
	Ceftazidime resistance	195	17.9	173	20.2	164	18.9	212	17.5	258	22.5	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	199	27.6	183	26.2	165	30.3	214	31.3	263	35.0	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	200	29.0	181	29.8	165	23.0	213	19.7	261	26.8	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	199	21.6	183	20.2	ND	ND	ND	ND	ND	ND	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	190	18.4	166	19.3	ND	ND	ND	ND	ND	ND	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	155	95.5	143	92.3	225	96.4	407	99.5	291	98.6	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	155	96.1	142	93.7	224	98.2	405	99.8	289	98.6	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	153	91.5	140	92.1	225	96.4	405	98.8	288	96.2	34.1 (0.0-96.2)	↑*
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	153	90.8	139	91.4	224	95.1	402	98.5	286	96.2	31.8 (0.0-96.2)	↑*
	MRSA <sup>f</sup>	458	26.4	358	24.9	424	29.2	600	34.8	611	31.1	15.2 (1.1-50.8)	↑*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	144	18.1	154	20.1	55	23.6	71	18.3	83	19.3	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	143	32.2	154	29.9	55	40.0	79	22.8	83	26.5	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	141	11.3	152	13.8	55	16.4	70	15.7	83	18.1	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	143	33.6	125	24.0	161	37.9	195	39.5	212	38.2	25.3 (6.7-100.0)	↑
<i>E. faecium</i>	Vancomycin resistance	71	25.4	74	25.7	88	33.0	113	39.8	131	36.6	17.6 (0.0-67.7)	↑*

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.



# CYPRUS

Participating institutions:

Microbiology Department, Nicosia General Hospital, <https://shso.org.cy/clinic/mikroviologiko/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Cyprus, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	85	35	75	75	75
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	51.1	56.9	60.9	73.8	84.4

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Cyprus, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	20	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	100	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Cyprus, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	4	151	19	1	92	NA	4	114	9	4	192	13	5	225	14
<i>K. pneumoniae</i>	4	87	33	1	60	NA	4	86	29	4	141	35	5	199	36
<i>P. aeruginosa</i>	4	55	39	1	33	25	4	64	37	4	103	42	5	98	36
<i>Acinetobacter</i> spp.	3	57	53	1	32	69	4	58	60	3	216	80	5	203	64
<i>S. aureus</i>	4	117	17	1	63	23	4	106	11	4	177	39	5	197	21
<i>S. pneumoniae</i>	3	16	NA	1	8	NA	3	5	NA	4	11	NA	5	14	NA
<i>E. faecalis</i>	4	87	34	1	37	20	4	75	41	4	139	57	5	126	39
<i>E. faecium</i>	4	45	37	1	32	38	3	43	32	4	84	46	5	109	39

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Cyprus

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	6.40	6.85	7.81	11.31	14.59	↑	+113.0
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	7.62	6.20	5.11	9.37	10.76	-	+73.6
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	2.59	2.61	2.55	5.51	9.87	↑	+278.4

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or metacillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Cyprus, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	151	64.9	92	71.7	114	67.5	191	70.2	223	63.2	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	151	37.1	92	20.7	114	29.8	192	32.8	225	32.4	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	150	2.0	92	0.0	114	0.0	192	1.0	212	0.9	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	151	42.4	92	43.5	114	48.2	192	51.6	220	46.4	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	151	19.9	92	10.9	114	21.1	192	19.8	224	15.2	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	151	14.6	92	6.5	114	13.2	192	10.9	219	11.9	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	87	48.3	60	48.3	86	54.7	141	54.6	199	63.8	32.7 (3.1-78.5)	↑
	Carbapenem (imipenem/meropenem) resistance	87	21.8	60	13.3	86	19.8	141	26.2	184	36.4	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	87	49.4	60	31.7	86	50.0	141	49.6	191	53.9	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	87	36.8	58	24.1	85	22.4	136	36.8	197	37.6	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	87	32.2	58	20.7	85	17.6	136	35.3	189	33.3	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	55	21.8	33	21.2	63	22.2	102	14.7	96	31.3	19.3 (3.8-50.5)	-
	Ceftazidime resistance	55	16.4	33	18.2	63	17.5	102	12.7	97	27.8	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	55	12.7	33	21.2	63	20.6	102	24.5	97	33.0	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	55	25.5	33	12.1	63	20.6	103	17.5	92	31.5	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	55	7.3	33	3.0	49	6.1	69	1.4	64	9.4	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	55	16.4	33	12.1	49	12.2	69	11.6	63	31.7	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	57	84.2	32	87.5	58	81.0	216	92.1	202	94.6	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	55	89.1	32	90.6	58	82.8	216	91.7	202	95.5	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	57	75.4	32	84.4	58	77.6	214	89.7	202	82.2	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	55	78.2	32	81.3	58	75.9	214	88.8	202	81.7	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	117	40.2	58	36.2	106	49.1	177	42.9	195	50.8	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	16	NA	2	NA	5	NA	11	NA	14	NA	16.3 (2.8-46.7)	NA
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	14	NA	8	NA	5	NA	11	NA	13	NA	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	14	NA	2	NA	5	NA	11	NA	13	NA	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	87	12.6	37	0.0	75	4.0	138	8.0	124	8.1	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	44	59.1	32	50.0	43	44.2	84	51.2	109	56.0	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cofoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# CZECHIA

Participating institutions:

National Institute of Public Health, [www.szu.cz](http://www.szu.cz)

National Reference Laboratory for Antibiotics, <https://szu.cz/odborna-centra-a-pracoviste/centrum-epidemiologie-a-mikrobiologie/oddeleni-bakterialni-rezistence-na-antibiotika-a-sbirka-kultur/nrl-pro-antibiotika>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Czechia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	81	81	80	80	80
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	17.0	16.8	19.7	21.3	21.7

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Czechia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	98	100	NA	88	92

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Czechia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	48	3 650	19	47	3 565	16	48	3 005	14	40	2 939	16	40	3 579	14
<i>K. pneumoniae</i>	48	1 485	31	48	1 563	27	48	1 476	30	43	1 618	33	44	1 638	23
<i>P. aeruginosa</i>	47	539	36	47	595	32	48	559	37	43	596	37	43	645	31
<i>Acinetobacter</i> spp.	21	91	32	20	95	48	20	82	44	21	122	52	18	85	50
<i>S. aureus</i>	48	2 244	24	49	2 108	23	48	2 090	24	44	2 279	26	45	2 417	21
<i>S. pneumoniae</i>	47	378	27	49	387	27	43	204	32	46	228	23	47	394	30
<i>E. faecalis</i>	44	594	35	43	528	30	44	584	35	40	764	37	40	640	25
<i>E. faecium</i>	41	358	37	39	350	38	44	413	36	40	581	46	40	381	33

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Czechia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	3.57	<b>3.06</b>	2.28	2.51	2.15	↓	<b>-29.7</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.45	<b>6.56</b>	4.65	4.94	6.25	-	<b>-4.7</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.03	<b>0.09</b>	0.07	0.16	0.24	↑	<b>+156.3</b>

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Czechia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	3 640	54.2	3 556	54.6	2 997	52.7	2 934	51.4	3 564	51.6	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3 641	15.2	3 557	15.9	2 997	13.3	2 934	14.4	3 566	14.8	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	1 752	0.1	1 689	0.0	1 500	0.1	1 342	0.0	1 685	0.2	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	3 638	24.3	3 554	23.0	2 997	20.2	2 934	19.7	3 564	18.2	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	3 643	9.5	3 559	11.4	2 999	10.2	2 935	9.6	3 567	9.4	9.7 (4.4-24.3)	-
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	3 638	6.3	3 554	6.6	2 995	5.4	2 934	5.6	3 564	4.9	5.1 (1.5-14.2)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 482	50.1	1 563	50.7	1 474	45.9	1 618	49.7	1 638	49.6	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 194	0.3	1 314	0.6	1 232	0.5	1 348	1.0	1 326	1.5	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 482	47.2	1 562	48.7	1 474	44.2	1 618	42.8	1 638	43.2	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 483	48.6	1 563	47.7	1 474	42.5	1 618	41.6	1 638	39.9	22.5 (0.0-67.9)	↓*
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 482	38.7	1 562	39.3	1 473	34.6	1 618	33.9	1 638	32.7	20.0 (0.0-66.2)	↓*
	Piperacillin-tazobactam resistance	531	22.6	584	23.6	550	20.4	590	21.5	640	25.2	19.3 (3.8-50.5)	-
	Ceftazidime resistance	539	20.4	594	22.7	559	19.0	596	19.3	645	22.8	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	539	18.0	595	14.5	559	15.7	595	16.3	645	20.6	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	539	33.4	594	33.7	559	28.4	596	26.7	645	27.8	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	539	19.3	594	21.7	559	13.2	596	12.6	645	16.6	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	531	21.7	584	19.0	550	15.5	589	15.4	640	17.7	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	91	19.8	95	30.5	82	32.9	122	53.3	85	38.8	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	91	24.2	95	32.6	82	35.4	122	53.3	85	41.2	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	91	22.0	95	33.7	82	34.1	122	50.8	85	37.6	34.1 (0.0-96.2)	↑*
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	91	18.7	95	29.5	82	30.5	122	50.8	85	36.5	31.8 (0.0-96.2)	↑*
	MRSA <sup>f</sup>	2 243	13.7	2 108	12.5	2 089	9.3	2 279	9.4	2 417	7.5	15.2 (1.1-50.8)	↓*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	378	5.0	387	4.9	204	4.4	228	5.7	394	6.3	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	378	10.1	387	10.3	204	6.9	228	10.5	394	10.2	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	378	2.6	387	2.3	204	2.0	228	3.5	394	2.5	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	594	33.7	527	31.5	583	30.2	762	38.5	639	30.7	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	358	20.7	349	19.8	410	16.6	578	12.6	379	19.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# DENMARK

Participating institutions:

Statens Serum Institut, <https://www.ssi.dk/>

Danish Study Group for Antimicrobial Resistance Surveillance (DANRES), [www.danmap.org](http://www.danmap.org)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Denmark, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	100	100	100	100
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	171.2	191.7	236.4	251.0	261.2

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Denmark, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	82	100	NA	100	91

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Denmark, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	10	5 398	8	10	5 613	2	10	5 878	3	10	6 025	3	10	5 940	5
<i>K. pneumoniae</i>	10	1 280	7	10	1 361	3	10	1 415	4	10	1 346	4	10	1 360	5
<i>P. aeruginosa</i>	10	489	9	10	493	5	10	505	4	10	517	5	10	498	4
<i>Acinetobacter</i> spp.	8	55	8	9	72	6	9	66	6	10	103	11	10	99	4
<i>S. aureus</i>	10	2 181	NA	10	2 172	NA	10	2 390	5	10	2 545	5	10	2 502	6
<i>S. pneumoniae</i>	10	760	NA	10	601	2	10	351	NA	10	334	NA	10	543	7
<i>E. faecalis</i>	10	606	8	10	632	5	10	651	7	10	686	6	10	660	7
<i>E. faecium</i>	10	782	27	10	737	23	10	795	20	10	802	28	10	638	22

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Denmark

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	0.62	<b>0.83</b>	0.70	0.79	0.61	-	<b>-25.9</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.40	<b>6.61</b>	6.08	5.72	6.01	-	<b>-9.1</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.10	<b>0.07</b>	0.19	0.10	0.10	-	<b>+48.3</b>

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime, or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or methicillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Denmark, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	5 383	46.0	5 593	46.3	5 864	44.1	6 001	41.5	5 883	42.2	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4 833	7.7	5 091	7.5	5 286	6.7	5 416	6.2	5 326	6.6	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	4 640	0.0	5 577	0.1	5 840	0.2	5 845	0.1	5 580	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 386	13.3	5 605	11.5	5 870	11.2	6 016	10.5	5 892	10.7	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	5 393	5.7	5 599	5.5	5 870	5.5	6 017	4.4	5 909	4.8	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	4 829	2.0	5 084	1.9	5 277	1.6	5 409	1.2	5 299	1.5	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 159	6.5	1 248	6.7	1 264	6.0	1 228	5.1	1 244	5.2	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 109	0.5	1 356	0.3	1 413	0.8	1 324	0.5	1 312	0.5	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 279	8.5	1 361	9.6	1 414	7.6	1 346	7.1	1 345	7.6	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 278	3.3	1 358	3.5	1 412	3.3	1 344	2.1	1 348	2.7	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 159	1.9	1 245	2.3	1 261	1.7	1 228	1.1	1 232	1.4	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	489	2.9	493	4.1	505	4.4	517	5.0	495	4.4	19.3 (3.8-50.5)	-
	Ceftazidime resistance	458	3.3	471	4.0	471	3.2	482	2.3	473	2.7	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	422	5.2	491	3.3	503	4.4	514	3.5	494	2.4	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	489	4.3	493	5.5	505	3.2	517	3.3	495	2.8	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	489	0.6	490	2.7	61	0.0	226	0.0	267	0.0	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	391	1.3	469	1.7	61	3.3	225	1.3	265	2.6	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	47	6.4	72	0.0	64	4.7	102	5.9	96	5.2	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	55	9.1	72	6.9	65	13.8	103	15.5	96	16.7	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	53	7.5	72	2.8	65	4.6	100	7.0	97	5.2	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	46	4.3	72	0.0	63	4.8	99	6.1	93	3.2	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	2 181	1.7	2 172	2.2	2 390	1.7	2 545	1.8	1 945	1.9	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	760	5.5	601	5.0	351	6.8	334	9.6	539	3.0	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	760	2.5	601	3.5	351	3.7	334	5.1	503	3.4	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	760	1.3	601	1.3	351	2.3	334	3.0	503	0.8	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	171	12.3	47	8.5	187	11.8	ND	ND	5	NA	25.3 (6.7-100.0)	NA
<i>E. faecium</i>	Vancomycin resistance	779	12.5	734	9.8	793	9.6	800	10.6	632	12.0	17.6 (0.0-67.7)	-

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# ESTONIA

Participating institutions:

Estonian Health Board, <https://www.terviseamet.ee/et>

East-Tallinn Central Hospital, <https://itk.ee/>

Tartu University Hospital, <https://www.kliinikum.ee/partnerile/uhendlabor/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Estonia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	100	100	100	100
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	31.9	33.4	35.8	39.2	39.9

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Estonia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	91	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Estonia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	10	850	7	9	910	8	9	979	7	9	930	6	9	1 003	8
<i>K. pneumoniae</i>	9	206	17	9	179	18	9	199	13	9	235	14	9	235	13
<i>P. aeruginosa</i>	7	48	19	8	70	13	9	79	20	9	87	23	9	86	16
<i>Acinetobacter</i> spp.	7	14	NA	5	16	NA	4	12	NA	3	5	NA	3	3	NA
<i>S. aureus</i>	9	360	8	9	366	11	9	367	11	9	398	8	9	407	8
<i>S. pneumoniae</i>	9	142	10	9	161	8	9	80	8	9	110	7	9	152	5
<i>E. faecalis</i>	8	88	20	9	93	18	9	108	19	7	85	9	9	96	14
<i>E. faecium</i>	7	64	36	7	74	43	8	61	16	6	83	35	9	85	28

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Estonia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	0.91	<b>0.83</b>	0.83	0.45	0.68	-	<b>-18.6</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.29	<b>7.93</b>	6.09	5.64	8.86	-	<b>+11.8</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.08	<b>0.00</b>	0.00	0.15	0.23	-	<b>NA</b>

NA: not applicable.

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Estonia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	457	43.5	499	42.1	422	45.7	338	41.1	274	43.4	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	850	9.8	910	11.5	979	8.3	929	8.1	1 003	11.8	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	758	0.0	800	0.0	861	0.0	826	0.0	854	0.1	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	829	17.6	897	17.1	959	14.1	922	13.4	987	16.3	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	849	6.2	907	5.3	968	5.5	926	5.5	1 001	5.6	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	828	3.0	894	2.1	948	1.6	917	2.1	985	2.8	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	206	13.6	179	10.6	199	11.6	235	12.8	235	14.9	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	179	0.6	152	0.0	173	0.0	218	0.9	204	1.5	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	205	21.0	179	16.2	197	17.3	235	16.6	235	16.2	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	205	10.2	179	6.1	197	8.1	235	7.7	235	8.1	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	204	8.8	179	5.6	196	7.1	235	5.5	235	6.4	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	48	8.3	70	7.1	77	9.1	87	6.9	84	10.7	19.3 (3.8-50.5)	-
	Ceftazidime resistance	47	4.3	66	4.5	77	6.5	83	3.6	82	8.5	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	48	16.7	69	5.8	79	12.7	87	14.9	85	15.3	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	45	13.3	68	5.9	76	10.5	84	16.7	84	14.3	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	48	4.2	67	3.0	1	NA	9	NA	6	NA	8.9 (0.0-42.2)	NA
		Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	44	4.5	62	3.2	ND	ND	5	NA	3	NA	13.4 (0.0-47.7)
<i>Acinetobacter species</i>	Carbapenem (imipenem/meropenem) resistance	14	NA	16	NA	11	NA	5	NA	3	NA	36.3 (1.0-98.6)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	11	NA	10	NA	7	NA	2	NA	2	NA	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	11	NA	8	NA	5	NA	2	NA	1	NA	34.1 (0.0-96.2)	NA
		Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	11	NA	8	NA	5	NA	2	NA	1	NA	31.8 (0.0-96.2)
<i>S. aureus</i>	MRSA <sup>f</sup>	359	3.3	366	3.0	367	3.0	398	1.5	407	2.2	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	142	2.8	161	4.3	79	5.1	109	4.6	152	4.6	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	136	7.4	158	7.0	76	9.2	98	6.1	132	12.1	17.9 (3.4-36.1)	-
		Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	136	2.2	158	2.5	75	2.7	97	4.1	132	3.8	9.7 (0.8-33.3)
<i>E. faecalis</i>	High-level gentamicin resistance	87	25.3	93	12.9	107	15.0	73	11.0	75	6.7	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	64	6.3	74	4.1	61	3.3	83	7.2	85	10.6	17.6 (0.0-67.7)	-

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.



# FINLAND

Participating institutions:

Finnish Institute for Health and Welfare, Department of Health Security, [www.thl.fi](http://www.thl.fi)

Finnish Study Group for Antimicrobial Resistance (FiRe), [www.finres.fi](http://www.finres.fi)

Finnish Hospital Infection Program (SIRO), [thl.fi/en/web/infectious-diseases/surveillance/healthcare-associated-infections](http://thl.fi/en/web/infectious-diseases/surveillance/healthcare-associated-infections)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Finland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	96	96	96	87
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	150.1	160.4	175.1	143.9	188.6

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Finland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	94	89	NA	88	92

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Finland, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	19	5 057	NA	19	5 418	NA	18	5 375	NA	19	5 802	NA	15	4 575	NA
<i>K. pneumoniae</i>	19	810	NA	18	869	NA	17	901	NA	19	971	NA	14	794	NA
<i>P. aeruginosa</i>	19	391	NA	19	470	NA	17	433	NA	19	451	NA	14	422	NA
<i>Acinetobacter</i> spp.	14	28	NA	16	43	NA	12	37	NA	14	47	NA	10	28	NA
<i>S. aureus</i>	18	2 105	NA	19	2 473	NA	18	2 188	NA	19	2 423	NA	15	2 418	NA
<i>S. pneumoniae</i>	19	662	NA	18	678	NA	18	293	NA	17	303	NA	15	470	NA
<i>E. faecalis</i>	19	528	NA	19	592	NA	18	566	NA	19	654	NA	14	490	NA
<i>E. faecium</i>	19	290	NA	19	291	NA	18	259	NA	18	262	NA	14	238	NA

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Finland

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	0.80	1.06	1.07	1.19	1.14	-	+7.8
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.93	8.02	7.26	7.21	5.78	-	-28.0
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.09	0.06	0.02	0.00	0.00	↓	-100.0

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Finland, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	3 129	35.3	3 000	35.5	2 928	34.1	3 177	31.7	2 615	32.5	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5 020	7.6	5 413	7.9	5 367	7.2	5 799	6.6	4 568	6.1	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	5 057	0.0	5 331	0.0	5 375	0.0	5 801	0.0	4 575	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 043	11.5	5 410	11.4	5 354	10.5	5 802	9.6	4 572	9.9	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	4 815	4.3	5 159	4.8	5 373	5.7	5 802	4.1	4 367	4.4	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	4 798	2.0	5 151	2.3	5 346	1.9	5 799	1.8	4 357	1.9	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	805	4.5	868	6.3	901	7.2	971	5.6	794	4.8	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	810	0.6	850	0.4	901	0.1	971	0.0	793	0.0	10.9 (0.0-72.0)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	808	6.3	865	7.3	893	7.4	971	5.5	794	5.7	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	774	2.6	831	4.2	901	5.8	971	4.2	764	2.5	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	771	1.6	827	3.1	893	3.5	971	2.2	764	1.8	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	391	6.6	457	6.6	433	5.5	450	4.7	421	3.8	19.3 (3.8-50.5)	↓*
	Ceftazidime resistance	390	4.4	463	4.5	433	5.3	451	4.9	422	3.6	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	391	4.9	462	6.3	433	3.7	451	4.2	422	5.0	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	376	12.8	468	8.5	431	10.2	451	9.8	422	7.3	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	391	1.0	458	0.7	433	1.4	451	0.9	422	0.5	8.9 (0.0-42.2)	NA
<i>Acinetobacter</i> species	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	376	1.9	455	2.4	431	3.5	450	1.6	421	1.4	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	28	0.0 <sup>h</sup>	43	0.0	37	5.4	47	2.1	28	3.6 <sup>h</sup>	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	28	0.0 <sup>h</sup>	43	0.0	36	8.3	47	2.1	28	3.6 <sup>h</sup>	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	27	7.4 <sup>h</sup>	42	0.0	37	2.7	47	2.1	28	3.6 <sup>h</sup>	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	27	0.0 <sup>h</sup>	42	0.0	36	2.8	47	2.1	28	3.6 <sup>h</sup>	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	2 105	2.1	2 473	2.3	2 188	2.6	2 423	2.6	2 418	2.3	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	600	11.5	594	12.0	252	11.5	247	14.6	339	8.3	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	653	12.1	655	10.5	288	11.8	301	13.3	470	11.1	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	591	5.8	571	6.3	247	7.3	245	8.6	339	4.4	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.3 (6.7-100.0)	NA	
<i>E. faecium</i>	Vancomycin resistance	289	1.7	291	0.0	259	0.4	261	0.4	238	0.8	17.6 (0.0-67.7)	-

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# FRANCE

Participating institutions:

Santé Publique France, [www.santepubliquefrance.fr](http://www.santepubliquefrance.fr)

Since 2020: Surveillance and Prevention of Antimicrobial RESistance in hospital settings (SPARES), <https://www.preventioninfection.fr/>

National Reference Centre for Pneumococci, [www.cnr-pneumo.com](http://www.cnr-pneumo.com)

Up to 2019: French National Observatory for the Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA) through three participating networks: Azay-Résistance, Île-de-France, Réussir networks, [www.onerba.org](http://www.onerba.org)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, France, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%) <sup>a</sup>					
Laboratories collecting <i>S. pneumoniae</i> (CNRP)	61	56	38	56	55
Laboratories collecting other species (SPARES network since 2020 <sup>b</sup> )	21	20	48	55	55
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient days	105.2	112.2	54.5	54.6	58.5

<sup>a</sup> Calculation based on proportion of hospital days in participating hospitals out of total hospital days in the country.

<sup>b</sup> ONERBA laboratories up to 2019.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, France, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	71	86	NA	ND	75

ND: no data available.

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, France, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	49	12 645	8	46	13 536	8	779	18 939	8	743	18 796	8	720	17 744	8
<i>K. pneumoniae</i>	49	3 043	17	46	3 170	15	558	5 078	16	545	4 985	17	527	5 105	14
<i>P. aeruginosa</i>	34	1 902	25	45	2 200	21	490	3 656	26	489	3 918	26	468	3 574	20
<i>Acinetobacter</i> spp.	47	498	11	45	515	17	241	710	10	219	737	11	238	870	13
<i>S. aureus</i>	49	7 097	15	46	6 723	14	672	10 967	12	661	11 809	13	625	10 731	12
<i>S. pneumoniae</i>	143	1 045	NA	193	1 264	NA	127	668	NA	194	1 339	NA	162	928	NA
<i>E. faecalis</i>	48	2 300	20	46	2 526	19	508	4 456	21	511	4 736	22	494	4 135	16
<i>E. faecium</i>	49	1 001	27	46	1 080	24	295	1 428	28	311	1 567	27	291	1 504	24

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, France

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	5.95	5.61	4.02	3.41	2.97	↓	-47.0
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.61	8.60	5.52	4.20	4.01	↓	-53.4
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.11	0.22	0.08	0.10	0.13	-	-42.5

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, France, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	12 553	55.6	13 415	54.5	17 674	53.9	17 706	52.3	17 191	52.8	53.4 (32.5-68.6)	NA
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	12 614	9.6	13 019	8.8	18 857	9.5	18 735	8.3	17 722	8.4	14.3 (5.8-40.2)	NA
	Carbapenem (imipenem/meropenem) resistance	12 399	0.0	12 636	0.0	17 838	0.0	17 546	0.1	16 989	0.1	0.2 (0.0-1.5)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	12 443	16.3	13 431	16.0	18 569	15.9	18 446	14.8	17 517	14.7	22.0 (9.9-46.4)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	12 283	7.4	13 133	7.0	17 786	6.7	17 653	5.8	15 900	6.2	9.7 (4.4-24.3)	NA
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	12 107	3.5	12 639	3.0	17 433	2.9	17 301	2.6	15 681	2.6	5.1 (1.5-14.2)	NA
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3 033	30.8	3 075	30.2	5 045	27.8	4 973	25.4	5 097	25.0	32.7 (3.1-78.5)	NA
	Carbapenem (imipenem/meropenem) resistance	2 998	0.5	3 003	1.0	4 796	0.5	4 727	0.8	4 965	1.0	10.9 (0.0-72.0)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	2 997	30.4	3 143	30.9	5 001	28.1	4 889	25.0	5 040	24.6	32.0 (5.7-78.7)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	2 990	24.8	3 103	23.4	4 767	18.8	4 706	17.4	4 703	16.8	22.5 (0.0-67.9)	NA
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	2 948	21.5	3 004	19.8	4 692	16.4	4 617	14.9	4 644	14.0	20.0 (0.0-66.2)	NA
	Piperacillin-tazobactam resistance	1 850	17.4	1 879	16.7	3 417	17.1	3 580	17.0	3 136	16.8	19.3 (3.8-50.5)	NA
	Ceftazidime resistance	1 892	13.0	1 999	11.5	3 574	12.8	3 754	12.5	3 375	11.9	16.2 (2.1-56.6)	NA
	Carbapenem (imipenem/meropenem) resistance	1 896	16.0	2 076	12.7	3 583	12.6	3 850	12.1	3 498	11.3	18.6 (2.4-53.9)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	1 893	15.1	2 074	13.7	3 585	14.8	3 785	14.1	3 359	13.7	18.6 (2.8-49.2)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	1 898	9.3	2 086	7.8	3 059	5.6	3 297	4.9	3 033	5.6	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	1 844	10.6	1 759	8.6	2 896	8.9	3 044	8.2	2 804	7.2	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	490	6.5	487	9.0	692	3.3	720	3.1	857	3.5	36.3 (1.0-98.6)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	491	12.0	481	13.3	653	9.0	672	7.1	791	6.4	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	482	8.9	473	14.6	661	8.3	673	6.1	757	7.0	34.1 (0.0-96.2)	NA
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	470	5.5	458	8.5	628	1.9	626	2.4	700	2.6	31.8 (0.0-96.2)	NA
	MRSA <sup>g</sup>	6 903	12.1	6 467	11.6	10 763	12.1	11 536	11.0	10 628	10.4	15.2 (1.1-50.8)	NA
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>h</sup>	1 045	29.1	1 264	25.3	668	32.3	1 339	32.0	928	33.7	16.3 (2.8-46.7)	NA
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 045	23.9	1 264	19.4	668	21.6	1 339	23.0	928	24.8	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>h</sup>	1 045	20.4	1 264	16.1	668	18.4	1 339	20.3	928	21.3	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	1 568	9.8	1 346	12.0	ND	ND	ND	ND	ND	ND	25.3 (6.7-100.0)	NA
<i>E. faecium</i>	Vancomycin resistance	987	0.6	1 062	0.7	1 385	0.6	1 517	0.5	1 470	0.7	17.6 (0.0-67.7)	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# GERMANY

Participating institutions:

Robert Koch Institute, [www.rki.de](http://www.rki.de)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Germany, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	27	27	33	35	36
Geographical representativeness	High	High	High	High	High
Hospital representativeness	Medium	Medium	Medium	Medium	Medium
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	30.8	37.9	ND	ND	ND

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Germany, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	86	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	91	95	NA	97	97

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Germany, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	48	21 994	15	47	23 415	15	52	28 462	15	56	29 024	15	67	31 670	15
<i>K. pneumoniae</i>	48	3 974	22	47	4 721	24	52	5 994	24	56	6 539	25	67	6 924	24
<i>P. aeruginosa</i>	47	1 792	26	46	2 108	27	52	2 662	25	55	2 866	29	67	2 985	27
<i>Acinetobacter</i> spp.	45	529	15	46	467	15	50	609	21	53	606	19	66	714	20
<i>S. aureus</i>	48	11 924	21	47	11 958	23	52	14 431	23	56	15 804	23	67	17 645	22
<i>S. pneumoniae</i>	48	1 916	24	46	2 035	24	52	1 357	27	54	1 249	27	67	2 415	24
<i>E. faecalis</i>	48	3 638	23	47	3 770	25	52	4 630	24	56	4 938	25	67	5 386	23
<i>E. faecium</i>	47	2 464	43	47	2 801	48	52	3 918	47	55	4 732	49	67	4 689	46

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Germany<sup>a</sup>

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>b</sup>	Change 2019–2022 <sup>c</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>d</sup>	4.08	3.56	2.91	2.64	2.31	↓	-35.1
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	12.00	12.02	10.74	9.07	9.95	↓	-17.2
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.08	0.20	0.11	0.18	0.24	↑	+20.7

<sup>a</sup> The hospital representativeness is rated as medium and the estimated national population coverage, based on the proportion of hospitals covered, is fairly low. Therefore, the estimated incidences should be interpreted with caution.

<sup>b</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>c</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>d</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Germany, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	20 841	49.2	23 324	48.7	28 227	47.6	28 500	45.6	31 062	46.0	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	21 989	12.2	23 413	11.5	28 461	10.4	29 021	9.1	31 666	9.4	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	21 957	0.0	23 391	0.0	28 458	0.0	29 015	0.0	31 662	0.0	0.2 (0.0-1.5)	↑
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	21 958	19.8	23 374	17.5	28 446	16.5	28 997	14.7	31 637	15.1	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	21 634	6.9	22 990	8.3	27 124	7.5	27 447	5.6	29 945	5.2	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	21 630	3.4	22 971	3.1	27 110	2.7	27 427	2.2	29 922	1.9	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3 973	12.9	4 719	12.2	5 988	10.9	6 538	10.4	6 923	10.3	32.7 (3.1-78.5)	↓*
	Carbapenem (imipenem/meropenem) resistance	3 968	0.4	4 718	0.9	5 991	0.5	6 538	0.8	6 923	1.0	10.9 (0.0-72.0)	↑
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	3 970	13.4	4 715	13.1	5 991	11.7	6 422	10.9	6 921	11.6	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	3 918	6.2	4 654	7.3	5 746	5.6	6 217	4.3	6 610	4.3	22.5 (0.0-67.9)	↓*
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	3 918	4.7	4 649	4.8	5 740	3.7	6 099	2.7	6 608	3.1	20.0 (0.0-66.2)	↓*
	Piperacillin-tazobactam resistance	1 765	12.4	2 077	11.7	2 641	11.7	2 842	13.3	2 979	13.8	19.3 (3.8-50.5)	↑
	Ceftazidime resistance	1 784	9.1	2 104	10.0	2 660	9.9	2 861	10.6	2 980	10.2	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	1 790	12.1	2 108	12.9	2 662	13.9	2 864	14.8	2 980	13.0	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	1 789	12.4	2 108	13.4	2 662	10.6	2 865	10.0	2 980	9.9	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	1 788	3.5	2 107	4.1	2 374	2.0	2 600	1.9	2 767	2.2	8.9 (0.0-42.2)	NA
<i>Acinetobacter</i> species	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	1 756	5.9	2 072	6.3	2 351	6.9	2 573	6.8	2 755	6.9	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	527	4.4	462	2.2	607	3.1	605	4.3	713	3.5	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	520	6.7	443	5.0	598	4.8	603	5.6	708	5.1	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	498	3.4	430	4.2	549	4.7	549	4.2	640	4.4	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	498	2.2	425	1.4	548	2.2	546	2.9	638	2.7	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	11 918	7.7	11 950	6.7	14 427	5.5	15 796	4.9	17 636	3.9	15.2 (1.1-50.8)	↓*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	1 867	5.2	1 962	5.7	1 315	6.0	1 196	7.8	2 334	5.9	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 883	7.1	1 970	7.7	1 324	7.2	1 188	6.6	2 323	6.4	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	1 839	2.5	1 903	3.0	1 282	2.1	1 136	2.2	2 242	2.8	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	2 273	22.9	1 561	18.0	2 352	16.2	2 670	14.5	3 746	11.6	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	2 458	23.7	2 797	26.3	3 906	22.3	4 721	21.6	4 683	18.2	17.6 (0.0-67.7)	↓*

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# GREECE

Participating institutions:

National Public Health Organization, Central Public Health Laboratory, <https://eody.gov.gr/en/>

University of West Attica, Department of Public Health Policy, School of Public Health, <https://php.uniwa.gr/en/homepage/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Greece, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	68	13	30	42	68
Geographical representativeness	High	Medium	High	High	High
Hospital representativeness	High	Medium	High	High	High
Isolate representativeness	Medium	Medium	Medium	Medium	High
Blood culture sets/1 000 patient-days	ND	ND	ND	ND	ND

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Greece, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	21	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	96	95	NA	85	90

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Greece, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	37	1 642	5	6	204	6	13	567	6	19	729	6	31	1 241	6
<i>K. pneumoniae</i>	36	1 500	37	6	312	37	12	728	38	19	1 418	49	30	1 814	37
<i>P. aeruginosa</i>	37	859	37	6	141	45	12	390	35	19	576	38	31	896	36
<i>Acinetobacter</i> spp.	34	1 015	48	5	196	45	12	742	47	19	1 378	60	31	1 565	44
<i>S. aureus</i>	36	889	7	5	171	8	13	449	14	19	584	13	31	922	11
<i>S. pneumoniae</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	46	11
<i>E. faecalis</i>	36	682	28	6	141	26	11	376	28	19	687	38	31	971	27
<i>E. faecium</i>	35	529	25	5	117	32	12	460	39	18	964	47	29	1 181	34

Labs: laboratories.

ND: no data available.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Greece<sup>a</sup>

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>b</sup>	Change 2019–2022 <sup>c</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>d</sup>	4.42	4.59	5.60	5.44	4.96	-	+8.2
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4.34	2.58	3.86	3.52	3.99	-	+54.7
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	13.10	13.05	14.96	23.30	18.02	↑	+38.0

<sup>a</sup> The representativeness has varied over the time period and the estimated national population coverage has been low for some of the years. Therefore the estimated incidences should be interpreted with caution.

<sup>b</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>c</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>d</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Greece, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	1 444	57.5	154	57.1	452	55.5	557	59.8	964	57.1	53.4 (32.5-68.6)	NA
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 640	19.3	190	18.9	567	21.9	727	21.7	1 235	23.3	14.3 (5.8-40.2)	NA
	Carbapenem (imipenem/meropenem) resistance	1 640	1.0	203	1.0	566	0.5	728	1.1	1 240	1.5	0.2 (0.0-1.5)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 631	30.8	203	29.6	565	32.7	728	33.9	1 239	37.8	22.0 (9.9-46.4)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 633	15.5	201	12.9	562	18.7	719	18.6	1 239	19.0	9.7 (4.4-24.3)	NA
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 628	9.8	186	8.6	561	10.5	717	11.9	1 231	10.1	5.1 (1.5-14.2)	NA
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 500	70.7	310	66.5	726	74.5	1 416	80.4	1 802	78.2	32.7 (3.1-78.5)	NA
	Carbapenem (imipenem/meropenem) resistance	1 498	63.9	312	58.3	726	66.3	1 418	73.7	1 803	72.0	10.9 (0.0-72.0)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 488	68.1	311	66.9	726	74.4	1 418	80.0	1 802	78.7	32.0 (5.7-78.7)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 487	54.4	310	55.2	718	61.0	1 399	69.1	1 803	67.9	22.5 (0.0-67.9)	NA
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 487	50.4	307	53.1	714	58.3	1 397	67.4	1 796	66.2	20.0 (0.0-66.2)	NA
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	815	21.5	109	34.9	270	35.6	513	36.5	847	50.5	19.3 (3.8-50.5)	NA
	Ceftazidime resistance	853	22.3	136	39.7	344	30.2	529	31.4	851	44.8	16.2 (2.1-56.6)	NA
	Carbapenem (imipenem/meropenem) resistance	856	37.5	141	48.9	378	35.7	576	33.3	887	48.7	18.6 (2.4-53.9)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	856	33.1	141	46.8	333	42.9	576	35.8	884	49.2	18.6 (2.8-49.2)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	856	26.5	141	42.6	301	28.6	432	28.5	601	41.1	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	814	26.5	107	31.8	171	33.9	378	31.7	549	45.5	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	1 013	92.4	196	92.3	740	94.6	1 377	96.9	1 531	95.9	36.3 (1.0-98.6)	NA
<i>Acinetobacter</i> species	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	998	93.5	189	95.8	729	95.7	1 371	97.2	1 527	96.5	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 003	81.6	194	88.7	727	90.4	1 269	91.4	1 527	89.1	34.1 (0.0-96.2)	NA
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	995	81.3	187	91.4	715	90.8	1 262	91.4	1 522	88.6	31.8 (0.0-96.2)	NA
	Carbapenem (imipenem/meropenem) resistance	888	36.4	170	37.6	448	40.2	583	41.9	918	39.0	15.2 (1.1-50.8)	NA
<i>S. aureus</i>	MRSA <sup>f</sup>	ND	ND	ND	ND	ND	ND	ND	ND	30	46.7	16.3 (2.8-46.7)	NA
	Penicillin non-wild-type <sup>g</sup>	ND	ND	ND	ND	ND	ND	ND	ND	44	34.1	17.9 (3.4-36.1)	NA
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	29	13.8 <sup>h</sup>	9.7 (0.8-33.3)	NA
<i>S. pneumoniae</i>	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	ND	ND	ND	ND	ND	ND	ND	ND	29	13.8 <sup>h</sup>	9.7 (0.8-33.3)	NA
	High-level gentamicin resistance	668	12.0	128	7.8	298	9.7	517	9.5	755	12.2	25.3 (6.7-100.0)	NA
<i>E. faecalis</i>	Vancomycin resistance	527	28.1	117	47.0	445	41.8	950	41.1	1 168	49.1	17.6 (0.0-67.7)	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period. For Greece the change comprises the decrease in the number of laboratories reporting data, starting with 2019 data as EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, fluocloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.



# HUNGARY

Participating institutions:

National Public Health Center, [www.oek.hu](http://www.oek.hu)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Hungary, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	90	90	90	90	90
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	12.2	12.3	17.2	22.0	18.4

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Hungary, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	93	97	NA	100	93

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Hungary, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	29	2 373	11	30	2 413	12	29	1 963	15	30	2 474	16	27	2 567	13
<i>K. pneumoniae</i>	28	850	24	29	912	26	26	730	32	30	1 110	33	26	973	28
<i>P. aeruginosa</i>	29	807	40	30	884	42	26	779	44	30	1 226	57	25	1 016	45
<i>Acinetobacter</i> spp.	26	358	54	27	420	56	24	534	NA	29	1 447	74	25	551	64
<i>S. aureus</i>	27	1 721	17	28	1 884	16	28	1 513	23	29	2 359	22	24	2 072	17
<i>S. pneumoniae</i>	25	207	20	27	222	19	21	124	25	27	186	27	25	293	17
<i>E. faecalis</i>	29	750	36	30	816	37	28	962	49	31	1 562	55	25	1 020	38
<i>E. faecium</i>	29	303	42	27	304	42	27	471	NA	30	710	NA	24	531	40

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Hungary

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	4.52	4.15	3.61	5.20	4.97	-	+19.7
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.09	5.65	4.49	5.75	6.64	-	+17.5
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.02	0.09	0.06	0.11	0.57	↑	+530.4

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Hungary, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	2 312	62.7	2 363	59.3	1 804	58.6	2 263	58.5	2 335	58.4	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	2 370	22.6	2 413	20.6	1 962	20.1	2 470	20.4	2 565	22.6	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	2 279	0.0	2 326	0.0	1 917	0.0	2 391	0.0	2 515	0.2	0.2 (0.0-1.5)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	2 364	33.2	2 398	30.3	1 958	30.3	2 460	28.0	2 531	29.3	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	2 264	17.4	2 411	15.7	1 954	16.7	2 469	17.5	2 561	16.3	9.7 (4.4-24.3)	-
Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>		2 254	11.4	2 397	10.4	1 950	8.8	2 452	10.0	2 526	10.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	848	40.2	911	36.7	728	40.4	1 110	38.6	972	40.7	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	827	0.2	890	0.9	721	0.7	1 092	0.9	948	5.3	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	842	38.0	909	36.7	728	40.8	1 096	37.8	953	39.6	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	845	32.7	912	30.8	727	34.9	1 107	31.8	973	32.6	22.5 (0.0-67.9)	-
Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>		837	28.9	908	26.4	723	31.8	1 093	29.2	952	28.8	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	791	24.3	860	19.7	774	20.3	1 195	19.5	1 008	18.8	19.3 (3.8-50.5)	↓*
	Ceftazidime resistance	804	22.5	882	18.4	772	20.6	1 221	19.8	1 014	17.9	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	807	37.3	883	33.2	779	33.8	1 226	34.3	1 016	31.2	18.6 (2.4-53.9)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	805	26.0	879	20.3	777	22.0	1 221	22.2	1 014	18.2	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	784	17.9	883	16.9	761	11.4	1 207	9.9	990	9.2	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>		763	20.6	854	17.7	751	15.6	1 170	16.2	983	12.7	13.4 (0.0-47.7)
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	357	55.2	418	51.0	534	73.0	1 445	83.0	549	57.9	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	356	66.0	412	63.3	530	77.0	1 441	85.6	550	63.8	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	343	48.7	419	50.6	532	72.4	1 434	81.8	547	47.2	34.1 (0.0-96.2)	↑*
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>		341	41.3	410	45.6	529	69.4	1 429	80.1	544	44.3	31.8 (0.0-96.2)
<i>S. aureus</i>	MRSA <sup>f</sup>	1 721	23.1	1 884	19.4	1 513	21.0	2 359	19.3	2 072	20.9	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	207	10.1	222	6.3	124	8.9	185	12.4	293	6.1	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	190	14.7	215	12.1	115	17.4	175	14.9	288	10.8	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>		190	7.9	215	5.1	115	8.7	174	6.3	288	4.5	9.7 (0.8-33.3)
<i>E. faecalis</i>	High-level gentamicin resistance	750	38.0	816	33.7	962	42.6	1 561	40.4	1 020	36.0	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	301	39.5	304	35.9	471	34.8	710	40.7	531	35.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# ICELAND

Participating institutions:

National University Hospital of Iceland, <https://www.landspitali.is>

Centre for Health Security and Infectious Disease Control, <https://www.landlaeknir.is>

Akureyri hospital, [www.sak.is](http://www.sak.is)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Iceland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	100	100	100	100
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	50.6	61.6	61.3	64.4	69.8

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Iceland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	50	100	NA	100	50

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Iceland, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	2	198	2	2	257	2	2	245	2	2	278	1	2	235	2
<i>K. pneumoniae</i>	2	16	NA	2	23	0 <sup>c</sup>	2	32	3	2	29	4 <sup>c</sup>	2	32	0
<i>P. aeruginosa</i>	2	12	NA	2	22	14 <sup>c</sup>	2	25	19 <sup>c</sup>	2	32	7	2	35	6
<i>Acinetobacter</i> spp.	1	2	NA	1	3	NA	1	3	NA	1	8	NA	1	2	NA
<i>S. aureus</i>	2	82	9	2	121	4	2	116	6	2	96	4	2	144	7
<i>S. pneumoniae</i>	2	31	3	2	44	0	2	20	0 <sup>c</sup>	2	16	NA	2	35	3
<i>E. faecalis</i>	2	30	7	2	35	9	2	30	7	2	37	6	2	29	7 <sup>c</sup>
<i>E. faecium</i>	2	16	NA	2	13	NA	2	19	NA	2	18	NA	2	33	6

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend by bacterial species and antimicrobial group/agent, Iceland, 2018–2022

Bacterial species	Antimicrobial group/agent	2018	2019	2020	2021	2022	Trend 2018–2022 <sup>a</sup>
<i>Staphylococcus aureus</i>	MRSA <sup>b</sup>	0.00	1.96	1.65	0.27	1.06	-
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4.59	5.04	7.41	7.86	6.11	-
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.00	ND	0.00	0.00	0.00	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Iceland, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	198	49.0	257	52.5	245	55.1	277	46.6	235	46.8	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	198	8.1	257	7.0	245	11.0	278	10.4	235	9.8	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	13	NA	2	NA	245	0.0	276	0.0	235	0.0	0.2 (0.0-1.5)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	192	17.2	252	13.1	245	11.8	277	14.4	235	10.2	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	197	6.1	256	4.7	245	7.8	278	9.4	235	7.7	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	191	2.1	251	0.4	245	3.3	277	2.9	235	3.8	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	16	NA	23	4.3 <sup>h</sup>	32	0.0	29	3.4 <sup>h</sup>	32	3.1	32.7 (3.1-78.5)	NA
	Carbapenem (imipenem/meropenem) resistance	1	NA	ND	ND	32	0.0	29	0.0 <sup>h</sup>	32	0.0	10.9 (0.0-72.0)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	16	NA	23	4.3 <sup>h</sup>	32	0.0	29	0.0 <sup>h</sup>	32	9.4	32.0 (5.7-78.7)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	16	NA	23	8.7 <sup>h</sup>	32	0.0	29	0.0 <sup>h</sup>	32	0.0	22.5 (0.0-67.9)	NA
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	16	NA	23	0.0 <sup>h</sup>	32	0.0	29	0.0 <sup>h</sup>	32	0.0	20.0 (0.0-66.2)	NA
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	ND	ND	2	NA	ND	ND	31	19.4	35	8.6	19.3 (3.8-50.5)	NA
	Ceftazidime resistance	12	NA	22	13.6 <sup>h</sup>	25	8.0 <sup>h</sup>	32	9.4	35	5.7	16.2 (2.1-56.6)	NA
	Carbapenem (imipenem/meropenem) resistance	12	NA	22	0.0 <sup>h</sup>	25	12.0 <sup>h</sup>	32	9.4	35	11.4	18.6 (2.4-53.9)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	12	NA	22	4.5 <sup>h</sup>	25	4.0 <sup>h</sup>	32	6.3	35	11.4	18.6 (2.8-49.2)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	12	NA	22	4.5 <sup>h</sup>	25	0.0 <sup>h</sup>	32	0.0	35	0.0	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	ND	ND	2	NA	ND	ND	31	3.2	35	2.9	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	2	NA	3	NA	3	NA	8	NA	2	NA	36.3 (1.0-98.6)	NA
<i>Acinetobacter species</i>	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	2	NA	3	NA	3	NA	8	NA	2	NA	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	2	NA	3	NA	3	NA	8	NA	2	NA	34.1 (0.0-96.2)	NA
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	2	NA	3	NA	3	NA	8	NA	2	NA	31.8 (0.0-96.2)	NA
	Carbapenem (imipenem/meropenem) resistance	2	NA	3	NA	3	NA	8	NA	2	NA	31.8 (0.0-96.2)	NA
<i>S. aureus</i>	MRSA <sup>f</sup>	82	0.0	121	5.8	116	5.2	95	1.1	144	2.8	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	31	9.7	44	15.9	20	30.0 <sup>h</sup>	16	NA	35	28.6	16.3 (2.8-46.7)	NA
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	31	12.9	44	15.9	20	30.0 <sup>h</sup>	16	NA	35	31.4	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	31	9.7	44	11.4	20	30.0 <sup>h</sup>	16	NA	35	28.6	9.7 (0.8-33.3)	NA
	High-level gentamicin resistance	30	16.7	35	11.4	30	6.7	37	8.1	29	20.7 <sup>h</sup>	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	16	NA	13	NA	19	NA	18	NA	33	0.0	17.6 (0.0-67.7)	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# IRELAND

Participating institutions:

Health Protection Surveillance Centre, [www.hpsc.ie](http://www.hpsc.ie)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Ireland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	96	96	96	93
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	57.3	58.9	56.5	56.5	55.8

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Ireland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	97	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	87	84	NA	ND	85

ND: no data available.

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Ireland, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	38	3 239	NA	34	3 233	NA	33	2 851	NA	32	2 906	NA	32	3 008	NA
<i>K. pneumoniae</i>	34	483	NA	30	527	NA	33	487	NA	31	502	NA	30	469	NA
<i>P. aeruginosa</i>	29	273	NA	27	276	NA	26	264	NA	26	280	NA	27	303	NA
<i>Acinetobacter</i> spp.	17	62	NA	21	66	NA	17	54	NA	17	68	NA	17	78	NA
<i>S. aureus</i>	37	1 188	NA	32	1 146	NA	31	1 024	NA	32	1 213	NA	31	1 178	NA
<i>S. pneumoniae</i>	32	455	NA	27	348	NA	27	177	NA	24	168	NA	25	286	NA
<i>E. faecalis</i>	36	332	NA	30	301	NA	31	312	NA	31	349	NA	30	357	NA
<i>E. faecium</i>	30	419	NA	27	443	NA	26	472	NA	25	603	NA	25	610	NA

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Ireland

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	3.04	<b>3.06</b>	2.50	2.68	2.61	-	-14.5
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.63	<b>8.28</b>	7.07	6.01	6.18	↓	-25.3
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.06	<b>0.11</b>	0.04	0.06	0.06	-	-40.0

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Ireland, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	3 237	67.6	3 201	67.5	2 841	65.0	2 898	63.0	3 003	61.8	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3 237	12.9	3 231	12.1	2 850	11.8	2 903	10.0	3 007	9.7	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	3 237	0.0	3 229	0.0	2 820	0.1	2 891	0.0	2 996	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	3 238	23.9	3 223	20.4	2 844	18.9	2 898	16.0	3 000	15.6	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	3 238	11.7	3 232	11.8	2 849	10.6	2 904	9.6	3 004	8.7	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	3 235	6.1	3 222	5.6	2 841	4.7	2 895	4.0	2 995	3.5	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	483	14.5	527	17.6	487	18.7	502	15.5	469	12.6	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	482	0.6	527	0.9	477	0.4	497	0.6	468	0.6	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	483	18.0	526	17.3	486	17.1	500	16.2	466	9.9	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	483	13.0	526	11.0	485	11.5	502	10.6	469	7.9	22.5 (0.0-67.9)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	483	8.1	525	5.3	484	7.9	500	7.6	466	3.4	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	270	8.1	276	10.9	241	12.9	262	15.3	237	10.1	19.3 (3.8-50.5)	-
	Ceftazidime resistance	261	8.4	272	9.2	240	10.4	277	11.2	281	9.6	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	273	6.6	275	6.5	261	7.3	280	8.2	302	8.6	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	272	8.8	276	9.4	262	13.7	277	8.7	299	7.7	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	273	5.5	276	6.5	161	1.9	244	3.3	267	1.9	8.9 (0.0-42.2)	NA
		Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	258	3.1	272	5.1	138	1.4	225	6.2	199	5.5	13.4 (0.0-47.7)
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	60	1.7	63	1.6	52	0.0	66	1.5	78	2.6	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	61	0.0	64	7.8	41	7.3	60	3.3	65	1.5	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	56	3.6	57	1.8	48	2.1	64	3.1	67	1.5	34.1 (0.0-96.2)	-
		Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	55	0.0	53	0.0	35	0.0	56	0.0	56	0.0	31.8 (0.0-96.2)
<i>S. aureus</i>	MRSA <sup>f</sup>	1 188	12.4	1 146	12.6	1 024	11.6	1 213	10.6	1 178	10.4	15.2 (1.1-50.8)	↓
	Penicillin non-wild-type <sup>g</sup>	455	20.7	348	14.4	177	15.8	168	19.6	286	24.5	16.3 (2.8-46.7)	-
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	419	13.6	340	12.6	170	12.9	159	12.6	270	15.9	17.9 (3.4-36.1)	-
		Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	419	10.0	340	8.2	170	10.0	159	7.5	270	12.2	9.7 (0.8-33.3)
<i>E. faecalis</i>	High-level gentamicin resistance	292	23.6	243	23.0	175	16.0	260	17.3	259	15.4	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	418	40.2	443	38.4	471	35.7	602	27.6	609	28.4	17.6 (0.0-67.7)	↓*

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# ITALY

Participating institutions:

National Institute of Health, [www.iss.it](http://www.iss.it)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Italy, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	36	41	47	61	61
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	55.4	ND	57.0	66.6	60.1

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Italy, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	95	95	NA	98	85

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Italy, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	97	16 539	7	128	18 866	6	151	19 086	6	135	21 292	7	172	25 850	7
<i>K. pneumoniae</i>	98	5 913	23	123	7 782	22	147	8 597	24	134	9 202	23	172	11 762	19
<i>P. aeruginosa</i>	95	3 050	23	124	3 895	23	145	4 678	27	134	4 759	25	170	6 032	23
<i>Acinetobacter</i> spp.	92	1 392	42	100	1 651	38	123	2 577	48	113	2 783	52	150	2 895	39
<i>S. aureus</i>	97	8 581	12	125	9 943	11	149	11 164	14	132	11 856	13	170	14 863	12
<i>S. pneumoniae</i>	80	1 160	9	100	1 351	10	109	685	10	101	660	13	136	1 201	11
<i>E. faecalis</i>	94	4 153	19	122	4 705	18	149	6 354	28	130	7 152	25	166	8 261	20
<i>E. faecium</i>	92	2 304	19	118	2 878	19	138	4 243	26	131	4 890	24	164	6 070	20

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Italy

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	12.90	13.42	13.07	9.41	11.70	-	-12.9
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	21.42	22.96	17.67	13.92	17.29	↓	-24.7
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	6.96	8.43	8.73	6.48	7.77	-	-7.8

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftaxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or metacillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Italy, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	7 533	64.5	4 457	68.1	4 214	64.5	5 518	58.9	7 590	61.6	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	16 253	28.7	18 409	30.9	18 750	26.4	21 153	23.8	25 656	24.2	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	15 452	0.4	17 086	0.4	18 001	0.5	19 905	0.4	24 042	0.3	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	16 043	41.7	18 417	40.6	18 840	37.6	20 989	32.5	25 320	31.6	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	15 901	16.0	18 382	15.9	17 994	14.9	20 614	13.2	25 448	14.2	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	15 622	11.4	17 961	11.6	17 593	9.8	20 392	8.3	24 996	9.0	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5 832	53.6	7 699	57.6	8 400	54.3	9 094	53.3	11 637	53.3	32.7 (3.1-78.5)	↓*
	Carbapenem (imipenem/meropenem) resistance	5 660	26.8	7 325	28.5	8 293	29.5	8 760	26.7	11 226	24.9	10.9 (0.0-72.0)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 752	52.7	7 692	54.7	8 486	52.4	9 028	50.0	11 513	48.7	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	5 693	27.0	7 682	32.6	8 084	31.6	8 821	30.1	11 516	31.8	22.5 (0.0-67.9)	↑*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	5 587	24.8	7 560	30.3	7 842	29.5	8 712	27.5	11 299	29.4	20.0 (0.0-66.2)	↑*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	2 938	23.9	3 768	24.1	4 537	24.2	4 530	23.4	5 894	24.1	19.3 (3.8-50.5)	-
	Ceftazidime resistance	2 974	19.9	3 798	19.0	4 473	19.3	4 560	19.1	5 894	19.0	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	3 014	15.8	3 794	13.7	4 615	15.9	4 708	16.4	5 963	16.4	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	2 994	22.9	3 875	21.7	4 599	19.6	4 665	18.6	5 962	18.5	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	2 983	12.8	3 859	11.4	ND	ND	ND	ND	3 248	6.9	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	2 849	14.5	3 581	13.0	ND	ND	ND	ND	3 128	12.5	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	1 383	79.2	1 588	79.3	2 552	80.8	2 734	86.9	2 742	88.5	36.3 (1.0-98.6)	↑*
<i>Acinetobacter species</i>	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	1 368	81.1	1 636	82.5	2 522	83.4	2 729	88.1	2 811	89.1	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 369	77.0	1 637	78.8	2 496	80.2	2 697	85.1	2 827	85.0	34.1 (0.0-96.2)	↑*
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	1 351	75.7	1 569	76.6	2 451	78.7	2 649	84.7	2 648	84.1	31.8 (0.0-96.2)	↑*
	Carbapenem (imipenem/meropenem) resistance	1 383	79.2	1 588	79.3	2 552	80.8	2 734	86.9	2 742	88.5	36.3 (1.0-98.6)	↑*
<i>S. aureus</i>	MRSA <sup>f</sup>	8 263	34.0	9 681	34.3	10 923	33.5	11 344	30.0	14 053	29.9	15.2 (1.1-50.8)	↓*
	Penicillin non-wild-type <sup>g</sup>	928	9.2	1 017	11.9	516	13.4	481	10.0	805	12.4	16.3 (2.8-46.7)	-
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 095	20.3	1 298	22.3	639	24.1	630	24.0	1 143	25.0	17.9 (3.4-36.1)	↑*
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	879	4.7	989	6.7	491	7.7	463	6.5	773	7.0	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	2 927	39.9	2 395	34.9	3 028	37.4	3 018	36.3	3 574	33.8	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	2 273	18.9	2 839	21.3	4 166	23.6	4 736	28.2	5 905	30.7	17.6 (0.0-67.7)	↑*

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.



# LATVIA

Participating institutions:

Disease Prevention and Control Center of Latvia, [www.spkc.gov.lv](http://www.spkc.gov.lv)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Latvia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	90	90	90	90	90
Geographical representativeness	High	High	High	High	High
Hospital representativeness	Medium	Medium	Medium	Medium	Medium
Isolate representativeness	Medium	Medium	Medium	Medium	Medium
Blood culture sets/1 000 patient-days	8.0	9.5	13.8	17.0	16.8

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Latvia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	53	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	ND	93

ND: no data available.

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Latvia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	11	348	27	10	442	20	10	379	21	11	394	20	11	484	19
<i>K. pneumoniae</i>	13	204	36	9	198	32	9	189	29	10	253	38	11	288	23
<i>P. aeruginosa</i>	4	39	31	6	49	44	9	43	31	9	78	51	9	72	35
<i>Acinetobacter</i> spp.	7	51	65	8	46	61	7	52	54	8	82	67	8	73	41
<i>S. aureus</i>	14	376	20	11	422	20	10	355	21	11	457	15	13	521	15
<i>S. pneumoniae</i>	7	69	38	6	79	33	5	42	38	7	56	22	8	106	25
<i>E. faecalis</i>	10	89	38	10	100	25	9	98	28	10	161	39	10	162	24
<i>E. faecium</i>	7	49	41	8	58	43	9	62	48	8	113	60	10	97	32

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Latvia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	1.03	1.91	1.92	1.41	2.19	-	+14.8
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4.08	5.03	5.30	4.23	5.75	-	+14.1
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.06	0.00	0.12	0.23	0.47	↑	NA

NA: not applicable.

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Latvia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	347	56.2	438	57.8	374	54.3	344	49.4	432	51.9	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	348	20.4	442	19.7	378	24.1	393	18.3	484	20.0	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	346	0.0	439	0.0	378	0.0	393	0.0	481	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	344	24.1	442	24.9	378	27.5	392	20.7	481	21.8	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	348	8.9	440	11.6	377	11.4	394	10.9	483	11.8	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	344	7.0	440	9.3	376	10.6	391	8.4	481	9.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	204	37.7	198	36.9	188	48.4	253	36.0	287	38.7	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	204	0.5	198	0.0	189	1.1	253	1.6	288	2.8	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	200	38.5	198	36.9	188	41.5	252	31.0	287	33.1	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	203	31.0	198	28.3	186	21.0	252	22.2	288	24.7	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	199	27.6	198	25.3	185	19.5	251	20.3	286	21.7	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	39	35.9	45	35.6	14	NA	76	27.6	72	26.4	19.3 (3.8-50.5)	NA
	Ceftazidime resistance	39	33.3	49	32.7	42	23.8	77	26.0	52	30.8	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	39	28.2	49	32.7	43	25.6	78	29.5	72	20.8	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	39	23.1	49	28.6	39	30.8	78	32.1	72	33.3	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	39	28.2	49	22.4	7	NA	23	17.4 <sup>h</sup>	42	31.0	8.9 (0.0-42.2)	NA
		Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	39	30.8	45	20.0	5	NA	23	13.0 <sup>h</sup>	24	37.5 <sup>h</sup>	13.4 (0.0-47.7)
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	51	78.4	46	84.8	52	82.7	82	79.3	73	71.2	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	47	80.9	24	83.3 <sup>h</sup>	50	86.0	60	86.7	60	78.3	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	48	60.4	44	68.2	52	63.5	82	68.3	73	57.5	34.1 (0.0-96.2)	-
		Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	44	56.8	22	50.0 <sup>h</sup>	50	64.0	60	70.0	60	63.3	31.8 (0.0-96.2)
<i>S. aureus</i>	MRSA <sup>f</sup>	315	5.7	421	7.8	353	9.3	457	5.3	513	7.2	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	69	10.1	79	10.1	41	17.1	56	3.6	106	2.8	16.3 (2.8-46.7)	↓*
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	66	9.1	76	5.3	27	11.1 <sup>h</sup>	34	0.0	103	4.9	17.9 (3.4-36.1)	-
		Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	66	6.1	76	3.9	27	3.7 <sup>h</sup>	34	0.0	103	1.0	9.7 (0.8-33.3)
<i>E. faecalis</i>	High-level gentamicin resistance	86	32.6	93	44.1	89	38.2	153	46.4	159	100.0	25.3 (6.7-100.0)	↑*
<i>E. faecium</i>	Vancomycin resistance	48	35.4	58	39.7	62	29.0	113	30.1	96	27.1	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# LIECHTENSTEIN

Participating institutions:

Liechtensteinisches Landesspital, <https://www.landesspital.li/>

Laboratory Dr Risch<sup>a</sup>, <https://www.risch.ch/de>

<sup>a</sup> Liechtenstein uses Laboratory Dr Risch as a participating institution at national level.

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Liechtenstein, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	ND	ND	ND	ND	40
Geographical representativeness	ND	ND	ND	ND	Medium
Hospital representativeness	ND	ND	ND	ND	Medium
Isolate representativeness	ND	ND	ND	ND	Medium
Blood culture sets/1 000 patient-days	ND	ND	ND	ND	2.7

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Liechtenstein, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	ND	ND	ND	ND	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	ND	ND	NA	ND	100

ND: no data available.

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Liechtenstein, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	13	NA
<i>K. pneumoniae</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
<i>P. aeruginosa</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
<i>Acinetobacter</i> spp.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
<i>S. aureus</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	5	NA
<i>S. pneumoniae</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	3	NA
<i>E. faecalis</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
<i>E. faecium</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Labs: laboratories.

ND: no data available.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend by bacterial species and antimicrobial group/agent, Liechtenstein, 2018–2022

Bacterial species	Antimicrobial group/agent	2018	2019	2020	2021	2022	Trend 2018–2022 <sup>a</sup>
<i>Staphylococcus aureus</i>	MRSA <sup>b</sup>	ND	ND	ND	ND	6.36	NA
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	ND	ND	ND	ND	6.36	NA
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	ND	ND	ND	ND	ND	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> MRSA is based on AST results for ceftoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Liechtenstein, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	53.4 (32.5-68.6)	NA
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	14.3 (5.8-40.2)	NA
	Carbapenem (imipenem/meropenem) resistance	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	0.2 (0.0-1.5)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	22.0 (9.9-46.4)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	9.7 (4.4-24.3)	NA
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	13	NA	5.1 (1.5-14.2)	NA
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	32.7 (3.1-78.5)	NA
	Carbapenem (imipenem/meropenem) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.9 (0.0-72.0)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	32.0 (5.7-78.7)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	22.5 (0.0-67.9)	NA
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.0 (0.0-66.2)	NA
	Piperacillin-tazobactam resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.3 (3.8-50.5)	NA
	Ceftazidime resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16.2 (2.1-56.6)	NA
	Carbapenem (imipenem/meropenem) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	18.6 (2.4-53.9)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	18.6 (2.8-49.2)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	36.3 (1.0-98.6)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	34.1 (0.0-96.2)	NA
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	31.8 (0.0-96.2)	NA
	MRSA <sup>f</sup>	ND	ND	ND	ND	ND	ND	ND	ND	5	NA	15.2 (1.1-50.8)	NA
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	ND	ND	ND	ND	ND	ND	ND	ND	2	NA	16.3 (2.8-46.7)	NA
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	3	NA	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	ND	ND	ND	ND	ND	ND	ND	ND	2	NA	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.3 (6.7-100.0)	NA
<i>E. faecium</i>	Vancomycin resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17.6 (0.0-67.7)	NA

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# LITHUANIA

Participating institutions:

National Public Health Surveillance Laboratory, [www.nvspl.lt](http://www.nvspl.lt)

Institute of Hygiene, [www.hi.lt](http://www.hi.lt)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Lithuania, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	100	100	100	100
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	5.3	6.1	8.1	9.8	7.9

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Lithuania, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	94	89	NA	100	93

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Lithuania, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	17	1 109	17	18	1 132	20	17	1 142	18	17	1 154	16	16	1 309	15
<i>K. pneumoniae</i>	17	371	24	17	440	28	16	413	25	14	512	29	14	517	29
<i>P. aeruginosa</i>	13	101	32	17	104	32	15	121	26	12	162	35	13	170	29
<i>Acinetobacter</i> spp.	13	88	58	13	108	57	12	157	71	13	361	78	12	141	62
<i>S. aureus</i>	18	693	24	18	656	21	17	704	22	16	746	21	15	828	18
<i>S. pneumoniae</i>	13	93	29	16	120	38	14	96	22	15	109	25	15	172	16
<i>E. faecalis</i>	14	138	25	15	143	30	14	140	28	14	183	41	13	167	29
<i>E. faecium</i>	14	99	34	14	128	38	15	145	43	13	211	44	13	164	42

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Lithuania

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	2.06	2.18	2.47	2.40	2.78	-	+27.3
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.05	5.62	6.51	5.62	7.20	-	+28.1
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.04	0.54	0.43	0.18	0.11	-	-80.1

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Lithuania, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	1 106	59.0	1 129	59.1	1 138	56.9	1 147	57.1	1 303	58.9	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 109	15.3	1 132	13.9	1 142	15.9	1 153	13.6	1 309	15.4	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	1 100	0.0	1 122	0.2	1 142	0.0	1 149	0.3	1 309	0.2	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 104	19.7	1 129	18.0	1 136	18.8	1 139	17.6	1 293	19.0	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 103	7.9	1 129	7.6	1 141	10.3	1 141	8.3	1 308	8.3	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 098	4.6	1 126	4.5	1 135	6.4	1 126	5.0	1 293	5.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	371	55.8	440	55.0	413	42.6	512	43.0	517	39.8	32.7 (3.1-78.5)	↓*
	Carbapenem (imipenem/meropenem) resistance	371	0.3	438	3.4	413	2.9	511	1.0	517	0.6	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	370	56.8	438	52.1	413	45.3	510	38.2	514	39.9	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	369	48.5	435	39.8	410	33.9	511	29.0	516	27.1	22.5 (0.0-67.9)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	368	45.1	433	35.3	410	28.5	509	25.0	514	21.6	20.0 (0.0-66.2)	↓*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	101	17.8	102	23.5	121	23.1	162	14.2	170	18.2	19.3 (3.8-50.5)	-
	Ceftazidime resistance	101	11.9	103	15.5	119	16.8	160	13.1	170	15.3	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	101	21.8	104	16.3	121	25.6	161	25.5	169	24.3	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	101	12.9	104	17.3	120	18.3	158	16.5	170	17.6	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	101	9.9	103	12.6	ND	ND	ND	ND	ND	ND	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	101	11.9	101	12.9	ND	ND	ND	ND	ND	ND	13.4 (0.0-47.7)	NA
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	88	89.8	108	85.2	157	91.1	360	96.1	141	88.7	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	88	90.9	108	91.7	154	92.9	361	96.7	139	89.2	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	87	85.1	107	83.2	153	86.3	351	93.4	133	84.2	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	87	85.1	107	78.5	150	86.7	350	92.9	131	83.2	31.8 (0.0-96.2)	-
<i>S. aureus</i>	MRSA <sup>f</sup>	691	8.4	656	9.3	704	9.8	746	9.0	828	9.4	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	93	19.4	120	10.8	96	13.5	109	8.3	172	6.4	16.3 (2.8-46.7)	↓*
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	92	20.7	119	10.1	96	14.6	109	18.3	172	14.5	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	92	13.0	119	7.6	96	9.4	109	4.6	172	2.9	9.7 (0.8-33.3)	↓*
<i>E. faecalis</i>	High-level gentamicin resistance	65	27.7	78	41.0	68	13.2	94	18.1	101	22.8	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	99	31.3	128	39.8	145	56.6	211	66.4	164	67.7	17.6 (0.0-67.7)	↑*

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# LUXEMBOURG

Participating institutions:

National Health Laboratory, <https://lns.lu/>

Microbiology Laboratory, Centre Hospitalier de Luxembourg, <https://www.chl.lu/fr/service/laboratoire-de-bacteriologie-microbiologie>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Luxembourg, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	100	ND	99	100	99
Geographical representativeness	High	ND	High	High	High
Hospital representativeness	High	ND	High	High	High
Isolate representativeness	High	ND	High	High	High
Blood culture sets/1 000 patient-days	28.2	ND	38.9	42.1	43.9

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Luxembourg, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	100	80

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Luxembourg, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	4	424	11	4	492	8	4	428	8	4	354	10	4	469	4
<i>K. pneumoniae</i>	4	85	18	4	103	18	4	87	23	4	101	20	4	117	17
<i>P. aeruginosa</i>	4	59	7	4	56	18	3	51	14	3	37	27	4	47	30
<i>Acinetobacter</i> spp.	2	11	NA	3	10	NA	2	7	NA	2	8	NA	2	13	NA
<i>S. aureus</i>	4	181	13	4	209	15	4	195	18	4	199	20	4	235	13
<i>S. pneumoniae</i>	4	45	21	4	38	11	3	24	13 <sup>c</sup>	4	21	5 <sup>c</sup>	4	44	14
<i>E. faecalis</i>	4	51	20	4	82	24	4	95	37	4	84	37	4	86	19
<i>E. faecium</i>	4	29	18 <sup>c</sup>	4	37	32	3	42	20	4	58	38	4	69	37

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Luxembourg

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	2.33	<b>2.12</b>	0.97	1.73	1.72	-	-18.7
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.80	<b>10.10</b>	7.91	6.30	7.67	-	-24.1
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.00	<b>0.16</b>	0.16	0.16	0.31	-	+92.2

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Luxembourg, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	420	55.2	492	57.5	427	52.5	352	53.4	469	49.7	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	424	12.5	492	12.6	428	11.4	354	11.3	469	10.4	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	424	0.0	492	0.6	428	0.0	354	0.0	469	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	418	21.8	492	20.5	428	21.7	354	20.9	469	16.8	22.0 (9.9-46.4)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	423	7.3	492	10.2	428	8.9	354	8.8	469	7.2	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	417	3.8	492	3.9	428	4.0	354	4.2	469	2.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	85	29.4	103	25.2	87	26.4	101	25.7	117	18.8	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	85	0.0	103	1.0	87	1.1	101	1.0	117	1.7	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	85	24.7	103	27.2	87	31.0	101	23.8	117	21.4	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	85	20.0	103	17.5	87	20.7	101	14.9	117	9.4	22.5 (0.0-67.9)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	85	15.3	103	13.6	87	20.7	101	12.9	117	5.1	20.0 (0.0-66.2)	↓*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	56	12.5	44	2.3	51	5.9	35	0.0	47	6.4	19.3 (3.8-50.5)	-
	Ceftazidime resistance	59	8.5	56	3.6	50	4.0	37	8.1	47	6.4	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	54	11.1	31	9.7	47	8.5	37	8.1	45	6.7	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	59	22.0	56	8.9	50	22.0	37	24.3	47	12.8	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	53	3.8	56	1.8	40	2.5	37	2.7	31	0.0	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	51	2.0	19	NA	40	5.0	35	0.0	29	0.0 <sup>h</sup>	13.4 (0.0-47.7)	NA
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	6	NA	8	NA	7	NA	8	NA	13	NA	36.3 (1.0-98.6)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	11	NA	10	NA	7	NA	8	NA	13	NA	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	11	NA	10	NA	7	NA	8	NA	13	NA	34.1 (0.0-96.2)	NA
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	6	NA	8	NA	7	NA	8	NA	13	NA	31.8 (0.0-96.2)	NA
<i>S. aureus</i>	MRSA <sup>f</sup>	181	7.7	209	6.2	195	3.1	199	5.5	235	4.7	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	45	11.1	38	21.1	24	16.7 <sup>h</sup>	21	14.3 <sup>h</sup>	44	13.6	16.3 (2.8-46.7)	-
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	45	11.1	38	7.9	24	12.5 <sup>h</sup>	21	28.6 <sup>h</sup>	44	15.9	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	45	4.4	38	2.6	24	0.0 <sup>h</sup>	21	9.5 <sup>h</sup>	44	11.4	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	45	6.7	82	4.9	95	10.5	84	11.9	86	10.5	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	28	0.0 <sup>h</sup>	37	2.7	42	11.9	58	0.0	69	5.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.



# MALTA

Participating institutions:

Malta Mater Dei Hospital, Msida, <https://healthservices.gov.mt/en/MDH/Pages/Home.aspx>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Malta, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	95	95	95	95	95
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	29.2	28.5	35.2	37.7	34.9

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Malta, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	100	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Malta, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	1	332	2	1	332	1	1	277	2	1	299	4	1	326	3
<i>K. pneumoniae</i>	1	137	13	1	129	10	1	132	6	1	135	14	1	120	14
<i>P. aeruginosa</i>	1	29	14 <sup>c</sup>	1	39	23	1	49	13	1	35	29	1	47	13
<i>Acinetobacter</i> spp.	1	9	NA	1	15	NA	1	7	NA	1	16	NA	1	14	NA
<i>S. aureus</i>	1	90	10	1	75	7	1	92	6	1	103	8	1	116	8
<i>S. pneumoniae</i>	1	37	0	1	27	0 <sup>c</sup>	1	16	NA	1	6	NA	1	14	NA
<i>E. faecalis</i>	1	32	6	1	30	3	1	28	20 <sup>c</sup>	1	39	16	1	33	16
<i>E. faecium</i>	1	15	NA	1	13	NA	1	23	24 <sup>c</sup>	1	38	42	1	32	20

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Malta

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	7.08	<b>3.84</b>	3.68	4.28	4.45	-	+15.8
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	11.29	<b>12.37</b>	6.96	8.36	7.48	↓	-39.6
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	4.65	<b>2.13</b>	2.05	1.84	1.21	↓	-43.2

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Malta, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	332	59.6	332	64.8	277	58.5	299	64.5	326	62.9	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	332	15.4	332	17.5	277	12.3	299	13.7	326	11.3	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	332	0.0	332	0.0	277	0.0	299	0.0	326	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	332	41.9	332	40.1	277	35.4	299	30.8	326	26.4	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	332	9.9	332	9.9	277	12.6	299	12.7	326	12.0	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	332	4.5	332	5.1	277	8.3	299	8.0	326	4.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	137	53.3	129	37.2	132	38.6	135	28.9	120	27.5	32.7 (3.1-78.5)	↓*
	Carbapenem (imipenem/meropenem) resistance	136	15.4	129	7.8	132	7.6	135	6.7	120	5.0	10.9 (0.0-72.0)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	137	55.5	129	44.2	132	37.1	135	34.8	120	31.7	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	137	46.7	129	26.4	132	23.5	135	20.0	120	5.8	22.5 (0.0-67.9)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	137	43.8	129	22.5	132	18.9	135	16.3	120	5.0	20.0 (0.0-66.2)	↓*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	29	17.2 <sup>b</sup>	39	15.4	49	18.4	35	28.6	47	8.5	19.3 (3.8-50.5)	-
	Ceftazidime resistance	29	13.8 <sup>b</sup>	39	15.4	49	12.2	35	14.3	47	2.1	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	29	3.4 <sup>b</sup>	39	7.7	49	8.2	35	11.4	47	10.6	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	29	0.0 <sup>b</sup>	39	12.8	49	16.3	35	8.6	47	4.3	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	29	0.0 <sup>b</sup>	39	5.1	49	2.0	35	2.9	47	0.0	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	29	3.4 <sup>b</sup>	39	7.7	49	10.2	35	8.6	47	4.3	13.4 (0.0-47.7)	NA
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	9	NA	15	NA	7	NA	16	NA	14	NA	36.3 (1.0-98.6)	NA
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	9	NA	15	NA	7	NA	16	NA	14	NA	38.8 (0.0-98.6)	NA
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	8	NA	14	NA	7	NA	16	NA	14	NA	34.1 (0.0-96.2)	NA
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	8	NA	14	NA	7	NA	16	NA	14	NA	31.8 (0.0-96.2)	NA
<i>S. aureus</i>	MRSA <sup>f</sup>	88	36.4	75	24.0	92	19.6	103	20.4	116	19.0	15.2 (1.1-50.8)	↓*
	Penicillin non-wild-type <sup>g</sup>	37	24.3	27	33.3 <sup>h</sup>	16	NA	6	NA	14	NA	16.3 (2.8-46.7)	NA
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	37	24.3	25	28.0 <sup>h</sup>	16	NA	6	NA	14	NA	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	37	13.5	25	20.0 <sup>h</sup>	16	NA	6	NA	14	NA	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	31	22.6	30	26.7	28	25.0 <sup>h</sup>	38	15.8	33	21.2	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	15	NA	13	NA	23	21.7 <sup>h</sup>	38	55.3	32	37.5	17.6 (0.0-67.7)	NA

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# NETHERLANDS

Participating institutions:

National Institute for Public Health and the Environment, [www.rivm.nl](http://www.rivm.nl)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Netherlands, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	72	70	72	72	74
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	ND	ND	ND	ND	ND

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Netherlands, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	92	89	NA	100	79

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Netherlands, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	39	8 276	5	35	7 302	5	38	7 498	4	35	6 576	3	36	7 217	3
<i>K. pneumoniae</i>	39	1 521	7	35	1 434	7	38	1 397	6	35	1 270	5	36	1 385	5
<i>P. aeruginosa</i>	39	808	11	35	683	12	37	749	11	35	730	13	36	756	9
<i>Acinetobacter</i> spp.	36	149	14	31	127	13	34	153	11	33	192	13	35	201	8
<i>S. aureus</i>	39	3 568	9	35	3 221	9	38	3 294	8	35	3 235	9	36	3 609	7
<i>S. pneumoniae</i>	39	1 938	8	35	1 552	7	38	997	6	35	839	6	36	1 538	4
<i>E. faecalis</i>	39	1 087	15	35	984	14	38	1 211	24	35	1 302	29	36	1 172	14
<i>E. faecium</i>	39	1 008	35	35	789	37	37	1 312	53	35	1 272	54	36	1 081	38

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Netherlands

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	0.35	0.40	0.39	0.39	0.52	-	+31.7
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	4.89	4.54	3.97	3.47	4.29	-	-5.4
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.06	0.02	0.01	0.02	0.05	-	+85.9

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or methicillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Netherlands, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	8 272	46.0	7 301	45.4	7 494	42.7	6 571	41.4	7 210	40.9	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8 270	7.3	7 300	7.5	7 494	6.6	6 575	6.6	7 215	7.7	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	8 272	0.0	7 299	0.0	7 487	0.0	6 569	0.0	7 210	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	8 274	14.7	7 298	14.6	7 490	13.3	6 575	13.3	7 213	13.1	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	8 275	6.3	7 301	7.0	7 495	6.4	6 576	6.0	7 216	6.2	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	8 268	2.2	7 296	2.6	7 486	1.9	6 574	2.0	7 210	2.1	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 520	10.7	1 434	9.6	1 397	11.2	1 270	10.1	1 385	9.8	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 520	0.5	1 433	0.2	1 396	0.1	1 270	0.2	1 384	0.4	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 521	11.6	1 432	11.1	1 395	13.1	1 270	10.2	1 385	12.6	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 521	7.0	1 434	6.0	1 397	7.3	1 270	5.6	1 385	6.3	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 520	4.4	1 432	3.5	1 395	4.3	1 270	4.3	1 385	4.1	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	764	6.2	621	5.8	701	6.1	699	5.4	720	9.4	19.3 (3.8-50.5)	↑*
	Ceftazidime resistance	805	2.7	662	3.5	748	2.9	728	2.7	756	4.8	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	805	5.1	682	5.1	746	3.6	730	5.2	756	6.0	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	808	8.9	682	10.4	749	9.1	730	7.9	756	7.3	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	808	2.4	683	1.6	748	1.1	728	0.4	756	0.4	8.9 (0.0-42.2)	NA
		Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	760	1.8	598	1.7	697	1.9	696	0.9	720	2.4	13.4 (0.0-47.7)
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	148	4.7	124	0.8	148	0.7	185	0.5	198	1.0	36.3 (1.0-98.6)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	149	7.4	127	7.9	147	4.1	186	3.8	198	3.0	38.8 (0.0-98.6)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	148	4.7	124	3.2	149	1.3	191	4.2	199	2.0	34.1 (0.0-96.2)	-
		Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	147	4.8	122	0.8	139	0.0	179	0.0	195	0.5	31.8 (0.0-96.2)
<i>S. aureus</i>	MRSA <sup>f</sup>	3 566	1.2	3 221	1.5	3 293	1.5	3 231	1.5	3 609	1.9	15.2 (1.1-50.8)	↑
	Penicillin non-wild-type <sup>g</sup>	1 713	3.0	1 360	4.0	799	4.8	648	6.2	1 157	6.4	16.3 (2.8-46.7)	↑*
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 806	3.9	1 406	4.8	919	3.5	766	3.3	1 419	3.4	17.9 (3.4-36.1)	-
		Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	1 583	0.9	1 215	1.3	722	0.8	575	0.9	1 039	1.4	9.7 (0.8-33.3)
<i>E. faecalis</i>	High-level gentamicin resistance	757	22.5	604	20.0	544	29.6	641	36.8	559	19.3	25.3 (6.7-100.0)	↑
<i>E. faecium</i>	Vancomycin resistance	1 006	1.3	786	0.9	1 310	0.5	1 272	0.3	1 081	0.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# NORWAY

Participating institutions:

University Hospital of North Norway

Norwegian Institute of Public Health

St. Olav University Hospital, Trondheim

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Norway, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	94	94	94	94	94
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	47.4	86.8	91.9	87.4	97.3

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Norway, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	89	89	NA	93	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Norway, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	18	3 880	3	18	4 075	3	18	3 764	4	18	3 840	3	18	3 835	3
<i>K. pneumoniae</i>	18	738	5	18	832	5	18	703	5	18	787	3	17	783	3
<i>P. aeruginosa</i>	18	250	5	18	296	4	18	283	5	18	309	3	18	362	6
<i>Acinetobacter</i> spp.	11	32	13	12	23	5 <sup>c</sup>	10	31	0	14	42	5	15	35	3
<i>S. aureus</i>	18	1 630	6	18	1 723	6	18	1 605	6	18	1 728	6	18	1 864	6
<i>S. pneumoniae</i>	18	506	6	18	507	5	18	243	3	18	263	3	18	454	4
<i>E. faecalis</i>	18	525	6	18	551	6	18	546	6	18	608	6	18	655	4
<i>E. faecium</i>	18	174	10	18	197	7	17	183	6	18	218	11	18	244	9

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend by bacterial species and antimicrobial group/agent, Norway, 2018–2022

Bacterial species	Antimicrobial group/agent	2018	2019	2020	2021	2022	Trend 2018–2022 <sup>a</sup>
<i>Staphylococcus aureus</i>	MRSA <sup>b</sup>	0.28	0.34	0.50	0.30	0.39	-
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5.26	5.03	4.32	4.16	4.27	↓
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.02	0.04	0.02	0.04	0.04	-

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Norway, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	3 880	42.3	4 072	41.0	3 758	39.8	3 837	35.4	3 737	37.8	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	3 879	6.8	4 075	6.2	3 762	5.8	3 839	5.5	3 739	5.8	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	3 879	0.0	4 040	0.0	3 646	0.0	3 820	0.0	3 738	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	3 877	12.9	4 068	11.3	3 735	10.0	3 827	9.9	3 726	10.5	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	3 880	5.7	4 074	5.6	3 763	5.7	3 839	5.4	3 831	5.4	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	3 876	2.0	4 068	1.7	3 734	1.6	3 826	1.6	3 726	1.6	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	737	7.5	832	7.7	702	10.1	787	7.4	769	6.6	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	736	0.1	826	0.2	687	0.1	783	0.3	769	0.3	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	735	13.1	832	8.8	696	11.2	782	11.8	765	10.1	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	737	5.3	831	6.1	702	7.3	786	5.1	782	4.0	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	735	3.8	831	3.9	696	4.7	782	2.9	764	3.0	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	227	5.7	270	4.1	254	5.9	278	5.8	316	9.8	19.3 (3.8-50.5)	↑*
	Ceftazidime resistance	240	6.3	282	3.9	277	5.4	295	6.4	354	7.3	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	250	4.8	296	7.4	282	6.4	309	6.8	362	6.1	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	250	10.4	296	5.7	282	8.5	309	4.2	361	7.5	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	236	0.8	292	0.3	281	0.4	308	0.0	362	0.6	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	204	2.9	252	2.0	246	2.8	263	2.7	307	3.3	13.4 (0.0-47.7)	NA
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	32	0.0	23	0.0 <sup>h</sup>	31	0.0	42	0.0	34	2.9	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	32	0.0	23	0.0 <sup>h</sup>	31	0.0	42	4.8	34	0.0	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	32	0.0	23	4.3 <sup>h</sup>	30	0.0	42	2.4	35	2.9	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	32	0.0	23	0.0 <sup>h</sup>	30	0.0	42	0.0	34	0.0	31.8 (0.0-96.2)	-
<i>S. aureus</i>	MRSA <sup>f</sup>	1 547	0.9	1 644	1.0	1 552	1.6	1 638	0.9	1 796	1.1	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	500	5.0	504	6.3	242	7.4	262	6.1	453	7.3	16.3 (2.8-46.7)	-
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	460	7.6	459	5.7	215	5.1	242	5.4	418	3.8	17.9 (3.4-36.1)	↓*
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	454	3.5	457	3.5	214	2.8	241	3.3	417	2.2	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	216	13.4	182	12.1	161	12.4	159	9.4	155	8.4	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	171	2.3	196	1.0	180	0.6	216	0.5	243	1.2	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# POLAND

Participating institutions:

National Medicines Institute, Department of Epidemiology and Clinical Microbiology, <https://www.nil.gov.pl>

National Reference Centre for Susceptibility Testing, <https://korld.nil.gov.pl>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Poland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	17	17	16	20	18
Geographical representativeness	Medium	Medium	Medium	Medium	Medium
Hospital representativeness	Medium	Medium	Medium	Medium	Medium
Isolate representativeness	Medium	Medium	Medium	High	High
Blood culture sets/1 000 patient-days	38.6	39.8	45.6	54.7	51.2

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Poland, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	93	98	NA	98	88

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Poland, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	55	2 627	27	54	2 809	31	49	2 179	25	52	2 376	28	52	2 538	25
<i>K. pneumoniae</i>	53	1 221	47	55	1 172	45	49	1 091	35	52	1 447	47	52	1 357	39
<i>P. aeruginosa</i>	54	394	45	54	421	40	48	317	38	49	445	49	52	476	39
<i>Acinetobacter</i> spp.	48	290	63	46	319	64	44	373	55	50	832	69	49	469	51
<i>S. aureus</i>	57	1 986	30	55	1 843	34	50	1 676	29	52	1 975	32	52	2 073	27
<i>S. pneumoniae</i>	53	369	28	49	364	29	40	165	33	47	260	35	49	456	33
<i>E. faecalis</i>	53	733	43	53	773	48	49	790	36	51	1 252	50	51	972	41
<i>E. faecium</i>	49	385	44	53	443	43	48	529	38	52	908	52	51	681	40

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Poland

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	4.55	4.26	3.08	3.74	3.91	-	-8.2
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	7.14	7.44	6.24	5.87	6.98	-	-6.1
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	1.49	1.38	1.45	3.69	3.30	↑	+139.7

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftaxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Poland, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	890	64.3	836	61.6	502	56.2	809	60.6	857	57.2	53.4 (32.5-68.6)	↓
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	2 620	17.6	2 803	17.1	2 172	17.4	2 371	18.7	2 531	18.7	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	2 500	0.1	2 683	0.0	2 080	0.0	2 290	0.1	2 451	0.1	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	2 567	34.7	2 753	33.0	2 149	33.0	2 268	33.1	2 392	30.8	22.0 (9.9-46.4)	↓
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	2 449	15.1	2 614	12.6	2 033	14.5	2 186	13.7	2 296	12.3	9.7 (4.4-24.3)	↓
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	2 386	10.5	2 564	9.3	1 998	9.4	2 077	10.2	2 149	8.1	5.1 (1.5-14.2)	↓
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 219	64.6	1 166	58.3	1 088	63.0	1 432	70.0	1 345	61.9	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 183	8.1	1 155	7.7	1 074	8.2	1 429	19.5	1 332	16.8	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 207	68.2	1 159	61.3	1 085	65.2	1 428	70.4	1 341	60.6	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 178	54.2	1 128	47.5	1 019	50.0	1 364	55.1	1 242	47.4	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 162	51.5	1 112	45.0	1 012	47.4	1 333	53.5	1 221	44.3	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	366	34.4	409	26.4	266	32.3	440	27.3	463	23.3	19.3 (3.8-50.5)	↓
	Ceftazidime resistance	390	26.9	418	20.1	312	21.8	442	20.4	471	17.0	16.2 (2.1-56.6)	↓
	Carbapenem (imipenem/meropenem) resistance	374	33.2	409	24.4	316	28.5	440	28.0	468	24.6	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	389	39.1	417	34.1	270	32.6	443	32.3	459	24.4	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	384	26.0	402	19.7	239	19.7	323	12.1	334	13.2	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	332	30.1	379	23.7	178	30.9	318	23.3	323	19.8	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	278	67.3	317	71.0	372	78.2	826	82.7	466	76.4	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	268	86.9	304	85.5	366	88.3	816	92.6	452	84.3	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	285	67.4	315	70.8	363	70.8	812	74.1	450	61.3	34.1 (0.0-96.2)	-
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	251	62.9	299	63.2	355	64.2	791	67.0	432	56.9	31.8 (0.0-96.2)	-
	MRSA <sup>f</sup>	1 959	15.9	1 841	14.9	1 351	13.8	1 718	16.5	2 000	13.3	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	343	15.7	310	15.5	158	10.8	255	18.8	445	11.9	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	309	24.9	312	25.0	123	22.8	213	29.1	352	24.7	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	285	10.9	268	13.4	116	9.5	208	14.9	342	9.1	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	645	41.6	706	40.2	703	51.6	1 153	55.2	878	47.5	25.3 (6.7-100.0)	↑*
<i>E. faecium</i>	Vancomycin resistance	374	35.8	432	44.0	527	38.5	900	34.3	680	40.6	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.



# PORTUGAL

Participating institutions:

National Institute of Health Doutor Ricardo Jorge, <https://www.insa.min-saude.pt/>

Directorate-General of Health, <https://www.dgs.pt/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Portugal, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	97	97	97	97	97
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	206.9	244.2	244.2	256.0	363.7

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Portugal, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	98	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	83	93	NA	81	91

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Portugal, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	59	5 921	4	58	6 433	4	63	5 858	4	57	5 633	4	63	5 558	4
<i>K. pneumoniae</i>	58	2 604	10	55	2 709	9	60	2 790	9	56	2 602	14	58	3 035	10
<i>P. aeruginosa</i>	55	1 115	12	54	1 061	11	57	1 061	9	53	1 016	14	56	1 131	10
<i>Acinetobacter</i> spp.	39	127	18	30	99	14	31	104	9	26	67	17	33	125	17
<i>S. aureus</i>	59	3 940	7	59	3 308	6	65	3 319	6	59	2 948	10	65	3 602	8
<i>S. pneumoniae</i>	55	1 062	NA	53	983	NA	48	588	NA	41	427	NA	50	706	2
<i>E. faecalis</i>	56	979	9	54	945	9	58	990	10	52	999	13	55	1 123	10
<i>E. faecium</i>	47	440	16	43	411	15	43	406	12	43	416	17	44	520	19

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Portugal

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	14.54	11.39	9.80	7.23	8.81	↓	-22.6
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.67	10.32	8.38	7.36	7.76	↓	-24.8
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	3.01	2.93	3.22	2.92	3.01	-	+2.7

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftaxime, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or methicillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Portugal, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	5 895	55.1	5 933	58.5	5 849	54.4	5 164	52.7	5 486	52.2	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5 881	14.7	6 390	16.1	5 793	14.4	5 615	13.1	5 526	14.1	14.3 (5.8-40.2)	↓*
	Carbapenem (imipenem/meropenem) resistance	5 797	0.5	6 372	0.1	5 833	0.2	5 466	0.3	5 362	0.3	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 868	25.5	6 431	26.5	5 845	23.9	5 618	22.5	5 530	21.4	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	5 825	12.2	6 428	12.1	5 788	11.7	5 605	10.6	5 544	11.7	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	5 746	6.2	6 384	6.3	5 716	6.1	5 591	5.1	5 496	6.0	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	2 579	50.0	2 697	47.6	2 762	47.6	2 581	45.0	3 013	45.2	32.7 (3.1-78.5)	↓*
	Carbapenem (imipenem/meropenem) resistance	2 563	11.7	2 690	10.9	2 780	11.6	2 520	11.6	2 935	10.3	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	2 592	43.8	2 704	45.8	2 779	42.7	2 596	41.6	3 030	40.7	32.0 (5.7-78.7)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	2 572	34.4	2 708	32.2	2 759	28.2	2 592	25.0	3 031	23.1	22.5 (0.0-67.9)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	2 538	26.7	2 692	26.5	2 734	23.8	2 571	20.6	3 005	19.7	20.0 (0.0-66.2)	↓*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	1 096	21.9	1 054	20.3	1 060	17.5	985	16.4	1 125	15.1	19.3 (3.8-50.5)	↓*
	Ceftazidime resistance	1 090	18.6	1 054	17.6	977	14.4	1 013	15.2	1 120	13.0	16.2 (2.1-56.6)	↓*
	Carbapenem (imipenem/meropenem) resistance	1 108	15.7	1 052	17.8	1 057	13.4	1 015	14.1	1 129	11.8	18.6 (2.4-53.9)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	1 104	23.7	1 057	21.6	1 059	18.5	1 012	18.1	1 120	14.3	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	1 109	11.9	1 060	9.9	877	5.4	875	6.3	991	4.0	8.9 (0.0-42.2)	NA
		Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	1 075	15.4	1 043	14.2	794	9.8	872	12.7	980	7.9	13.4 (0.0-47.7)
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	127	30.7	90	31.1	104	15.4	67	10.4	122	31.1	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	123	34.1	88	26.1	101	17.8	62	17.7	123	32.5	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	126	25.4	93	24.7	104	12.5	64	12.5	118	21.2	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	123	22.0	83	20.5	101	8.9	59	8.5	114	19.3	31.8 (0.0-96.2)	-
<i>S. aureus</i>	MRSA <sup>f</sup>	3 810	38.1	3 265	34.8	3 299	29.7	2 873	25.1	3 544	25.0	15.2 (1.1-50.8)	↓*
	Penicillin non-wild-type <sup>g</sup>	986	13.4	887	13.9	513	13.8	369	14.4	583	8.9	16.3 (2.8-46.7)	↓
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	985	15.5	952	12.8	565	15.6	404	19.1	684	14.9	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	922	8.0	865	7.5	492	8.5	348	9.8	566	5.7	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	778	26.6	881	22.2	862	19.8	802	18.2	873	19.7	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	436	4.4	410	9.0	399	7.8	409	8.6	513	11.1	17.6 (0.0-67.7)	↑*

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# ROMANIA

Participating institutions:

National Institute of Public Health, [www.insp.gov.ro](http://www.insp.gov.ro)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Romania, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	11	11	4	4	6
Geographical representativeness	Low	Low	Low	Low	ND
Hospital representativeness	Low	Low	Low	Low	Medium
Isolate representativeness	Low	Low	Low	Low	ND
Blood culture sets/1 000 patient-days	34.0	20.5	26.4	32.7	32.5

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Romania, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	69	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	93	100	NA	100	94

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Romania, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	17	654	13	15	671	12	15	455	17	16	499	18	17	702	15
<i>K. pneumoniae</i>	17	443	44	15	488	43	16	478	54	16	538	52	17	628	48
<i>P. aeruginosa</i>	17	156	40	14	192	44	15	148	53	16	208	51	16	230	50
<i>Acinetobacter</i> spp.	17	218	73	15	268	75	15	298	72	16	386	73	15	319	69
<i>S. aureus</i>	17	626	24	14	634	23	16	418	30	16	469	27	17	597	22
<i>S. pneumoniae</i>	12	93	24	11	107	15	11	42	20	10	28	23 <sup>c</sup>	11	43	7
<i>E. faecalis</i>	17	178	25	14	166	35	15	167	58	16	227	47	17	246	36
<i>E. faecium</i>	15	79	43	14	144	48	16	122	53	14	194	53	16	185	45

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Romania

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	12.14	13.72	24.83	24.61	20.31	↑	+48.0
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	6.21	6.32	11.51	12.11	10.77	↑	+70.3
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	6.12	7.12	29.62	38.15	26.26	↑	+269.0

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Romania, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	542	62.2	538	63.0	316	62.7	352	64.2	542	62.4	53.4 (32.5-68.6)	-
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	654	20.2	664	20.3	452	19.7	495	18.8	690	17.8	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	653	0.0	666	0.6	454	0.7	498	0.4	697	0.6	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	646	29.1	654	28.3	450	26.0	498	24.7	690	23.8	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	649	12.8	594	11.6	367	10.9	406	10.6	602	12.0	9.7 (4.4-24.3)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	641	7.2	576	7.3	360	5.8	401	5.0	582	6.2	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	443	61.4	479	64.1	477	67.9	534	70.8	614	63.5	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	441	29.5	470	32.3	474	48.3	538	54.5	627	47.8	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	441	57.4	471	62.0	474	66.2	536	67.2	618	60.4	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	436	50.9	411	53.0	399	49.6	440	51.6	508	52.8	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	434	46.3	402	52.0	397	47.9	434	48.4	487	51.1	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	135	45.9	178	52.8	121	42.1	195	47.2	216	48.6	19.3 (3.8-50.5)	-
	Ceftazidime resistance	152	46.7	180	52.2	144	41.0	202	46.0	218	47.7	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	156	55.1	184	55.4	148	43.9	207	45.9	230	53.9	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	155	52.3	184	52.2	140	46.4	204	45.1	229	48.9	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	146	50.7	176	48.9	124	37.1	168	41.7	180	42.2	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	125	48.8	159	52.2	96	41.7	159	42.1	176	47.7	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	218	85.3	264	88.3	297	93.3	386	93.5	318	89.3	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	218	88.1	262	91.2	297	95.3	385	94.5	315	91.1	38.8 (0.0-98.6)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	210	80.0	241	83.8	253	90.1	336	91.1	267	88.8	34.1 (0.0-96.2)	↑*
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	210	77.6	236	83.5	251	88.8	335	89.9	264	87.5	31.8 (0.0-96.2)	↑*
	MRSA <sup>f</sup>	600	43.0	625	46.9	406	47.3	461	41.0	596	38.9	15.2 (1.1-50.8)	↓*
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	90	40.0	86	19.8	39	38.5	28	35.7 <sup>h</sup>	42	35.7	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	93	32.3	92	17.4	37	27.0	25	36.0 <sup>h</sup>	36	36.1	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	90	26.7	74	9.5	34	23.5	25	28.0 <sup>h</sup>	36	33.3	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	168	37.5	155	40.6	148	43.2	212	37.3	218	43.1	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	77	40.3	140	35.7	112	39.3	191	44.5	184	37.0	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# SLOVAKIA

Participating institutions:

National Reference Centre for Antimicrobial Resistance

Public Health Authority of the Slovak Republic, <https://www.uvzsr.sk>

Regional Public Health Authority Banská Bystrica

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Slovakia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	64	56	56	56	56
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	23.7	36.1	27.0	32.1	29.5

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Slovakia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	100	NA	100	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Slovakia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	12	983	14	10	851	14	11	732	17	13	663	16	13	784	17
<i>K. pneumoniae</i>	11	505	33	10	370	26	11	405	35	13	551	41	13	409	30
<i>P. aeruginosa</i>	11	259	32	10	201	30	11	246	35	13	275	42	13	238	30
<i>Acinetobacter</i> spp.	11	146	36	8	97	44	11	95	37	12	148	57	12	155	42
<i>S. aureus</i>	12	627	25	10	567	18	11	540	22	13	583	20	13	578	21
<i>S. pneumoniae</i>	9	47	13	6	40	20	5	15	NA	6	22	18 <sup>c</sup>	10	34	26
<i>E. faecalis</i>	12	256	32	10	212	32	11	199	30	12	335	42	12	275	31
<i>E. faecium</i>	11	168	33	10	139	32	10	121	31	12	224	52	13	155	36

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

<sup>c</sup> A small number of isolates were tested (n < 30), and the percentage of isolates from ICUs should be interpreted with caution.

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Slovakia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	4.65	5.01	4.38	4.25	3.42	↓	-31.8
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.41	6.39	6.45	4.91	5.98	↓	-6.4
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.49	0.52	1.05	1.96	1.87	↑	+257.3

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Slovakia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	967	61.7	849	57.8	728	57.1	660	54.5	767	54.2	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	973	30.1	846	23.0	727	27.1	649	23.1	768	23.7	14.3 (5.8-40.2)	↓
	Carbapenem (imipenem/meropenem) resistance	924	0.0	785	0.1	705	0.1	625	0.0	738	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	969	42.1	850	34.0	729	34.2	662	29.8	782	32.4	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	969	21.6	847	16.6	731	18.5	663	14.2	783	13.8	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	965	16.6	842	12.7	724	14.9	648	10.3	767	10.8	5.1 (1.5-14.2)	↓*
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	497	55.9	367	57.5	399	54.4	545	68.4	399	56.1	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	488	3.5	351	4.6	392	8.2	515	11.7	379	15.0	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	497	61.0	367	56.9	403	53.8	550	64.9	409	47.9	32.0 (5.7-78.7)	↓
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	496	54.8	369	49.3	405	48.9	551	59.7	408	43.6	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	491	49.5	366	45.1	399	44.4	544	51.8	399	37.3	20.0 (0.0-66.2)	↓*
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	236	28.0	175	28.0	213	33.3	254	31.5	213	24.9	19.3 (3.8-50.5)	-
	Ceftazidime resistance	237	32.1	178	31.5	214	32.7	253	32.4	213	25.4	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	248	44.0	197	39.1	231	48.9	258	44.2	218	30.7	18.6 (2.4-53.9)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	252	52.4	201	46.3	246	49.6	273	48.0	237	43.5	18.6 (2.8-49.2)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	254	37.4	199	33.2	242	33.1	265	33.6	236	26.7	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	230	36.5	175	32.0	210	35.7	244	34.0	213	27.2	13.4 (0.0-47.7)	NA
<i>Acinetobacter</i> species	Carbapenem (imipenem/meropenem) resistance	141	44.0	96	55.2	91	30.8	134	61.2	150	61.3	36.3 (1.0-98.6)	↑
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	141	56.0	94	61.7	95	38.9	148	68.2	155	65.2	38.8 (0.0-98.6)	↑
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	144	44.4	97	46.4	95	28.4	147	61.9	154	64.3	34.1 (0.0-96.2)	↑*
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	139	36.0	93	41.9	91	24.2	134	53.7	149	59.7	31.8 (0.0-96.2)	↑*
<i>S. aureus</i>	MRSA <sup>f</sup>	610	26.6	563	27.2	540	24.8	582	22.3	578	18.0	15.2 (1.1-50.8)	↓*
	Penicillin non-wild-type <sup>g</sup>	46	13.0	40	5.0	14	NA	22	9.1 <sup>h</sup>	33	9.1	16.3 (2.8-46.7)	NA
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	45	24.4	36	11.1	15	NA	21	14.3 <sup>h</sup>	32	21.9	17.9 (3.4-36.1)	NA
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	44	11.4	36	2.8	14	NA	21	4.8 <sup>h</sup>	31	3.2	9.7 (0.8-33.3)	NA
<i>E. faecalis</i>	High-level gentamicin resistance	215	40.0	201	32.8	195	35.9	325	52.6	265	34.7	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	161	32.3	137	29.2	120	40.0	219	34.7	153	41.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

<sup>h</sup> Only a small number of isolates were tested (n < 30), and the percentage resistance should be interpreted with caution.

# SLOVENIA

Participating institutions:

National Institute of Public Health, [www.nijz.si](http://www.nijz.si)

Medical faculty, University of Ljubljana, <https://imi.si/>

National Laboratory of Health, Environment and Food, <https://www.nlzoh.si/>

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Slovenia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	99	99	99	99	99
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	36.8	40.4	47.1	56.1	56.4

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Slovenia, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	91	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	91	NA	100	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Slovenia, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	10	1 668	7	10	1 610	6	10	1 617	6	10	1 681	5	10	1 660	5
<i>K. pneumoniae</i>	10	289	14	10	303	14	10	291	17	10	351	14	10	372	10
<i>P. aeruginosa</i>	10	174	24	10	175	26	10	186	35	9	257	20	9	220	24
<i>Acinetobacter</i> spp.	8	39	33	8	40	38	7	36	39	9	124	56	8	60	37
<i>S. aureus</i>	10	606	9	10	656	10	10	711	14	10	768	12	10	644	8
<i>S. pneumoniae</i>	10	271	13	10	283	10	10	172	9	10	187	8	10	225	5
<i>E. faecalis</i>	10	162	15	9	141	24	9	182	15	9	205	20	10	194	11
<i>E. faecium</i>	9	134	32	10	137	32	9	177	32	10	219	34	8	158	30

Labs: laboratories.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Slovenia

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	3.47	<b>2.38</b>	3.37	2.87	2.68	-	<b>+12.9</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	9.24	<b>7.67</b>	8.24	7.47	7.43	-	<b>-3.1</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.10	<b>0.05</b>	0.00	0.14	0.34	↑	<b>+591.3</b>

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftaxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Slovenia, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	1 668	53.5	1 610	51.7	1 617	51.3	1 681	50.8	1 659	49.0	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 668	11.3	1 610	9.8	1 617	10.6	1 681	9.3	1 660	9.3	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	1 668	0.0	1 610	0.0	1 617	0.0	1 681	0.0	1 660	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 668	22.8	1 610	19.0	1 617	18.1	1 681	16.7	1 660	16.6	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 668	9.4	1 610	7.8	1 616	6.8	1 681	6.6	1 660	8.0	9.7 (4.4-24.3)	↓*
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 668	4.7	1 610	4.0	1 616	3.6	1 681	2.8	1 660	3.7	5.1 (1.5-14.2)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	289	14.9	303	16.5	291	15.8	351	21.7	372	20.7	32.7 (3.1-78.5)	↑*
	Carbapenem (imipenem/meropenem) resistance	289	0.7	303	0.3	291	0.0	351	0.9	372	1.9	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	289	27.3	303	19.5	291	24.7	351	24.2	372	22.0	32.0 (5.7-78.7)	-
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	289	12.8	303	8.3	290	10.0	351	13.7	372	12.4	22.5 (0.0-67.9)	-
<i>P. aeruginosa</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	289	10.0	303	7.6	290	7.6	351	12.3	372	11.0	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	174	16.1	175	14.9	186	14.5	257	14.8	220	13.2	19.3 (3.8-50.5)	-
	Ceftazidime resistance	174	14.9	175	16.0	186	13.4	257	14.4	220	13.2	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	174	14.9	175	20.0	186	13.4	257	13.2	220	14.5	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	174	21.8	175	18.9	186	15.6	257	16.7	220	10.5	18.6 (2.8-49.2)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	174	6.9	175	4.0	56	3.6	174	3.4	204	2.5	8.9 (0.0-42.2)	NA
<i>Acinetobacter species</i>	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	174	11.5	175	12.0	56	7.1	174	10.3	204	8.3	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	39	17.9	40	22.5	36	19.4	124	66.9	60	43.3	36.3 (1.0-98.6)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	39	28.2	40	27.5	36	27.8	124	73.4	60	46.7	38.8 (0.0-98.6)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	39	20.5	40	25.0	36	25.0	124	68.5	60	43.3	34.1 (0.0-96.2)	↑*
<i>S. aureus</i>	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	39	17.9	40	20.0	36	16.7	124	66.9	60	41.7	31.8 (0.0-96.2)	↑*
	MRSA <sup>f</sup>	606	11.7	656	7.5	711	9.8	768	7.8	644	8.7	15.2 (1.1-50.8)	-
<i>S. pneumoniae</i>	Penicillin non-wild-type <sup>g</sup>	271	9.6	283	11.0	172	13.4	187	6.4	225	7.1	16.3 (2.8-46.7)	-
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	271	10.3	283	9.9	172	14.5	187	7.0	225	8.0	17.9 (3.4-36.1)	-
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	271	4.8	283	4.9	172	7.6	187	2.1	225	2.7	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	161	20.5	138	22.5	179	18.4	196	19.4	190	17.9	25.3 (6.7-100.0)	-
<i>E. faecium</i>	Vancomycin resistance	134	0.0	137	2.9	177	1.1	219	3.7	158	1.3	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.



# SPAIN

Participating institutions:

Health Institute Carlos III, [www.isciii.es](http://www.isciii.es)

National Centre for Microbiology

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Spain, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	31	32	36	31	30
Geographical representativeness	Medium	Medium	Medium	Medium	Medium
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	57.3	67.6	109.5	165.4	705.3

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Spain, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	71	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	95	91	NA	91	91

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Spain, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	39	7 933	NA	39	8 353	NA	43	7 939	NA	39	7 583	NA	41	9 889	NA
<i>K. pneumoniae</i>	38	1 995	NA	39	2 403	NA	42	2 244	NA	39	2 174	NA	41	3 008	NA
<i>P. aeruginosa</i>	38	1 122	NA	39	1 108	NA	41	1 228	NA	39	1 185	NA	41	1 423	NA
<i>Acinetobacter</i> spp.	18	81	NA	21	83	NA	21	92	NA	24	95	NA	24	92	NA
<i>S. aureus</i>	39	2 531	NA	41	2 719	NA	42	2 542	NA	41	2 835	NA	41	3 168	NA
<i>S. pneumoniae</i>	37	1 033	NA	37	1 038	NA	41	614	NA	37	391	NA	41	851	NA
<i>E. faecalis</i>	38	1 163	NA	38	1 301	NA	41	1 531	NA	40	1 542	NA	39	1 623	NA
<i>E. faecium</i>	37	769	NA	37	848	NA	42	1 104	NA	39	997	NA	39	1 123	NA

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Spain

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	4.17	4.21	3.13	3.01	4.62	-	+9.7
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	7.54	7.84	6.40	6.65	10.15	-	+29.5
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.53	0.76	0.60	0.72	1.08	↑	+42.6

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftazidime, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or methicillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Spain, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	7 599	62.9	7 831	61.2	7 214	57.6	7 075	56.2	8 722	57.1	53.4 (32.5-68.6)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	7 923	13.8	8 345	14.1	7 744	14.1	7 425	13.2	9 757	14.8	14.3 (5.8-40.2)	-
	Carbapenem (imipenem/meropenem) resistance	7 924	0.0	8 346	1.9	7 848	0.4	6 227	0.1	9 721	0.6	0.2 (0.0-1.5)	↓*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	7 616	32.1	8 192	29.5	7 799	28.6	7 571	26.6	9 515	28.6	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	7 924	14.1	8 304	13.6	7 829	13.6	7 567	12.4	9 539	12.5	9.7 (4.4-24.3)	↓*
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	7 598	6.4	8 138	6.3	7 512	6.3	7 408	5.4	9 035	6.3	5.1 (1.5-14.2)	-
<i>K. pneumoniae</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 994	25.5	2 396	25.3	2 185	26.6	2 127	27.6	2 973	26.6	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 995	3.8	2 398	4.8	2 228	4.6	1 847	5.7	2 952	5.2	10.9 (0.0-72.0)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 927	23.8	2 375	24.0	2 222	25.7	2 168	27.7	2 851	28.7	32.0 (5.7-78.7)	↑*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 995	19.3	2 370	18.2	2 229	20.1	2 169	20.6	2 934	19.2	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 926	15.7	2 339	15.5	2 149	16.4	2 121	18.0	2 744	16.6	20.0 (0.0-66.2)	-
<i>P. aeruginosa</i>	Piperacillin-tazobactam resistance	1 076	9.1	1 077	14.2	1 173	11.3	1 124	13.9	1 326	16.3	19.3 (3.8-50.5)	↑*
	Ceftazidime resistance	1 087	8.7	1 098	11.1	1 167	9.7	1 036	11.8	1 393	15.2	16.2 (2.1-56.6)	↑*
	Carbapenem (imipenem/meropenem) resistance	1 120	18.5	1 107	21.8	1 226	16.8	1 175	17.0	1 412	22.5	18.6 (2.4-53.9)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	1 102	20.1	1 105	18.7	1 211	18.2	1 157	20.3	1 373	23.4	18.6 (2.8-49.2)	↑
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	1 121	11.6	1 083	15.0	1 197	8.8	1 143	10.9	1 347	7.3	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>e</sup>	1 023	11.1	1 040	13.5	1 119	9.6	980	11.1	1 238	13.8	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	81	54.3	83	56.6	92	60.9	93	57.0	92	35.9	36.3 (1.0-98.6)	↓
<i>Acinetobacter species</i>	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	81	56.8	82	54.9	92	62.0	93	58.1	92	39.1	38.8 (0.0-98.6)	↓
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	81	49.4	83	47.0	92	53.3	93	58.1	91	33.0	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	81	44.4	82	47.6	92	51.1	92	53.3	91	29.7	31.8 (0.0-96.2)	-
	Carbapenem (imipenem/meropenem) resistance	81	44.4	82	47.6	92	51.1	92	53.3	91	29.7	31.8 (0.0-96.2)	-
<i>S. aureus</i>	MRSA <sup>f</sup>	2 444	24.7	2 711	23.3	2 313	23.1	1 824	24.3	2 547	25.8	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	981	18.5	958	19.8	543	20.8	329	21.3	712	21.6	16.3 (2.8-46.7)	-
<i>S. pneumoniae</i>	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	1 007	18.0	975	21.0	589	22.1	373	27.1	797	20.7	17.9 (3.4-36.1)	↑
	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	957	9.6	905	10.9	527	11.8	318	12.6	672	11.8	9.7 (0.8-33.3)	-
<i>E. faecalis</i>	High-level gentamicin resistance	1 002	34.8	1 051	36.7	1 329	34.1	1 362	31.4	1 428	25.4	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	764	2.5	846	1.2	1 079	1.2	996	1.0	1 108	2.8	17.6 (0.0-67.7)	-

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.

# SWEDEN

Participating institutions:

The Public Health Agency of Sweden, [www.folkhalsomyndigheten.se](http://www.folkhalsomyndigheten.se)

## Population and hospitals contributing data: coverage, representativeness and blood culture rate, Sweden, 2018–2022

Parameter	2018	2019	2020	2021	2022
Estimated national population coverage (%)	51	78	86	89	89
Geographical representativeness	High	High	High	High	High
Hospital representativeness	High	High	High	High	High
Isolate representativeness	High	High	High	High	High
Blood culture sets/1 000 patient-days	107.0	105.6	105.6	ND	ND

ND: no data available.

For data reported in 2018–2020, isolate representativeness refers to patient and isolate representativeness as defined in the report 'Antimicrobial resistance surveillance in Europe 2022 – 2020 data'.

## Laboratories contributing data: use of clinical breakpoint guidelines and participation in EARS-Net EQA, Sweden, 2018–2022

Parameter	2018	2019	2020	2021	2022
Percentage of laboratories using EUCAST or EUCAST-harmonised guidelines	100	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Percentage of laboratories participating in EARS-Net EQA	100	95	NA	100	100

NA: not applicable. In 2020 there was no EARS-Net EQA.

<sup>a</sup> Starting with 2019 data, EARS-Net was restricted to laboratories using EUCAST or EUCAST-harmonised methodology and breakpoints.

## Annual number of reporting laboratories,<sup>a</sup> number of reported isolates and percentage<sup>b</sup> of isolates reported from patients in ICUs, Sweden, 2018–2022

Bacterial species	2018			2019			2020			2021			2022		
	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)	Labs (n)	Isolates (n)	Isolates from ICU (%)
<i>E. coli</i>	9	5 392	NA	19	9 424	NA	20	9 852	NA	21	10 634	NA	21	10 563	NA
<i>K. pneumoniae</i>	9	1 089	NA	19	1 795	NA	20	1 843	NA	21	2 001	NA	21	2 164	NA
<i>P. aeruginosa</i>	9	412	NA	19	707	NA	20	735	NA	21	803	NA	21	853	NA
<i>Acinetobacter</i> spp.	1	55	NA	1	113	NA	1	126	NA	1	138	NA	1	149	NA
<i>S. aureus</i>	9	3 640	NA	20	6 173	NA	20	6 891	NA	21	7 736	NA	21	7 940	NA
<i>S. pneumoniae</i>	9	676	NA	19	1 071	NA	20	551	NA	21	672	NA	21	1 102	NA
<i>E. faecalis</i>	9	687	NA	19	1 297	NA	20	1 443	NA	21	1 635	NA	21	1 581	NA
<i>E. faecium</i>	9	428	NA	19	703	NA	20	789	NA	21	1 006	NA	21	1 022	NA

Labs: laboratories.

NA: not applicable.

<sup>a</sup> Number of laboratories reporting at least one isolate during the specific year. The total number of participating laboratories might be higher.

<sup>b</sup> Isolates with missing information on hospital department are excluded from the calculation, and the percentage of isolates from ICU is presented only if there are ≥20 isolates of which ≥70% have data on hospital department. If not, the percentage is presented as not applicable (NA).

## Estimated total incidence of bloodstream infections with MRSA, third-generation cephalosporin-resistant *Escherichia coli*, and carbapenem-resistant *Klebsiella pneumoniae* (number per 100 000 population) and trend, 2018–2022, as well as the percentage change 2019–2022, by bacterial species and antimicrobial group/agent, Sweden

Bacterial species	Antimicrobial group/agent	2018	2019 (baseline year)	2020	2021	2022	Trend 2018–2022 <sup>a</sup>	Change 2019–2022 <sup>b</sup> (%)
<i>Staphylococcus aureus</i>	MRSA <sup>c</sup>	1.36	<b>1.34</b>	1.80	1.65	1.58	-	<b>+17.8</b>
<i>Escherichia coli</i>	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	8.70	<b>9.24</b>	8.73	8.19	8.52	-	<b>-7.7</b>
<i>Klebsiella pneumoniae</i>	Carbapenem (imipenem/meropenem)	0.04	<b>0.03</b>	0.06	0.03	0.04	-	<b>+71.6</b>

<sup>a</sup> ↑ and ↓ indicate statistically significant increasing and decreasing trends, respectively; – indicates no statistically significant trend.

<sup>b</sup> The 'Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach', (2023/C 220/01), includes 2030 EU targets with 2019 as the baseline year ([https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC\\_2023\\_220\\_R\\_0001](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001)).

<sup>c</sup> MRSA is based on AST results for ceftoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

**Total number of invasive isolates tested (n) and percentage of isolates with resistance phenotype (%)<sup>a</sup>, by bacterial species and antimicrobial group/agent, 2022 EU/EEA range, population-weighted mean and trend, Sweden, 2018–2022**

Bacterial species	Antimicrobial group/agent	2018		2019		2020		2021		2022		2022 EU/EEA range and population-weighted mean <sup>b</sup>	Trend 2018-2022 <sup>c</sup>
		n	%	n	%	n	%	n	%	n	%		
<i>E. coli</i>	Aminopenicillin (amoxicillin/ampicillin) resistance	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	53.4 (32.5-68.6)	NA
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	5 390	8.3	9 419	7.8	9 852	7.9	10 633	7.1	10 563	7.5	14.3 (5.8-40.2)	↓
	Carbapenem (imipenem/meropenem) resistance	5 388	0.0	9 413	0.0	9 846	0.0	10 626	0.1	10 558	0.0	0.2 (0.0-1.5)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	5 378	18.1	9 412	15.9	9 798	14.1	10 570	13.7	10 513	13.8	22.0 (9.9-46.4)	↓*
	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	5 378	7.7	9 410	6.0	9 840	5.9	10 299	6.0	10 549	5.7	9.7 (4.4-24.3)	↓*
<i>K. pneumoniae</i>	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	5 368	3.1	9 405	2.2	9 792	2.1	10 247	1.9	10 502	2.1	5.1 (1.5-14.2)	↓*
	Third-generation cephalosporin (cefotaxime/ceftriaxone/ceftazidime) resistance	1 089	5.5	1 795	8.3	1 842	8.1	2 000	7.0	2 161	7.8	32.7 (3.1-78.5)	-
	Carbapenem (imipenem/meropenem) resistance	1 088	0.2	1 793	0.1	1 843	0.3	1 997	0.2	2 162	0.2	10.9 (0.0-72.0)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin/ofloxacin) resistance	1 087	10.1	1 789	10.5	1 830	10.2	1 989	11.1	2 147	12.3	32.0 (5.7-78.7)	↑*
<i>P. aeruginosa</i>	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	1 087	3.0	1 794	4.2	1 839	3.6	1 939	3.9	2 160	3.4	22.5 (0.0-67.9)	-
	Combined resistance to third-generation cephalosporins, fluoroquinolones, and aminoglycosides <sup>d</sup>	1 086	2.6	1 789	3.2	1 827	2.4	1 927	2.3	2 142	2.0	20.0 (0.0-66.2)	-
	Piperacillin-tazobactam resistance	411	7.8	706	6.8	735	5.4	803	8.7	851	7.1	19.3 (3.0-50.5)	-
	Ceftazidime resistance	412	6.1	706	5.1	735	5.0	803	6.6	851	5.2	16.2 (2.1-56.6)	-
	Carbapenem (imipenem/meropenem) resistance	412	4.4	706	9.8	733	4.2	803	11.8	853	11.0	18.6 (2.4-53.9)	↑*
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	408	7.1	706	9.2	733	7.4	803	10.7	851	9.2	18.6 (2.8-49.2)	-
<i>Acinetobacter species</i>	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>e</sup>	411	1.0	707	2.3	464	0.6	562	0.7	603	0.2	8.9 (0.0-42.2)	NA
	Combined resistance to ≥3 antimicrobial groups (among piperacillin-tazobactam, ceftazidime, carbapenems, fluoroquinolones and aminoglycosides) <sup>f</sup>	406	2.0	706	3.5	464	1.9	562	3.4	598	3.7	13.4 (0.0-47.7)	NA
	Carbapenem (imipenem/meropenem) resistance	54	3.7	112	3.6	126	7.1	138	0.7	149	2.7	36.3 (1.0-98.6)	-
	Fluoroquinolone (ciprofloxacin/levofloxacin) resistance	55	7.3	113	8.0	126	7.1	137	1.5	149	2.0	38.8 (0.0-98.6)	↓*
<i>S. aureus</i>	Aminoglycoside (gentamicin/netilmicin/tobramycin) resistance <sup>d</sup>	55	5.5	113	5.3	125	8.0	138	5.1	147	1.4	34.1 (0.0-96.2)	-
	Combined resistance to carbapenems, fluoroquinolones and aminoglycosides <sup>d</sup>	54	3.7	112	2.7	125	7.2	137	0.0	147	1.4	31.8 (0.0-96.2)	-
<i>S. pneumoniae</i>	MRSA <sup>f</sup>	3 639	1.9	5 948	1.8	6 871	2.3	7 733	2.0	7 936	1.9	15.2 (1.1-50.8)	-
	Penicillin non-wild-type <sup>g</sup>	676	5.2	1 070	6.5	544	8.5	668	7.5	1 096	8.9	16.3 (2.8-46.7)	↑
	Macrolide (azithromycin/clarithromycin/erythromycin) resistance	674	4.5	1 069	6.5	549	6.6	669	4.8	1 100	5.5	17.9 (3.4-36.1)	-
<i>E. faecalis</i>	Combined penicillin non-wild-type and resistance to macrolides <sup>g</sup>	674	2.7	1 068	3.7	542	2.8	665	2.6	1 095	2.9	9.7 (0.8-33.3)	-
	High-level gentamicin resistance	627	12.8	1 225	10.0	1 238	10.1	1 078	6.7	999	8.2	25.3 (6.7-100.0)	↓*
<i>E. faecium</i>	Vancomycin resistance	428	1.4	693	1.0	600	0.2	984	0.3	1 021	0.3	17.6 (0.0-67.7)	↓*

ND: no data available.

NA: not applicable.

<sup>a</sup> Percentages of isolates with resistance phenotype are presented only if data are available for ≥20 isolates. If not, the percentage is presented as not applicable (NA).

<sup>b</sup> Lowest and highest national resistance percentage among reporting EU/EEA countries (n = 30).

<sup>c</sup> ↑ and ↓ indicate statistically significantly increasing and decreasing trends, respectively, in the overall data; \* indicates confirmation in the form of a significant trend in the data that only included laboratories reporting continuously for all five years; – indicates no statistically significant trend. NA: not applicable indicates that data were not reported for all years, a significant change in data source occurred during the period, or the number of isolates was < 20 in any year during the period.

<sup>d</sup> The aminoglycoside group includes only gentamicin and tobramycin from 2020 onwards.

<sup>e</sup> The aminoglycoside group includes only tobramycin from 2020 onwards.

<sup>f</sup> MRSA is based on AST results for cefoxitin or, if unavailable, oxacillin. AST results reported for cloxacillin, dicloxacillin, flucloxacillin or meticillin are accepted as a marker for oxacillin resistance if oxacillin is not reported. If no phenotypic results are available, data from molecular confirmation tests (detection of *mecA* gene PCR or a positive PBP2A-agglutination test) are accepted as a marker for MRSA.

<sup>g</sup> Penicillin results are based on penicillin or, if unavailable, oxacillin. For *S. pneumoniae*, the term penicillin non-wild-type is used in this report, referring to *S. pneumoniae* isolates reported by the local laboratories as susceptible, increased exposure (I) or resistant (R) to penicillin, assuming MIC to benzylpenicillin above those of wild-type isolates (> 0.06 mg/L). The qualitative susceptibility categories (S/I/R) as reported by the laboratory are used, since quantitative susceptibility information is missing for a large part of the data. Laboratories not using EUCAST clinical breakpoints in 2018 may have used different interpretive criteria for the susceptibility categories.