EUROPEAN ANTIBIOTIC AWARENESS DAY

A European Health Initiative

ecdc EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

Summary of the latest data on antibiotic resistance in the European Union

EARS-Net surveillance data
November 2016

- For most combinations of bacteria and antimicrobial groups reported to the European Antimicrobial Resistance Surveillance Network (EARS-Net) for 2015, antibiotic resistance percentages showed large variations across Europe. Resistance percentages were generally higher in southern and south-eastern Europe than in northern Europe.
- For *Klebsiella pneumoniae*, combined resistance to three or more of the antimicrobial groups under surveillance was the most common resistance phenotype. Over the last four years (2012–2015), resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides, as well as combined resistance to all three groups, increased significantly at EU/EEA level.
- For *Escherichia coli*, resistance to third-generation cephalosporins and combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides increased significantly at EU/EEA level between 2012 and 2015.
- Carbapenems are an important group of last-line antimicrobials for the treatment of infections with multidrug-resistant gram-negative bacteria such as *K. pneumoniae* and *E. coli*. Although carbapenem resistance remained at relatively low levels for most countries in 2015, the continuous significant increase of the population-weighted EU/EEA mean percentage of carbapenem resistance in *K. pneumoniae* is a cause for great concern and a threat to patient safety in Europe.
- For *Acinetobacter* spp., high percentages of invasive isolates with combined resistance to fluoroquinolones, aminoglycosides and carbapenems were reported from the Baltic countries, southern and south-eastern Europe in 2015.
- In countries with high levels of multi-drug resistance, including resistance to carbapenems, only a few therapeutic options are available; among these is colistin. In these countries, the large number of isolates with resistance to colistin is an important warning that options for the treatment of infected patients are becoming even more limited.
- The percentage of meticillin-resistant *Staphylococcus aureus* (MRSA) showed a significantly decreasing trend at EU/EEA level between 2012 and 2015. Despite this positive development, MRSA remains a public health priority in Europe as eight out of thirty countries reported MRSA percentages above 25%.
- Significantly increasing trends of vancomycin-resistant *Enterococcus faecium* could be noted in almost half of the reporting countries between 2012 and 2015. Although a similar increase was not observed at EU/EEA level, this might indicate a change in the epidemiology for this pathogen in Europe.
- Prudent antimicrobial use and comprehensive infection prevention and control strategies targeting all healthcare sectors (acute, long-term care facilities and ambulatory care) are the cornerstones of effective interventions aiming to prevent selection and transmission of antimicrobial-resistant bacteria.

Suggested citation: European Centre for Disease Prevention and Control. Summary of the latest data on antibiotic resistance in the European Union. Stockholm: ECDC; 2016.

Antibiotic resistance in the European Union

The data presented in this section were collected by the European Antimicrobial Resistance Surveillance Network (EARS-Net), which is coordinated by ECDC. For 2015, a total of 30 countries, including all EU Member States and two EEA countries (Iceland and Norway), reported data to EARS-Net. For more details on EARS-Net, surveillance results and information on methods, please refer to the EARS-Net Annual Report 2014[i] and the ECDC Surveillance Atlas of Infectious Diseases[ii].

Klebsiella pneumoniae

Klebsiella pneumoniae is a common cause of urinary tract, respiratory tract and bloodstream infections. It can spread rapidly between patients in healthcare settings and is a frequent cause of hospital outbreaks if appropriate prevention and control measures are not implemented.

Antibiotic resistance in *K. pneumoniae* is a public health concern of increasing importance in Europe. More than one third of the *K. pneumoniae* isolates reported to EARS-Net for 2015 were resistant to at least one of the antibiotic groups under surveillance (fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems), and combined resistance to multiple antibiotic groups was common. This is the continuation of a worrying trend described in previous years. A north-to-south and south-east gradient was noted for most antimicrobial groups, with generally lower resistance percentages reported from northern European countries and higher percentages from the southern and south-eastern parts of Europe (Figures 1–3).

The EU/EEA population-weighted mean percentages of *K. pneumoniae* resistant to fluoroquinolones, third-generation cephalosporins, aminoglycosides, and combined resistance to all three of these antibiotic groups, increased significantly between 2012 and 2015. The increasing trend of combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides from 17.7% in 2012 to 18.6% in 2015 (Table 1), means that for patients who are infected with these multidrug-resistant bacteria, only a few therapeutic options remain available. Among these are the carbapenems, a last-line group of antibiotics.

Although carbapenem resistance percentages remained at low levels for most countries in 2015, resistance to carbapenems at EU/EEA level significantly increased over the last four years, from a population-weighted mean percentage of 6.2% in 2012 to 8.1% in 2015 (Table 2). The vast majority of the carbapenem-resistant isolates had additional resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides.

Resistance to carbapenems was more frequently reported in *K. pneumoniae* invasive isolates from countries in southern and south-eastern Europe than other parts of Europe.

Very few therapeutic options are left for patients infected with multidrug-resistant *K. pneumoniae* with additional resistance to carbapenems, and are often limited to combination therapy and to older antibiotics such as colistin, an antibiotic from the polymyxin group. Although data on colistin resistance are not complete in the EARS-Net surveillance database, the fact that countries with already high percentages of carbapenem resistance report large numbers of isolates with combined carbapenem and colistin resistance (Figure 3) is an indication of the further loss of effective treatment options for gram-negative bacterial infections.

[i] European Centre for Disease Prevention and Control. Antimicrobial resistance surveillance in Europe 2014. Annual Report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). Stockholm: ECDC; 2015 Available from http://ecdc.europa.eu/en/publications/publications/antimicrobial-resistance-europe-2014.pdf

[ii] European Centre for Disease Prevention and Control. Surveillance Atlas of Infectious Diseases. Available at http://atlas.ecdc.europa.eu/public/

Figure 1. *Klebsiella pneumoniae*: percentage of invasive isolates with combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides, EU/EEA, 2012 (left), 2015 (right)

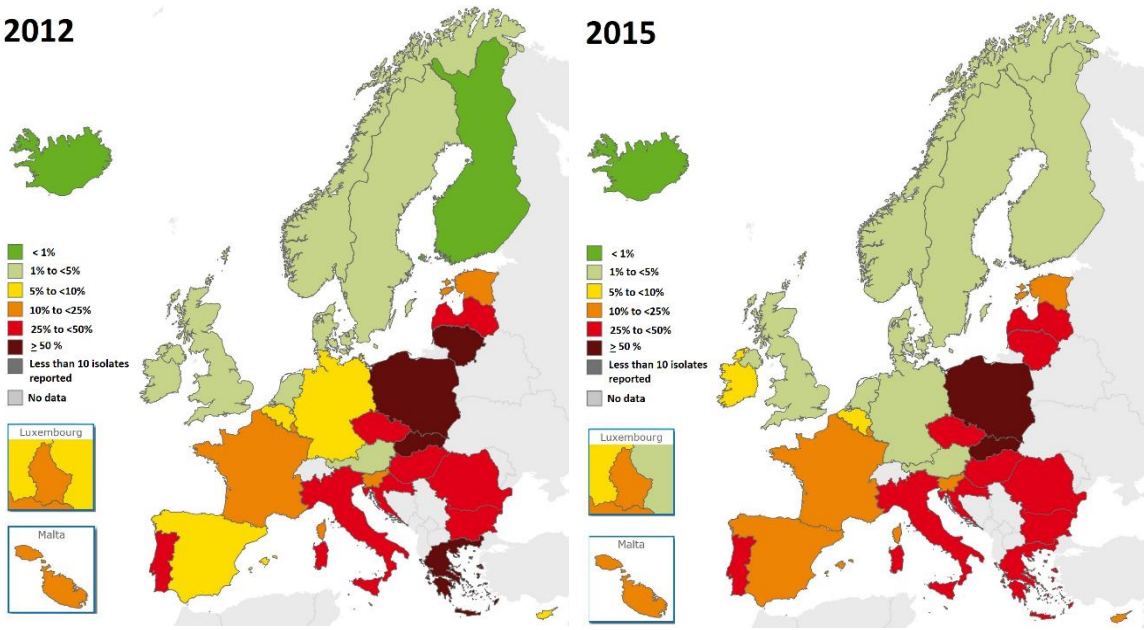


Figure 2. *Klebsiella pneumoniae*: percentage of invasive isolates with resistance to carbapenems, EU/EEA, 2012 (left), 2015 (right)

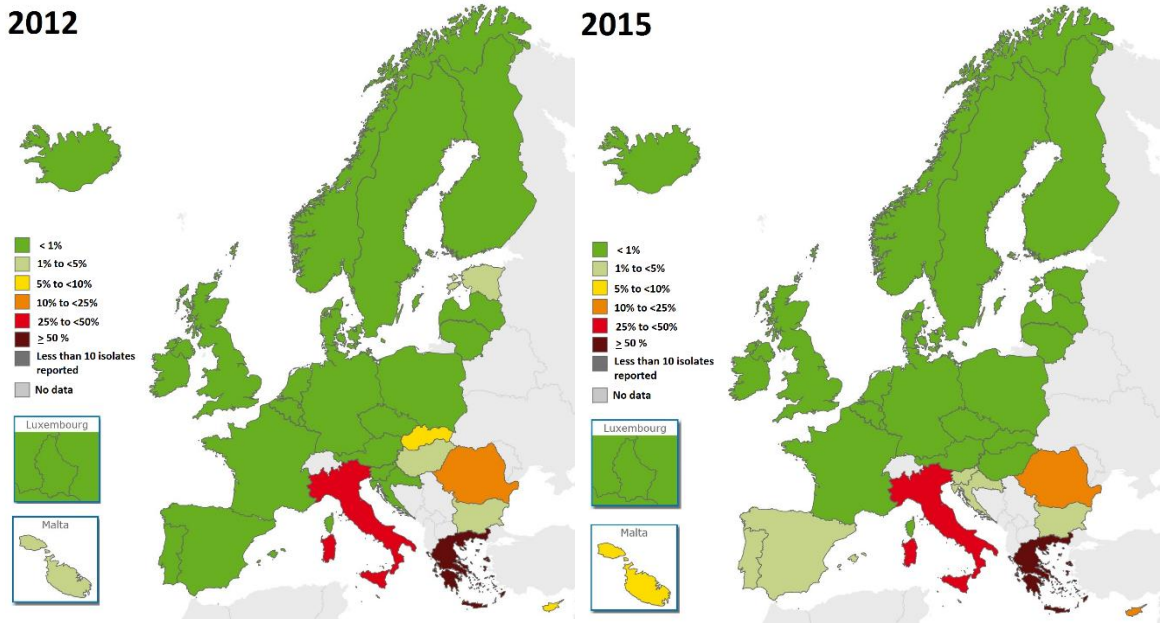
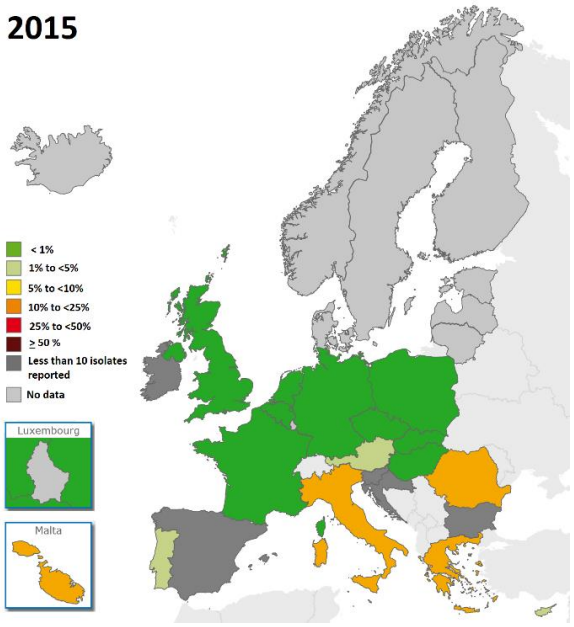


Figure 3. *Klebsiella pneumoniae*: percentage of invasive isolates with combined resistance to carbapenems and colistin*, EU/EEA, 2015



** Only isolates that were tested for both carbapenem resistance and colistin resistance were included in the analysis.*

Table 1. *Klebsiella pneumoniae*: Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2012-2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Iceland	14	0.0	(0-23)	28	0.0	(0-12)	28	0.0	(0-12)	35	0.0	(0-10)		N/A
Denmark	577	3.1	(2-5)	519	3.5	(2-5)	925	3.1	(2-4)	924	1.1	(1-2)		< #
Finland	516	0.2	(0-1)	514	0.4	(0-1)	556	1.4	(1-3)	623	1.1	(0-2)		> #
Sweden	977	1.4	(1-2)	1235	1.7	(1-3)	623	1.4	(1-3)	860	1.9	(1-3)		
Norway	593	1.5	(1-3)	616	1.8	(1-3)	744	3.9	(3-6)	699	2.3	(1-4)		
Netherlands	667	2.7	(2-4)	630	2.2	(1-4)	865	2.0	(1-3)	908	3.0	(2-4)		
Germany	663	6.2	(4-8)	753	7.0	(5-9)	979	5.3	(4-7)	1515	3.1	(2-4)		<
Austria	827	4.0	(3-6)	837	3.6	(2-5)	900	3.2	(2-5)	936	3.3	(2-5)		
United Kingdom	913	2.3	(1-3)	1070	4.8	(4-6)	975	3.1	(2-4)	906	4.2	(3-6)		
Ireland	326	3.4	(2-6)	316	7.9	(5-11)	353	7.4	(5-11)	387	7.2	(5-10)		
Belgium	411	8.5	(6-12)	464	8.2	(6-11)	341	7.9	(5-11)	353	9.3	(7-13)		
Spain	1150	8.9	(7-11)	1241	11.2	(9-13)	1263	10.1	(8-12)	1488	11.7	(10-13)		
Luxembourg	50	20.0	(10-34)	53	17.0	(8-30)	66	16.7	(9-28)	60	13.3	(6-25)		
Malta	57	19.3	(10-32)	69	20.3	(12-32)	101	26.7	(18-36)	92	15.2	(9-24)		
Slovenia	254	17.3	(13-23)	245	15.9	(12-21)	233	18.9	(14-25)	237	16.9	(12-22)		
Cyprus	65	9.2	(3-19)	68	5.9	(2-14)	80	15.0	(8-25)	62	17.7	(9-30)		
EU/EEA (population-weighted mean)	**15617**	**17.7**	**(17-18)**	**17711**	**18.9**	**(18-20)**	**19195**	**19.1**	**(19-20)**	**21871**	**18.6**	**(18-19)**		**>**
Estonia	86	10.5	(5-19)	87	9.2	(4-17)	131	11.5	(7-18)	36	22.2	(10-39)		
France	1097	19.2	(17-22)	1916	22.9	(21-25)	2172	23.7	(22-26)	2324	22.5	(21-24)		
Portugal	776	25.1	(22-28)	909	21.7	(19-24)	1705	22.8	(21-25)	2084	25.0	(23-27)		
Bulgaria	126	36.5	(28-46)	132	35.6	(27-44)	143	44.1	(36-53)	84	28.6	(19-39)		
Italy	752	33.9	(31-37)	1360	29.6	(27-32)	1164	32.0	(29-35)	1940	29.7	(28-32)		
Hungary	480	37.9	(34-42)	549	32.2	(28-36)	636	28.6	(25-32)	698	30.2	(27-34)		<
Croatia	331	30.8	(26-36)	367	30.0	(25-35)	330	30.6	(26-36)	380	32.4	(28-37)		
Latvia	78	42.3	(31-54)	88	39.8	(29-51)	104	41.3	(32-51)	112	36.6	(28-46)		
Lithuania	184	52.2	(45-60)	144	33.3	(26-42)	152	35.5	(28-44)	178	39.9	(33-47)		<
Czech Republic	1399	41.8	(39-44)	1291	38.3	(36-41)	1382	38.7	(36-41)	1416	41.5	(39-44)		
Greece	1426	57.0	(54-60)	1164	51.5	(49-54)	1061	55.1	(52-58)	1160	46.7	(44-50)		<
Romania	97	42.3	(32-53)	210	42.9	(36-50)	247	56.3	(50-63)	261	49.8	(44-56)		
Poland	350	50.3	(45-56)	350	54.3	(49-60)	443	54.6	(50-59)	645	54.0	(50-58)		
Slovakia	375	55.5	(50-61)	486	57.8	(53-62)	493	63.3	(59-68)	468	59.6	(55-64)		

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*
N/A: Not applicable as data were not reported for all years, or number of isolates was below 20 in any year during the period.

Table 2. *Klebsiella pneumoniae*: Total number of invasive isolates tested (N) and percentage with resistance to carbapenems (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2012-2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Denmark	680	0.3	(0-1)	645	0.2	(0-1)	830	0.2	(0-1)	846	0.0	(0-0)		
Estonia	79	1.3	(0-7)	74	2.7	(0-9)	92	0.0	(0-4)	56	0.0	(0-6)		
Finland	536	0.0	(0-1)	550	0.0	(0-1)	583	0.0	(0-1)	658	0.0	(0-1)		
Iceland	16	0.0	(0-19)	28	0.0	(0-12)	28	0.0	(0-12)	35	0.0	(0-11)		N/A
Latvia	77	0.0	(0-5)	92	0.0	(0-4)	118	1.7	(0-6)	112	0.0	(0-3)		
Lithuania	185	0.0	(0-2)	144	0.0	(0-3)	154	1.3	(0-5)	177	0.0	(0-2)		
Luxembourg	48	0.0	(0-7)	53	1.9	(0-10)	66	1.5	(0-8)	60	0.0	(0-6)		
Sweden	977	0.1	(0-1)	1269	0.0	(0-0)	978	0.0	(0-0)	900	0.0	(0-0)		
Germany	661	0.0	(0-1)	763	0.7	(0-2)	1006	0.7	(0-1)	1520	0.1	(0-0)		
Hungary	481	2.9	(2-5)	531	1.7	(1-3)	621	1.1	(0-2)	687	0.1	(0-1)		<
Netherlands	684	0.1	(0-1)	646	0.2	(0-1)	903	0.2	(0-1)	907	0.1	(0-1)		
Norway	623	0.5	(0-1)	645	0.2	(0-1)	746	0.0	(0-0)	700	0.1	(0-1)		
Czech Republic	1307	0.3	(0-1)	1133	0.5	(0-1)	1148	0.1	(0-0)	1100	0.3	(0-1)		
United Kingdom	888	0.5	(0-1)	1051	0.5	(0-1)	1069	0.8	(0-2)	962	0.4	(0-1)		
Belgium	545	0.7	(0-2)	618	0.3	(0-1)	429	0.5	(0-2)	389	0.5	(0-2)		
France	1627	0.5	(0-1)	1842	0.7	(0-1)	2103	0.5	(0-1)	2244	0.5	(0-1)		
Ireland	338	0.0	(0-1)	317	0.3	(0-2)	353	0.6	(0-2)	389	0.5	(0-2)		
Poland	359	0.8	(0-2)	370	0.8	(0-2)	451	1.3	(0-3)	660	0.5	(0-1)		
Austria	738	0.8	(0-2)	910	1.2	(1-2)	971	0.6	(0-1)	1022	0.8	(0-2)		
Slovakia	331	6.3	(4-10)	342	0.6	(0-2)	456	2.6	(1-5)	436	0.9	(0-2)		<#
Slovenia	254	0.4	(0-2)	245	0.4	(0-2)	233	0.9	(0-3)	237	1.3	(0-4)		
Spain	1152	0.8	(0-1)	1241	1.6	(1-2)	1266	2.3	(2-3)	1483	2.2	(1-3)		>
Croatia	331	0.0	(0-1)	376	0.5	(0-2)	334	0.9	(0-3)	380	2.4	(1-4)		>
Bulgaria	108	1.9	(0-7)	129	0.0	(0-3)	139	7.2	(4-13)	95	3.2	(1-9)		
Portugal	749	0.7	(0-2)	904	1.8	(1-3)	1701	1.8	(1-3)	2085	3.4	(3-4)		>
Malta	57	3.5	(0-12)	69	5.8	(2-14)	101	9.9	(5-17)	92	5.4	(2-12)		
EU/EEA (population-weighted mean)	**16287**	**6.2**	**(6-7)**	**17932**	**8.2**	**(8-9)**	**19619**	**7.1**	**(7-7)**	**21749**	**8.1**	**(8-8)**		**>**
Cyprus	65	9.2	(3-19)	68	5.9	(2-14)	80	5.0	(1-12)	62	12.9	(6-24)		
Romania	102	13.7	(8-22)	215	20.5	(15-26)	257	31.5	(26-38)	271	24.7	(20-30)		>##
Italy	845	29.1	(26-32)	1453	34.3	(32-37)	1315	32.9	(30-36)	1999	33.5	(31-36)		
Greece	1460	60.5	(58-63)	1209	59.4	(57-62)	1088	62.3	(59-65)	1185	61.9	(59-65)		

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*
N/A: Not applicable as data were not reported for all years, or number of isolates was below 20 in any year during the period.

Escherichia coli

Escherichia coli is one of the most frequent causes of bloodstream infections and community- and healthcare-associated urinary tract infections worldwide.

Antibiotic resistance in *E. coli* requires close attention as the percentages of isolates resistant to commonly used antibiotics continue to increase throughout Europe. More than half of the isolates reported to EARS-Net in 2015 were resistant to at least one antibiotic group under surveillance (aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems). The highest resistance percentages were reported from southern and south-eastern Europe (Figures 4–5).

Of particular concern is the increase in resistance to third-generation cephalosporins which increased significantly at EU/EEA level from 11.9% in 2012 to 13.1% in 2015 (Table 3), and combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides which increased significantly at EU/EEA level from 4.9% in 2012 to 5.3% in 2015 (Table 4).

Resistance to carbapenems in *E. coli* remains low (<0.1%) in Europe.

Figure 4. *Escherichia coli*: percentage of invasive isolates with resistance to third-generation cephalosporins, EU/EEA, 2012 (left), 2015 (right)

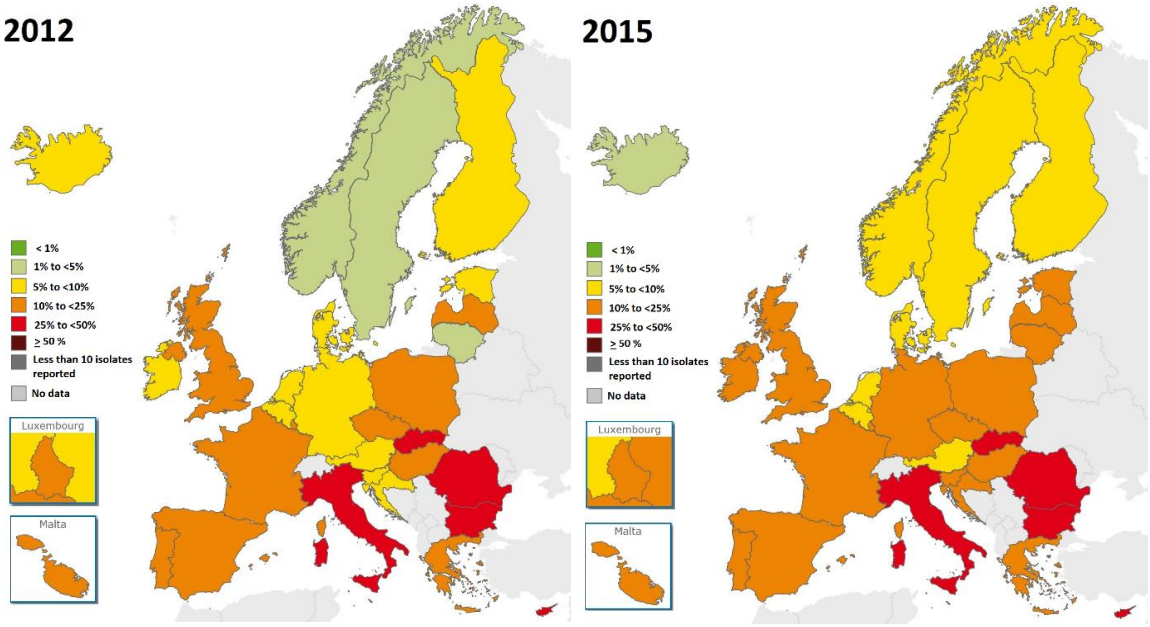


Figure 5. *Escherichia coli*: percentage of invasive isolates with combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides, EU/EEA, 2012 (left), 2015 (right)

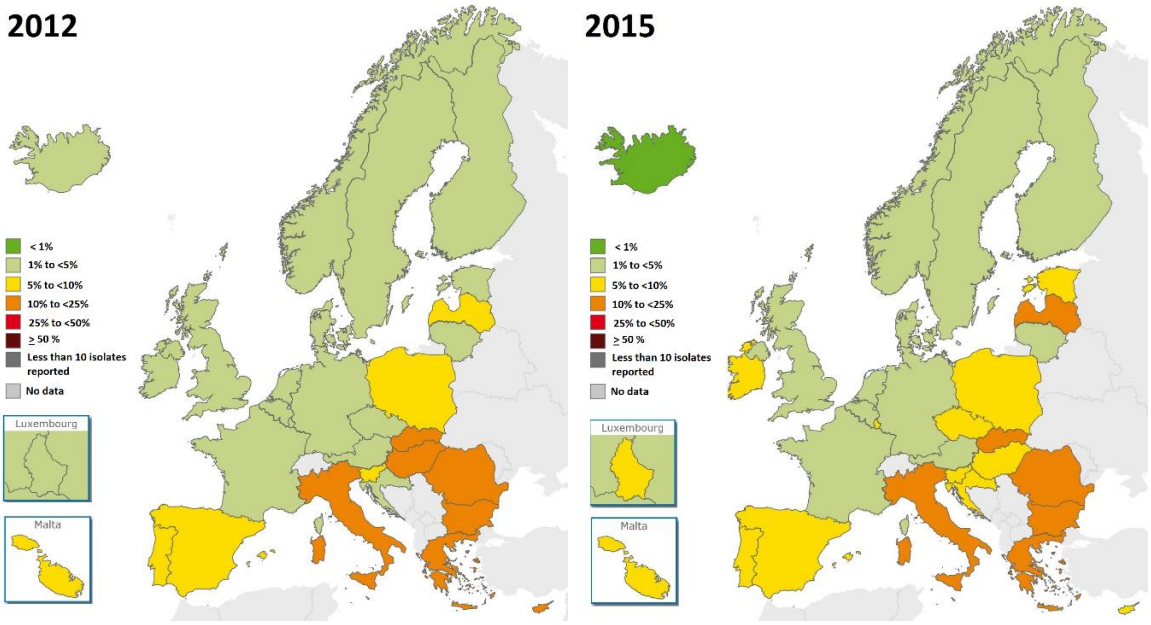


Table 3. *Escherichia coli*: Total number of invasive isolates tested (N) and percentage with resistance to third-generation cephalosporins (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2012–2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Iceland	138	5.1	(2-10)	121	5.0	(2-10)	152	3.3	(1-8)	173	1.7	(0-5)		
Netherlands	4702	6.0	(5-7)	4740	5.8	(5-7)	6497	5.7	(5-6)	5378	5.7	(5-6)		
Norway	3019	4.9	(4-6)	3077	5.5	(5-6)	3421	5.8	(5-7)	3301	6.0	(5-7)		>
Finland	3162	6.2	(5-7)	3720	7.1	(6-8)	4009	5.4	(5-6)	4342	6.1	(5-7)		
Sweden	5537	4.5	(4-5)	7532	5.2	(5-6)	6546	5.6	(5-6)	5995	6.2	(6-7)		>
Denmark	2519	7.9	(7-9)	2451	8.1	(7-9)	4410	7.0	(6-8)	4561	7.5	(7-8)		
Austria	3710	8.7	(8-10)	4376	9.8	(9-11)	4739	9.4	(9-10)	4900	9.7	(9-11)		
Belgium	4097	6.9	(6-8)	4051	8.0	(7-9)	2802	9.7	(9-11)	2593	9.7	(9-11)		>
Germany	4186	8.8	(8-10)	5335	10.7	(10-12)	6246	10.5	(10-11)	8724	10.4	(10-11)		
France	9563	10.0	(9-11)	10154	9.5	(9-10)	10349	9.9	(9-11)	11051	11.0	(10-12)		>
Malta	216	13.9	(10-19)	248	8.9	(6-13)	279	10.8	(7-15)	258	11.2	(8-16)		
United Kingdom	5663	13.1	(12-14)	6586	14.7	(14-16)	6221	10.3	(10-11)	5169	11.3	(10-12)		<
Estonia	305	7.9	(5-11)	340	7.4	(5-11)	410	9.3	(7-12)	246	11.4	(8-16)		
Ireland	2288	9.2	(8-10)	2480	10.6	(9-12)	2691	10.7	(10-12)	2638	11.4	(10-13)		>
Spain	5672	13.5	(13-14)	5932	13.3	(12-14)	5821	12.3	(12-13)	6428	11.6	(11-12)		<
Poland	1037	12.9	(11-15)	1036	10.9	(9-13)	1085	10.5	(9-12)	1610	11.9	(10-14)		
Croatia	906	7.6	(6-10)	1040	8.8	(7-11)	1079	10.8	(9-13)	1046	12.5	(11-15)		>
Luxembourg	334	11.4	(8-15)	301	10.6	(7-15)	368	12.0	(9-16)	347	12.7	(9-17)		
EU/EEA (population-weighted mean)	**70888**	**11.9**	**(12-12)**	**79082**	**12.6**	**(12-13)**	**85103**	**12.0**	**(12-12)**	**89839**	**13.1**	**(13-13)**		**>**
Slovenia	1168	9.5	(8-11)	1224	8.7	(7-10)	1216	12.7	(11-15)	1326	13.7	(12-16)		>
Czech Republic	2812	11.5	(10-13)	2954	13.1	(12-14)	2978	14.0	(13-15)	3172	14.5	(13-16)		>
Lithuania	462	4.8	(3-7)	434	7.6	(5-11)	594	8.1	(6-11)	581	16.0	(13-19)		>
Portugal	2154	13.5	(12-15)	2678	14.9	(14-16)	5024	16.4	(15-17)	5376	16.1	(15-17)		> #
Hungary	1411	17.4	(15-20)	1437	18.9	(17-21)	1619	16.4	(15-18)	2026	16.7	(15-18)		
Latvia	154	13.0	(8-19)	136	14.0	(9-21)	165	10.9	(7-17)	201	17.9	(13-24)		
Greece	1393	16.2	(14-18)	1255	17.2	(15-19)	1122	21.0	(19-24)	1215	19.8	(18-22)		> #
Romania	191	25.1	(19-32)	298	22.8	(18-28)	306	29.4	(24-35)	369	26.8	(22-32)		
Cyprus	176	31.8	(25-39)	162	38.9	(31-47)	153	28.8	(22-37)	123	28.5	(21-37)		
Slovakia	693	30.7	(27-34)	807	29.7	(27-33)	889	31.8	(29-35)	893	30.0	(27-33)		
Italy	2997	26.3	(25-28)	3990	26.2	(25-28)	3694	28.7	(27-30)	5592	30.1	(29-31)		>
Bulgaria	223	38.1	(32-45)	187	39.6	(33-47)	218	40.4	(34-47)	205	38.5	(32-46)		

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*

Table 4. *Escherichia coli*: Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2012–2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Iceland	134	1.5	(0-5)	116	0.9	(0-5)	141	1.4	(0-5)	162	0.0	(0-2)		
Norway	2835	1.9	(1-3)	2971	2.5	(2-3)	3413	2.0	(2-2)	3298	1.9	(1-2)		
Netherlands	4675	1.8	(1-2)	4722	1.9	(2-2)	6425	2.1	(2-3)	5377	2.0	(2-2)		
Denmark	2285	2.6	(2-3)	2377	2.2	(2-3)	4406	1.9	(1-2)	4531	2.5	(2-3)		
Sweden	5534	1.8	(1-2)	7094	2.0	(2-2)	4203	2.0	(2-2)	5257	2.5	(2-3)		>\#
Finland	2993	3.1	(3-4)	3457	3.2	(3-4)	3787	2.2	(2-3)	4103	2.6	(2-3)		<\#
Austria	3573	2.3	(2-3)	4258	3.1	(3-4)	4609	2.6	(2-3)	4785	2.9	(2-3)		
Germany	4179	3.2	(3-4)	5282	2.7	(2-3)	6158	3.0	(3-3)	8707	3.0	(3-3)		
Belgium	2998	2.0	(2-3)	3138	2.7	(2-3)	2045	3.9	(3-5)	2285	3.5	(3-4)		>\#
France	5655	3.3	(3-4)	10068	3.2	(3-4)	10299	3.5	(3-4)	10988	3.9	(4-4)		>\#
Lithuania	454	1.3	(0-3)	428	1.9	(1-4)	582	2.6	(1-4)	581	4.3	(3-6)		>
United Kingdom	5577	4.2	(4-5)	6535	4.4	(4-5)	6191	4.4	(4-5)	5119	4.5	(4-5)		
Estonia	301	1.7	(1-4)	335	3.3	(2-6)	404	3.5	(2-6)	233	5.2	(3-9)		>
Luxembourg	334	2.7	(1-5)	283	2.1	(1-5)	367	3.8	(2-6)	347	5.2	(3-8)		>
EU/EEA (population-weighted mean)	**64514**	**4.9**	**(5-5)**	**76499**	**4.6**	**(4-5)**	**80907**	**4.7**	**(5-5)**	**87798**	**5.3**	**(5-5)**		**>**
Ireland	2282	3.6	(3-4)	2477	4.7	(4-6)	2689	4.7	(4-6)	2621	5.4	(5-6)		>
Spain	5651	5.8	(5-6)	5921	5.8	(5-6)	5814	5.3	(5-6)	6416	5.5	(5-6)		
Poland	990	6.1	(5-8)	978	5.0	(4-7)	1026	5.6	(4-7)	1532	6.1	(5-7)		
Hungary	1382	10.6	(9-12)	1418	11.0	(9-13)	1599	8.2	(7-10)	2015	6.7	(6-8)		<
Croatia	885	2.7	(2-4)	1003	3.5	(2-5)	1070	6.0	(5-8)	1000	6.9	(5-9)		>
Czech Republic	2809	4.3	(4-5)	2953	4.9	(4-6)	2976	6.4	(6-7)	3165	6.9	(6-8)		>
Malta	216	7.4	(4-12)	248	5.2	(3-9)	279	6.8	(4-10)	258	7.0	(4-11)		
Portugal	2151	9.2	(8-10)	2676	8.1	(7-9)	4989	8.2	(7-9)	5366	7.6	(7-8)		<
Slovenia	1168	5.0	(4-6)	1224	4.5	(3-6)	1216	7.1	(6-9)	1325	8.1	(7-10)		>
Cyprus	176	14.8	(10-21)	162	20.4	(14-27)	153	13.1	(8-19)	123	9.8	(5-16)		
Latvia	152	6.6	(3-12)	132	3.8	(1-9)	163	2.5	(1-6)	191	10.5	(7-16)		
Greece	1368	10.7	(9-12)	1234	10.3	(9-12)	1102	10.7	(9-13)	1187	10.7	(9-13)		
Bulgaria	219	16.0	(11-22)	187	18.7	(13-25)	188	20.2	(15-27)	182	12.6	(8-18)		
Romania	179	15.6	(11-22)	292	9.2	(6-13)	298	14.4	(11-19)	364	13.5	(10-17)		
Italy	2667	14.3	(13-16)	3724	12.5	(11-14)	3428	13.7	(13-15)	5389	14.6	(14-16)		
Slovakia	692	13.4	(11-16)	806	17.2	(15-20)	887	17.0	(15-20)	891	17.1	(15-20)		

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*

Acinetobacter species

Acinetobacter species mainly cause healthcare-associated infections, such as pneumonia and bloodstream infections, and often result in hospital outbreaks if appropriate prevention and control measures are not implemented.

Antibiotic resistance in *Acinetobacter* spp. showed large variations across Europe, with generally high resistance percentages reported from the Baltic countries and southern and south-eastern Europe (Figure 6). Combined resistance to fluoroquinolones, aminoglycosides and carbapenems was the most frequently reported resistance phenotype in 2015, and accounted for almost half of the reported isolates. Nine out of 27 countries reporting resistance results for 10 or more isolates had percentages for this type of combined resistance of 50% or higher (Table 5). This is an indication of seriously limited options for the treatment of patients infected with *Acinetobacter* spp. in these countries.

Resistance to colistin, an antibiotic from the polymyxin group, was observed in 4% of the isolates, with the vast majority reported from southern Europe. These results should be interpreted with caution due to the low number of isolates tested and differences in laboratory methodology to determine resistance. However, the high levels of resistance to multiple antibiotics reported from several countries is of great concern, especially in countries where resistance to carbapenems is already high and resistance to colistin is starting to be reported. The presence of *Acinetobacter* spp. in the healthcare environment is problematic as it can persist in the environment and is difficult to eradicate once established.

Figure 6. *Acinetobacter* spp: percentage of invasive isolates with combined resistance to fluoroquinolones, aminoglycosides and carbapenems, EU/EEA, 2012 (left), 2015 (right)

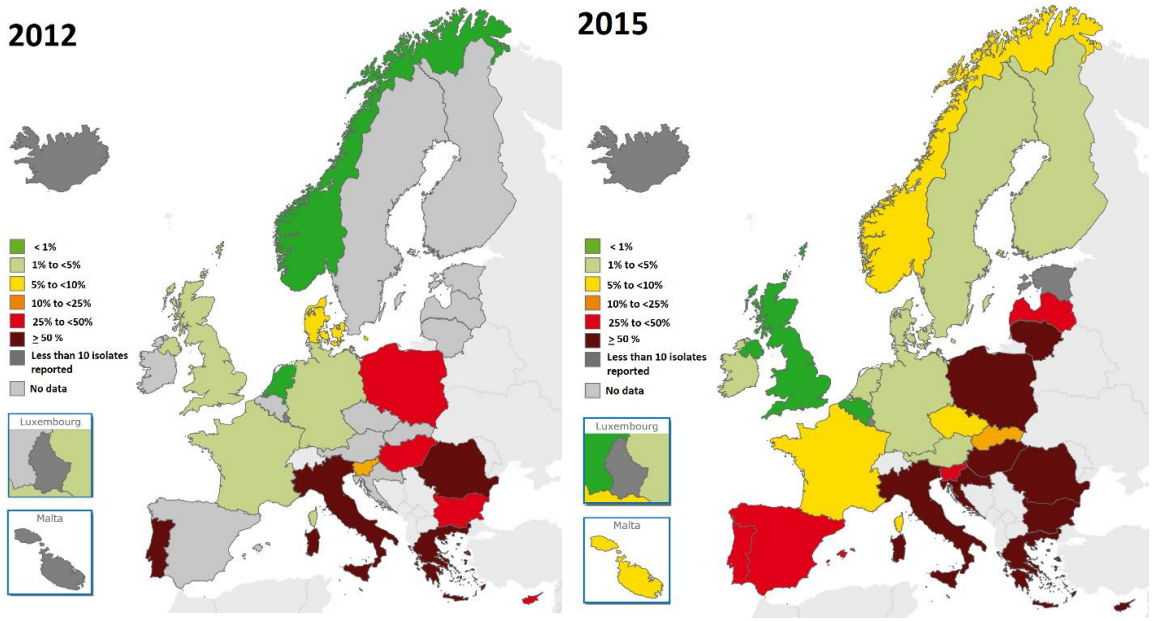


Table 5. *Acinetobacter* spp: Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, aminoglycosides and carbapenems (%R), including 95% confidence intervals (95% CI), by country, EU/EEA countries, 2012-2015.

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Belgium	-	-	(-)	1	**	(**)	2	**	(**)	13	0.0	(0-25)		N/A
United Kingdom	79	1.3	(0-7)	149	1.3	(0-5)	119	1.7	(0-6)	131	0.0	(0-3)		
Ireland	-	-	(-)	84	0.0	(0-4)	79	1.3	(0-7)	75	1.3	(0-7)		N/A
Finland	-	-	(-)	34	0.0	(0-10)	30	0.0	(0-12)	42	2.4	(0-13)		N/A
Denmark	58	8.6	(3-19)	57	1.8	(0-9)	49	0.0	(0-7)	60	3.3	(0-12)		
Germany	119	4.2	(1-10)	174	5.2	(2-10)	188	2.1	(1-5)	325	3.7	(2-6)		
Sweden	-	-	(-)	71	5.6	(2-14)	36	2.8	(0-15)	26	3.8	(0-20)		N/A
Netherlands	10	0.0	(0-31)	64	1.6	(0-8)	69	0.0	(0-5)	73	4.1	(1-12)		N/A
Austria	-	-	(-)	51	5.9	(1-16)	74	2.7	(0-9)	61	4.9	(1-14)		N/A
Czech Republic	-	-	(-)	91	4.4	(1-11)	59	5.1	(1-14)	60	5.0	(1-14)		N/A
France	272	4.0	(2-7)	389	4.1	(2-7)	391	1.5	(1-3)	424	5.2	(3-8)		
Malta	5	**	(**)	7	**	(**)	10	10.0	(0-45)	15	6.7	(0-32)		N/A
Norway	25	0.0	(0-14)	36	0.0	(0-10)	33	3.0	(0-16)	32	9.4	(2-25)		> #
Slovakia	-	-	(-)	141	24.8	(18-33)	160	24.4	(18-32)	142	23.2	(17-31)		N/A
Slovenia	25	12.0	(3-31)	25	16.0	(5-36)	34	20.6	(9-38)	31	35.5	(19-55)		> #
Spain	-	-	(-)	71	66.2	(54-77)	78	55.1	(43-66)	94	41.5	(31-52)		N/A
Portugal	168	64.3	(57-72)	222	56.3	(50-63)	260	39.2	(33-45)	302	45.0	(39-51)		<
Latvia	-	-	(-)	-	-	(-)	52	61.5	(47-75)	60	46.7	(34-60)		N/A
Hungary	394	41.6	(37-47)	465	42.8	(38-47)	438	38.4	(34-43)	462	51.7	(47-56)		>
Poland	206	36.9	(30-44)	184	46.2	(39-54)	184	38.0	(31-45)	240	54.6	(48-61)		>
Bulgaria	58	32.8	(21-46)	86	39.5	(29-51)	85	47.1	(36-58)	112	66.1	(57-75)		>
Italy	217	77.4	(71-83)	444	78.8	(75-83)	437	86.3	(83-89)	650	72.6	(69-76)		< #
Cyprus	23	47.8	(27-69)	33	60.6	(42-77)	57	73.7	(60-84)	59	72.9	(60-84)		>
Lithuania	-	-	(-)	-	-	(-)	65	60.0	(47-72)	73	76.7	(65-86)		N/A
Romania	54	50.0	(36-64)	137	74.5	(66-82)	121	76.9	(68-84)	186	76.9	(70-83)		>
Greece	1203	74.5	(72-77)	809	79.6	(77-82)	793	82.6	(80-85)	943	82.2	(80-85)		>
Croatia	-	-	(-)	111	78.4	(70-86)	162	80.9	(74-87)	193	87.0	(81-91)		N/A
Iceland	2	**	(**)	-	-	(-)	3	**	(**)	6	**	(**)		N/A
Luxembourg	5	**	(**)	1	**	(**)	6	**	(**)	7	**	(**)		N/A
Estonia	-	-	(-)	-	-	(-)	-	-	(-)	1	**	(**)		N/A

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*

*** Fewer than 10 isolates reported, resistance percentage not calculated.*

N/A: Not applicable as data were not reported for all years, or number of isolates was below 20 in any year during the period.

–: No data reported

Meticillin-resistant *Staphylococcus aureus*

Meticillin-resistant *Staphylococcus aureus* (MRSA) is one of the most frequent causes of antibiotic-resistant healthcare-associated infections worldwide. In addition, increasing levels of community-associated MRSA are being reported from many parts of the world, including Europe.

In 2015, as in previous years, large inter-country variations in MRSA percentages among invasive isolates of *S. aureus* were observed across Europe (Figure 7), with percentages ranging from zero to 57.2% (Table 6). The EU/EEA population-weighted mean percentage decreased significantly from 18.8% in 2012 to 16.8% in 2015. Despite this positive development, MRSA remains a public health priority in Europe as eight out of 30 countries reported MRSA percentages above 25%. Comprehensive MRSA strategies targeting all healthcare sectors (acute, long-term care facilities and ambulatory care) remain essential to sustain the reduction of the spread of MRSA in Europe.

Figure 7. *Staphylococcus aureus*: percentage of invasive isolates with resistance to meticillin (MRSA), EU/EEA, 2012 (left), 2015 (right)

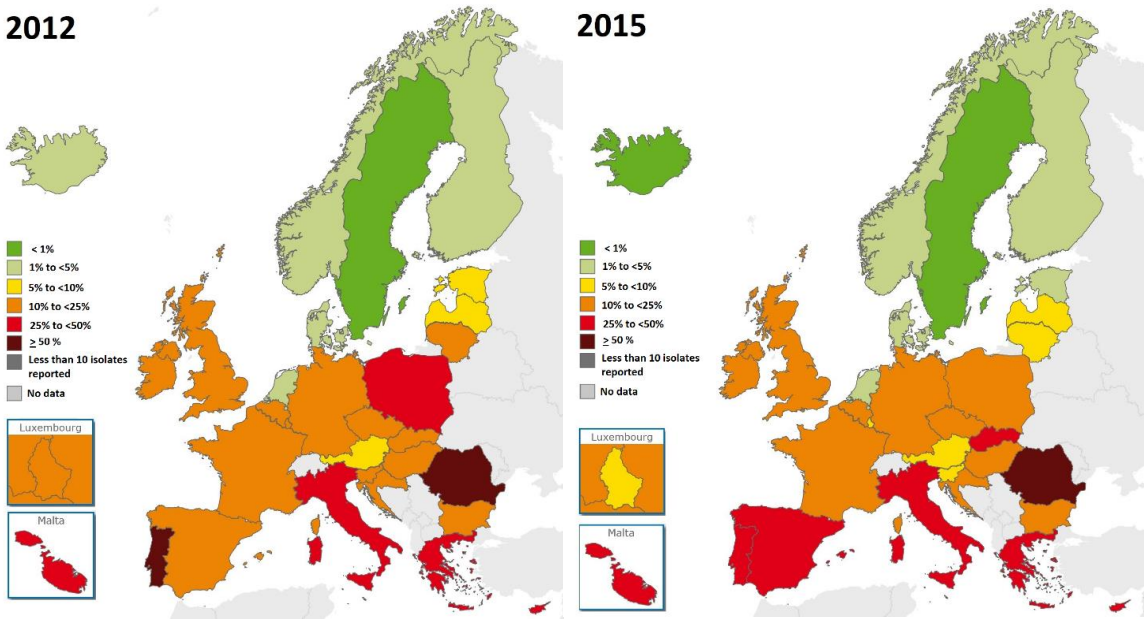


Table 6. *Staphylococcus aureus*: Total number of invasive isolates tested (N) and percentage with resistance to meticillin (MRSA) including 95% confidence intervals (95% CI), EU/EEA countries, 2012-2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Iceland	58	1.7	(0-9)	69	0.0	(0-5)	61	3.3	(0-11)	88	0.0	(0-4)		
Sweden	3263	0.7	(0-1)	4099	1.0	(1-1)	2745	1.0	(1-1)	3124	0.8	(1-1)		
Norway	1430	1.3	(1-2)	1473	0.7	(0-1)	1544	1.0	(1-2)	1453	1.2	(1-2)		
Netherlands	1944	1.3	(1-2)	2062	1.2	(1-2)	2524	1.0	(1-1)	2107	1.3	(1-2)		
Denmark	1431	1.3	(1-2)	1685	1.7	(1-2)	1874	2.5	(2-3)	1876	1.6	(1-2)		
Finland	1409	2.1	(1-3)	1580	1.8	(1-3)	1831	2.6	(2-3)	2070	1.9	(1-3)		
Estonia	104	7.7	(3-15)	170	3.5	(1-8)	223	3.1	(1-6)	151	4.0	(1-8)		
Latvia	211	9.0	(6-14)	172	7.0	(4-12)	220	8.2	(5-13)	251	5.6	(3-9)		
Austria	2164	7.7	(7-9)	2534	9.2	(8-10)	2651	7.8	(7-9)	2785	7.5	(7-9)		
Lithuania	323	10.2	(7-14)	267	9.7	(6-14)	383	7.8	(5-11)	376	8.5	(6-12)		
Luxembourg	131	15.3	(10-23)	135	8.9	(5-15)	125	12.0	(7-19)	135	8.9	(5-15)		
Slovenia	445	10.3	(8-14)	465	9.0	(7-12)	495	13.1	(10-16)	513	9.2	(7-12)		
United Kingdom	2676	14.0	(13-15)	2117	13.7	(12-15)	2400	11.3	(10-13)	2757	10.8	(10-12)		<
Germany	2563	15.4	(14-17)	3128	12.8	(12-14)	3146	12.9	(12-14)	4871	11.2	(10-12)		<
Belgium	1568	16.6	(15-19)	1612	16.9	(15-19)	988	13.5	(11-16)	913	12.3	(10-15)		<#
Bulgaria	227	19.8	(15-26)	214	19.2	(14-25)	216	20.8	(16-27)	222	13.1	(9-18)		
Czech Republic	1611	13.0	(11-15)	1707	13.2	(12-15)	1695	13.0	(11-15)	1806	13.7	(12-15)		
France	5228	19.2	(18-20)	5431	17.1	(16-18)	5484	17.4	(16-18)	5535	15.7	(15-17)		<
Poland	783	25.4	(22-29)	743	16.0	(13-19)	490	20.6	(17-24)	958	15.8	(14-18)		<
EU/EEA (population-weighted mean)	**36989**	**18.8**	**(18-19)**	**40976**	**18.1**	**(18-18)**	**40910**	**17.5**	**(17-18)**	**45364**	**16.8**	**(17-17)**		**<**
Ireland	1038	22.6	(20-25)	1069	19.9	(18-22)	1075	19.4	(17-22)	1057	18.1	(16-21)		<
Croatia	403	21.3	(17-26)	520	24.0	(20-28)	484	21.3	(18-25)	486	24.5	(21-29)		
Hungary	1143	24.8	(22-27)	1200	24.0	(22-27)	1279	23.1	(21-25)	1517	24.7	(23-27)		
Spain	1899	24.2	(22-26)	1777	22.6	(21-25)	1920	22.1	(20-24)	1970	25.3	(23-27)		
Slovakia	474	21.7	(18-26)	552	26.6	(23-31)	640	28.0	(25-32)	583	28.1	(25-32)		>
Italy	1636	35.2	(33-38)	2394	35.8	(34-38)	2134	33.6	(32-36)	3000	34.1	(32-36)		
Greece	876	41.0	(38-44)	757	40.3	(37-44)	556	37.1	(33-41)	612	39.4	(35-43)		
Cyprus	165	35.2	(28-43)	157	32.5	(25-40)	136	36.0	(28-45)	143	43.4	(35-52)		
Portugal	1455	53.8	(51-56)	2390	46.8	(45-49)	3193	47.4	(46-49)	3619	46.8	(45-48)		<
Malta	102	47.1	(37-57)	114	51.8	(42-61)	82	42.7	(32-54)	89	48.3	(38-59)		
Romania	229	53.3	(47-60)	383	64.5	(59-69)	316	56.0	(50-62)	297	57.2	(51-63)		

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*
N/A: Not applicable as data were not reported for all years, or number of isolates was below 20 in any year during the period.

Vancomycin-resistant enterococci

Enterococcus faecium and *Enterococcus faecalis* can cause a variety of infections, including endocarditis, bloodstream infections, and urinary tract infections. Vancomycin-resistant enterococci (VRE) mainly cause healthcare-associated infections and often result in hospital outbreaks if appropriate prevention and control measures are not implemented.

In 2015, as in previous years, vancomycin resistance was more common in *E. faecium* than in *E. faecalis*. For *E. faecium,* high percentages of vancomycin resistance were reported from countries in eastern and south-eastern Europe (Figure 8). Between 2012 and 2015, a significant increase in the percentage of *E. faecium* invasive isolates that were VRE was observed in 12 out of the 26 countries reporting more than 20 isolates per year (Table 7). Although the small resulting increase at EU/EEA level, from 8.1% in 2012 to 8.3% in 2015, was not statistically significant, trends for individual countries may indicate a change in the epidemiology of VRE in Europe. As for other antimicrobial-resistant pathogens, comprehensive infection prevention and control strategies paired with prudent antibiotic use are the cornerstones of prevention of VRE.

Figure 8. *Enterococcus faecium*: percentage of invasive isolates with resistance to vancomycin, EU/EEA, 2012 (left), 2015 (right)

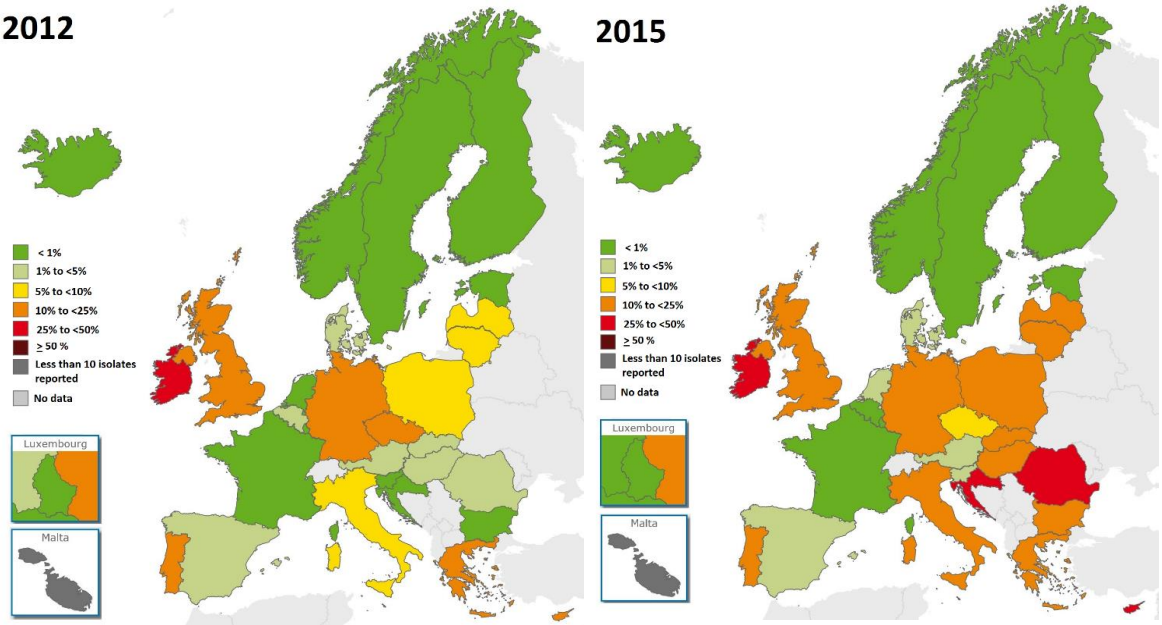


Table 7. *Enterococcus faecium.* Total number of invasive isolates tested (N) and percentage with resistance to vancomycin (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2012–2015

	2012			2013			2014			2015				
Country	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	N	%R	(95% CI)	Trend 2012-2015*	
Estonia	40	0.0	(0-9)	40	0.0	(0-9)	48	0.0	(0-7)	27	0.0	(0-13)		
Iceland	12	0.0	(0-26)	17	5.9	(0-29)	11	0.0	(0-28)	20	0.0	(0-17)		N/A
Luxembourg	20	0.0	(0-17)	19	5.3	(0-26)	31	3.2	(0-17)	23	0.0	(0-15)		N/A
Norway	168	0.6	(0-3)	211	2.4	(1-5)	227	1.8	(0-4)	185	0.0	(0-2)		
Sweden	404	0.0	(0-1)	575	0.0	(0-1)	452	0.4	(0-2)	408	0.0	(0-1)		
Finland	274	0.7	(0-3)	304	0.3	(0-2)	368	0.0	(0-1)	298	0.3	(0-2)		
Belgium	212	1.4	(0-4)	235	1.7	(0-4)	195	3.1	(1-7)	163	0.6	(0-3)		
France	614	0.8	(0-2)	733	0.1	(0-1)	737	0.5	(0-1)	849	0.8	(0-2)		
Netherlands	484	0.0	(0-1)	439	0.5	(0-2)	532	1.1	(0-2)	572	1.4	(1-3)		>
Spain	537	1.5	(1-3)	553	0.9	(0-2)	546	2.4	(1-4)	571	2.5	(1-4)		>
Austria	376	3.2	(2-6)	437	5.9	(4-9)	480	4.4	(3-7)	483	3.1	(2-5)		
Denmark	593	2.0	(1-4)	644	3.4	(2-5)	715	4.5	(3-6)	690	3.2	(2-5)		
Slovenia	95	0.0	(0-4)	102	1.0	(0-5)	115	1.7	(0-6)	124	4.8	(2-10)		>
EU/EEA (population-weighted mean)	**7203**	**8.1**	**(7-9)**	**8307**	**9**	**(8-10)**	**8324**	**8.2**	**(8-9)**	**9123**	**8.3**	**(8-9)**		
Czech Republic	262	11.5	(8-16)	268	9.0	(6-13)	250	4.4	(2-8)	322	9.6	(7-13)		
Germany	647	16.2	(13-19)	855	14.6	(12-17)	882	9.1	(7-11)	1312	10.2	(9-12)		<
Italy	435	6.0	(4-9)	563	4.4	(3-6)	472	8.5	(6-11)	756	11.2	(9-14)		>
Bulgaria	42	0.0	(0-8)	44	2.3	(0-12)	60	13.3	(6-25)	41	14.6	(6-29)		>
Slovakia	82	4.9	(1-12)	132	7.6	(4-13)	129	10.1	(5-17)	143	14.7	(9-22)		>
Hungary	142	3.5	(1-8)	210	7.1	(4-12)	224	8.5	(5-13)	240	16.7	(12-22)		>
United Kingdom	362	13.3	(10-17)	442	23.3	(19-28)	423	21.3	(17-25)	218	17.0	(12-23)		
Lithuania	37	5.4	(1-18)	25	0.0	(0-14)	44	4.5	(1-15)	52	17.3	(8-30)		>
Latvia	18	5.6	(0-27)	25	12.0	(3-31)	15	13.3	(2-40)	34	17.6	(7-35)		N/A
Poland	157	8.3	(4-14)	173	12.7	(8-19)	182	21.4	(16-28)	215	17.7	(13-23)		> #
Greece	418	17.2	(14-21)	345	21.2	(17-26)	264	26.9	(22-33)	315	19.7	(15-25)		
Portugal	257	23.3	(18-29)	350	22.0	(18-27)	363	20.1	(16-25)	459	20.3	(17-24)		
Romania	34	2.9	(0-15)	54	11.1	(4-23)	56	25.0	(14-38)	72	25.0	(16-37)		>
Croatia	60	0.0	(0-6)	74	6.8	(2-15)	67	10.4	(4-20)	93	25.8	(17-36)		>
Cyprus	29	10.3	(2-27)	30	23.3	(10-42)	35	40.0	(24-58)	28	28.6	(13-49)		>
Ireland	386	44.0	(39-49)	398	42.7	(38-48)	390	45.1	(40-50)	404	45.8	(41-51)		
Malta	6	**	(**)	10	0.0	(0-31)	11	0.0	(0-28)	6	**	(**)		N/A

** The symbols > and < indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data, which was not observed when only data from laboratories consistently reporting for all four years were included.*

*** Fewer than 10 isolates reported, resistance pertcentage not calculated.*

N/A: Not applicable as data were not reported for all years, or number of isolates was below 20 in any year during the period.