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

ESAC-Net surveillance data
November 2017

- Provision of reliable and comparable national antibiotic consumption data is a prerequisite for understanding the epidemiology of antibiotic resistance in Europe, since antibiotic use is one of the main factors responsible for antibiotic resistance.
- Although most courses of antibiotics are consumed in the community (outside hospitals), antibiotic use in hospitals is a major driver of the emergence of multidrug-resistant bacteria responsible for healthcare-associated infections.
- During 2012–2016, antibiotic consumption at community level within the European Union/European Economic Area (EU/EEA) (expressed as defined daily doses (DDD) per 1 000 inhabitants per day) showed no significant trend overall, although some countries showed significant decreasing or increasing trends. The large inter-country variation in antibiotic consumption remained. When expressing antibiotic consumption as a number of packages per 1 000 inhabitants per day (used by ESAC-Net as a surrogate for prescriptions), four countries had experienced a statistically significant decrease during the period 2012–2016.
- During 2012–2016, antibiotic consumption in the EU/EEA hospital sector (expressed as DDD per 1 000 inhabitants per day) showed no significant trend overall. However, statistically significant increases or decreases were observed for several countries. There was also no significant trend observed in the consumption of antibiotics to treat patients infected with serious multidrug-resistant bacteria during this period at EU level.

Recent national antibiotic consumption data for the community and the hospital sector are publicly available from the European Surveillance of Antimicrobial Consumption Network (ESAC-Net). At EU and national level these data are provided for healthcare professionals to identify areas that can be addressed by national antimicrobial stewardship programmes or to help evaluate the effectiveness of awareness campaigns on the prudent use of antibiotics.

Antibiotic consumption in the community

In 2016, the EU/EEA population-weighted mean consumption of antibiotics for systemic use in the community was 21.9 DDD per 1 000 inhabitants per day which, although lower than in previous years, did not display any statistically significant trend during 2012–2016. Finland, Luxembourg, Norway and Sweden showed a decreasing trend during the period, whereas Greece and Spain showed an increasing trend. In 2016, consumption ranged from 10.4 (the Netherlands) to 36.3 DDD per 1 000 inhabitants per day (Greece); a 3.5-fold difference, similar to previous years.

Expressed in packages per 1 000 inhabitants per day, the EU/EEA population-weighted mean consumption was 3.1 packages per 1 000 inhabitants per day and it did not show any statistically significant trend during the period 2012–2016. At country level, a statistically significant decrease was observed for Denmark, Estonia, Finland, and Sweden. In 2016, consumption ranged from 1.0 (Sweden) to 4.7 packages per 1 000 inhabitants per day (France).

Antibiotic consumption in the hospital sector

In 2016, the EU/EEA population-weighted mean consumption of antibiotics for systemic use in the hospital sector was 2.1 DDD per 1 000 inhabitants per day. Consumption ranged from 1.0 (the Netherlands) to 2.9 (Malta) DDD per 1 000 inhabitants per day. The EU/EEA population-weighted mean consumption did not show any statistically significant trend during 2012–2016. Greece, Malta and Slovenia showed an increasing trend, while Estonia, Finland and Luxembourg showed a decreasing trend.

The EU/EEA population-weighted mean consumption of carbapenems, a last-line group of antibiotics used to treat patients infected with multidrug-resistant bacteria, did not show any statistically significant overall trend during 2012–2016. In ten countries (Bulgaria, Croatia, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Romania and Slovakia), there was an increasing trend, and one country (Portugal) showed a decreasing trend during the same period.

The EU/EEA population-weighted mean consumption of polymyxins (e.g. colistin, which is used to treat infections with carbapenem-resistant bacteria) did not show any statistically significant trend during 2012–2016. At country level, there were increases in nine countries (Bulgaria, Denmark, Greece, Hungary, Italy, Malta, Romania, Slovakia and Slovenia), but also decreases in two countries (France and Ireland).

Erratum: on 29 November 2017, changes were made to Tables 1, 2 and Figure 3 and in the fifth paragraph on page 2 the number of countries reporting data has been reduced from 20 to 19 (66%) following the removal of data from Belgium for the 2015 and 2016 packages.

Antibiotic consumption in Europe

Antibiotic consumption data presented in this summary were collected by the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) at ECDC.

The indicator 'defined daily doses (DDD) per 1 000 inhabitants per day' is used to report antibiotic consumption in the community (i.e. outside hospitals) and in the hospital sector. It gives a rough estimate of the proportion of the population treated daily with antibiotics. DDD is an internationally accepted unit for measuring antibiotic consumption and for making comparisons between countries. This indicator takes into consideration the amount of antibiotics (doses) consumed in a country and its potential burden or ecological effect on the development of antimicrobial resistance.

For antibiotic consumption in the community, the indicator 'packages per 1 000 inhabitants per day' is reported for a subset of countries which have a policy of dispensing whole packages per antibiotic prescription in community pharmacies and provided data on the number of packages consumed according to the ATC/DDD index. This indicator only considers orally administered antibiotics, which represent most of the antibiotics for systemic use consumed in the community. It does not take into account dosage information. Some studies have shown that the indicator 'packages per 1 000 inhabitants per day' may be a valuable additional indicator for assessing trends in antibiotic consumption when surveillance data on antibiotic prescriptions are not available, which is the case for ESAC-Net.

The EU/EEA figures refer to the corresponding population-weighted mean consumption, calculated by adding up the products of each country's consumption in DDD per 1 000 inhabitants per day, multiplied by the country population as in Eurostat, and then dividing this sum by the total EU/EEA population.

In 2016, 29 EU/EEA countries reported data on antibiotic consumption in the community expressed as DDD per 1 000 inhabitants per day, and 19 (66%) of these countries were also able to report data on antibiotic packages. Two countries (Cyprus and Romania) were only able to report data on total consumption in the country – i.e. without differentiating between the community and the hospital sector.

In 2016, 23 countries reported data on antibiotic consumption specifically for the hospital sector.

For both the community and the hospital sector, these data were mainly on sales of antibiotics in the country, or a combination of sales and reimbursement data. Spain provided only reimbursement data (i.e. not including antibiotics obtained without a prescription or other non-reimbursed courses).

Inter-country comparisons of data on antibiotic consumption in the community presented in this summary should be made with caution. A few countries reported total consumption (i.e. community plus hospital sector), while most of the other countries reported data on community consumption only. In addition, reporting practices may vary from year to year, even in the same country.

Antibiotic consumption data are collected using the Anatomical Therapeutic Chemical (ATC) classification system and defined daily dose (DDD) methodology developed by the WHO Collaborating Centre for Drug Statistics Methodology (Oslo, Norway, 2016). More details on the methods, collection, validation and reporting of European antibiotic consumption data are available from the ESAC-Net pages on the ECDC website and are also described in the ESAC-Net surveillance reports. The most recent data on antibiotic consumption are available from the public ESAC-Net interactive database (data for 1997–2016) on the ECDC website.

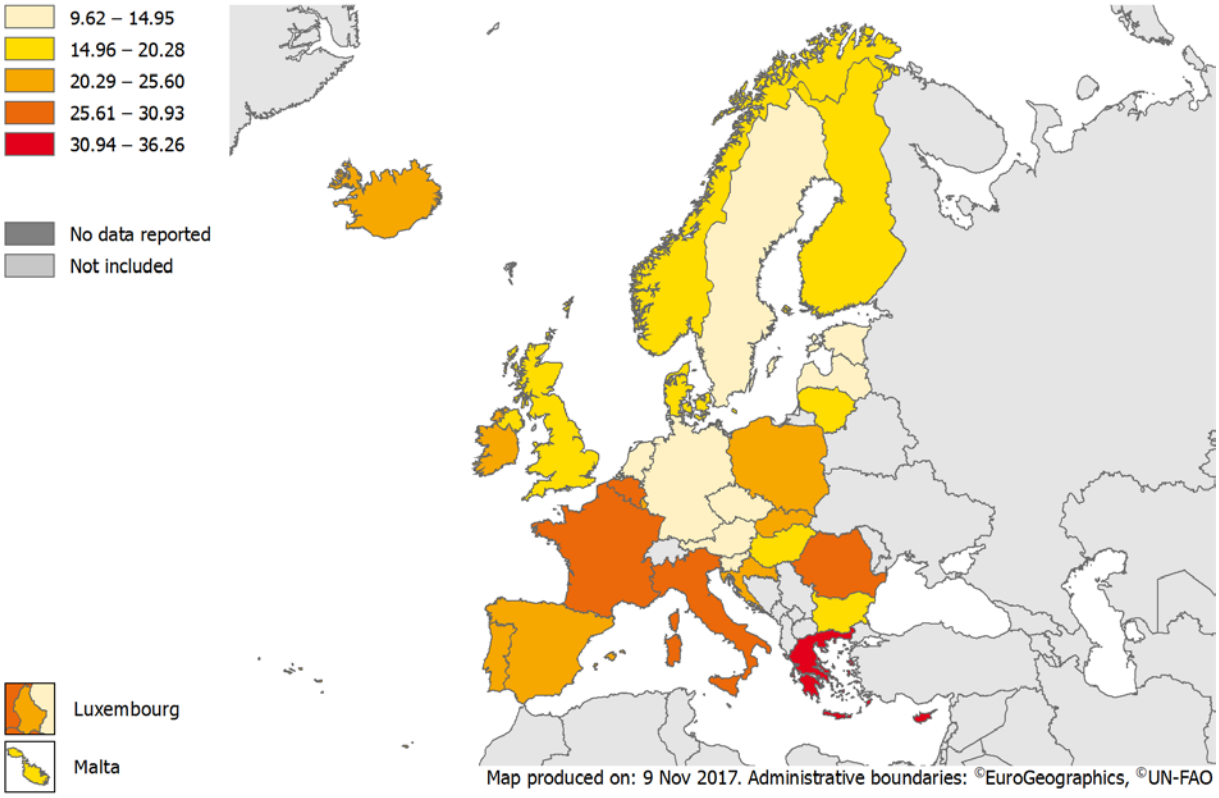
Broadly accepted standards and metrics reflecting responsible antibiotic use have not been defined until now. The development of evidence-based and consensually validated quantity metrics to evaluate antibiotic use, both for community and hospital settings, was one of the objectives of the 'Driving re-investment in Research & Development (R&D) and responsible antibiotic use' project (DRIVE-AB), a public–private consortium funded by the EU Innovative Medicines Initiative (IMI). The project has proposed quality indicators and quantity metrics for antibiotic use (http://drive-ab.eu/wp-content/uploads/2014/09/WP1A_Final-QMs-QIs_final.pdf). The proposed metrics have been used in the summary.

Consumption of antibiotics in the community

DDDs

Consumption of antibiotics for systemic use at community level in EU/EEA countries in 2016 expressed in DDD per 1 000 inhabitants per day is shown in Figure 1.

Figure 1. Consumption of antibiotics for systemic use in the community, EU/EEA countries, 2016 (expressed as DDD per 1 000 inhabitants per day)



Cyprus and Romania provided total care data (i.e. including the hospital sector.)

Spain provided reimbursement data (i.e. not including consumption without a prescription or other non-reimbursed courses.)

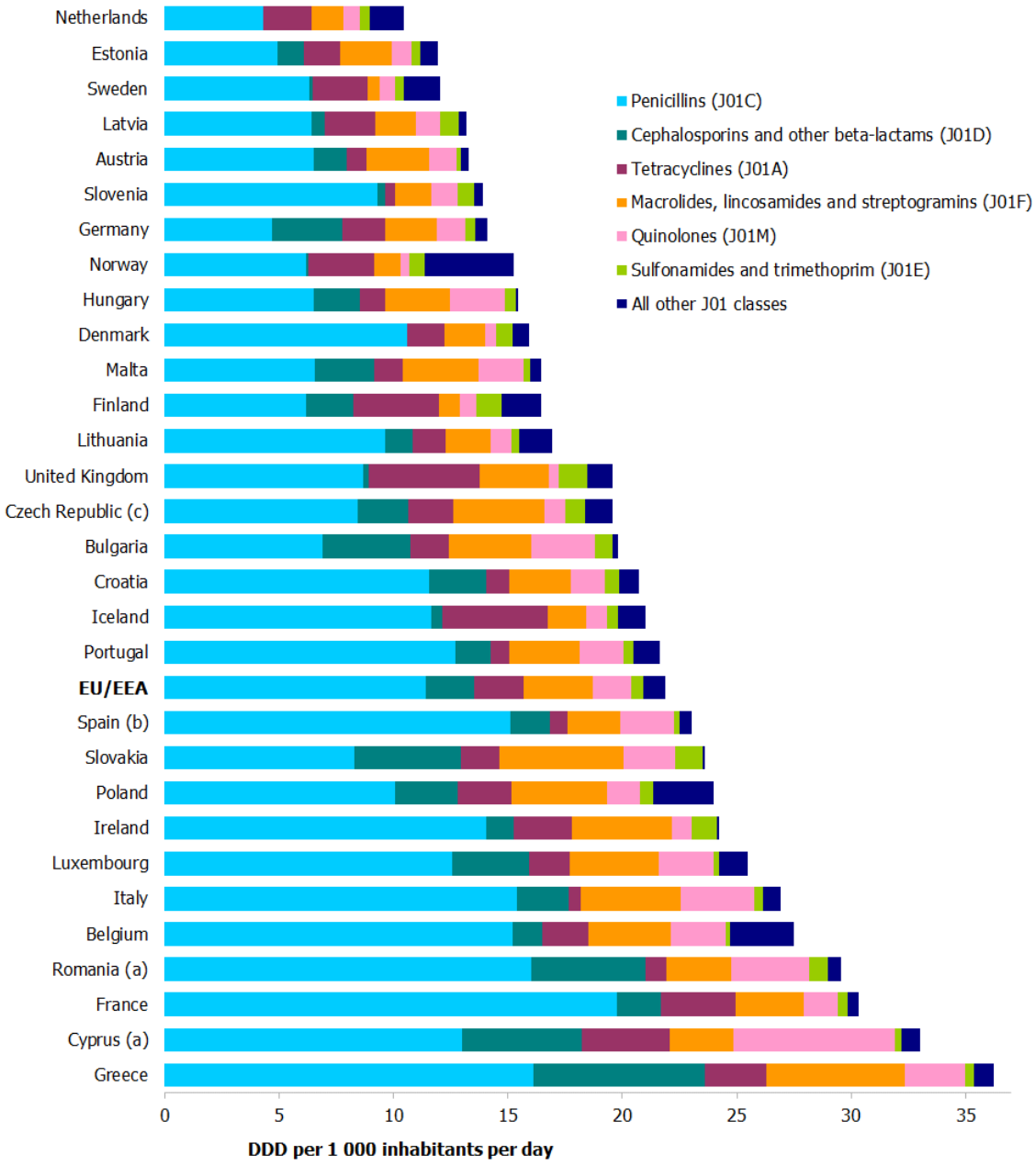
In 2016, EU/EEA population-weighted mean consumption of antibiotics for systemic use in the community (i.e. outside hospitals) was 21.9 DDD per 1 000 inhabitants per day, ranging from 10.4 in the Netherlands to 36.3 in Greece (Figure 2).

Data on total consumption from Cyprus and Romania are shown together with community consumption from other countries, because on average, 90% of the total antibiotic consumption data refer to consumption in the community.

The distribution of antibiotic consumption by country and main antibiotic group is shown in Figure 2.

As in previous years, penicillins were the most frequently used antibiotics in all countries, ranging from 33% (Germany) to 67% (Slovenia) of the total consumption in the community. The proportion of other antibiotic groups varied more widely between countries - e.g. cephalosporins and other beta-lactams, from 0.2% (Denmark) to 22% (Germany); macrolides, lincosamides and streptogramins, from 5% (Sweden) to 23% (Slovakia); and quinolones, from 2% (United Kingdom) to 21% (Cyprus) (Figure 2).

Figure 2. Consumption of antibiotics for systemic use in the community by antibiotic group, EU/EEA countries, 2016 (at ATC group level 3, expressed as DDD per 1 000 inhabitants per day)



(a) Cyprus and Romania provided total care data (i.e. including the hospital sector).

(b) Spain provided reimbursement data (i.e. not including consumption without a prescription or other non-reimbursed courses.)

(c) Czech Republic: data from 2015

EU/EEA refers to the corresponding population-weighted mean consumption.

Trends in antibiotic consumption in the community for 2012–2016 are presented in Table 1. The EU/EEA population-weighted mean consumption increased from 21.7 to 21.9 DDD per 1 000 inhabitants per day during this period, but the trend was not statistically significant. During 2012–2016, Greece and Spain showed an increasing trend while a decreasing trend was observed for Finland, Luxembourg, Norway and Sweden.

Table 1. Trends in consumption of antibiotics for systemic use in the community, EU/EEA countries, 2012–2016 (expressed as DDD per 1 000 inhabitants per day)

Country	2012	2013	2014	2015	2016	Trends in antimicrobial consumption, 2012–2016	Average annual change 2012–2016	Statistically significant trend
Netherlands	11.3	10.8	10.6	10.7	10.4		-0.19	
Estonia	11.7	11.7	11.7	12.0	12.0		0.07	
Sweden	14.1	13.0	13.0	12.3	12.0		-0.48	↓
Latvia	13.0	13.5	12.6	13.3	13.2		0.01	
Austria	14.0	16.3	13.9	14.0	13.3		-0.37	
Slovenia	14.3	14.5	14.2	14.5	13.9		-0.08	
Germany	14.8	15.7	14.6	14.3	14.1		-0.27	
Norway	16.9	16.2	15.9	15.8	15.2		-0.38	↓
Hungary	15.0	15.5	16.2	17.0	15.4		0.23	
Denmark	16.4	16.4	15.9	16.1	15.9		-0.13	
Malta	22.5	23.8	23.7	22.2	16.4		-1.37	
Finland	19.5	18.3	18.1	17.2	16.5		-0.71	↓
Lithuania	16.2	18.5	16.0	16.7	16.9		-0.03	
United Kingdom	20.1	20.6	20.8	20.1	19.6		-0.15	
Bulgaria	18.5	19.9	21.2	21.4	19.8		0.42	
Croatia	21.7	21.1	21.4	21.8	20.7		-0.12	
Iceland	22.1*	21.9*	19.3*	19.9	21.0		N/A	
Portugal	22.7	19.6†	20.3†	21.3†	21.6†		N/A	
EU/EEA	**21.7**	**22.3**	**21.9**	**22.4**	**21.9**		**0.05**	
Spain	19.7†	20.3†	21.6†	22.2†	23.0†		0.86	↑
Slovakia	20.0*	23.6	20.9	24.5	23.6		N/A	
Poland	22.9	23.6	22.8	26.2	24.0		0.47	
Ireland	23.0	23.8	23.1	25.6	24.2		0.42	
Luxembourg	27.7	27.7	25.8	26.3	25.5		-0.57	↓
Italy	27.5	28.6	27.8	27.5	26.9		-0.24	
Belgium	29.8	29.6	28.5	29.3	27.5		-0.48	
Romania	30.4*	31.6*	31.2*	33.3*	29.5*		0.00	
France	29.7	30.1	29.0	29.9	30.3		0.11	
Cyprus	29.7*	28.3*	26.1*	31.1*	33.0*		0.95	
Greece	32.5	32.2	35.1	36.1	36.3		1.15	↑
Czech Republic	17.5	18.9	19.1	19.5			N/A	

** Total care data, including the hospital sector.*
† Reimbursement data (i.e. not including consumption without a prescription or other non-reimbursed courses).

N/A = not applicable; linear regression was not applied due to missing data, changes in the type of data or changes of sector for which data were reported (community versus total care data) between 2012 and 2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

EU/EEA refers to the corresponding population-weighted mean consumption.

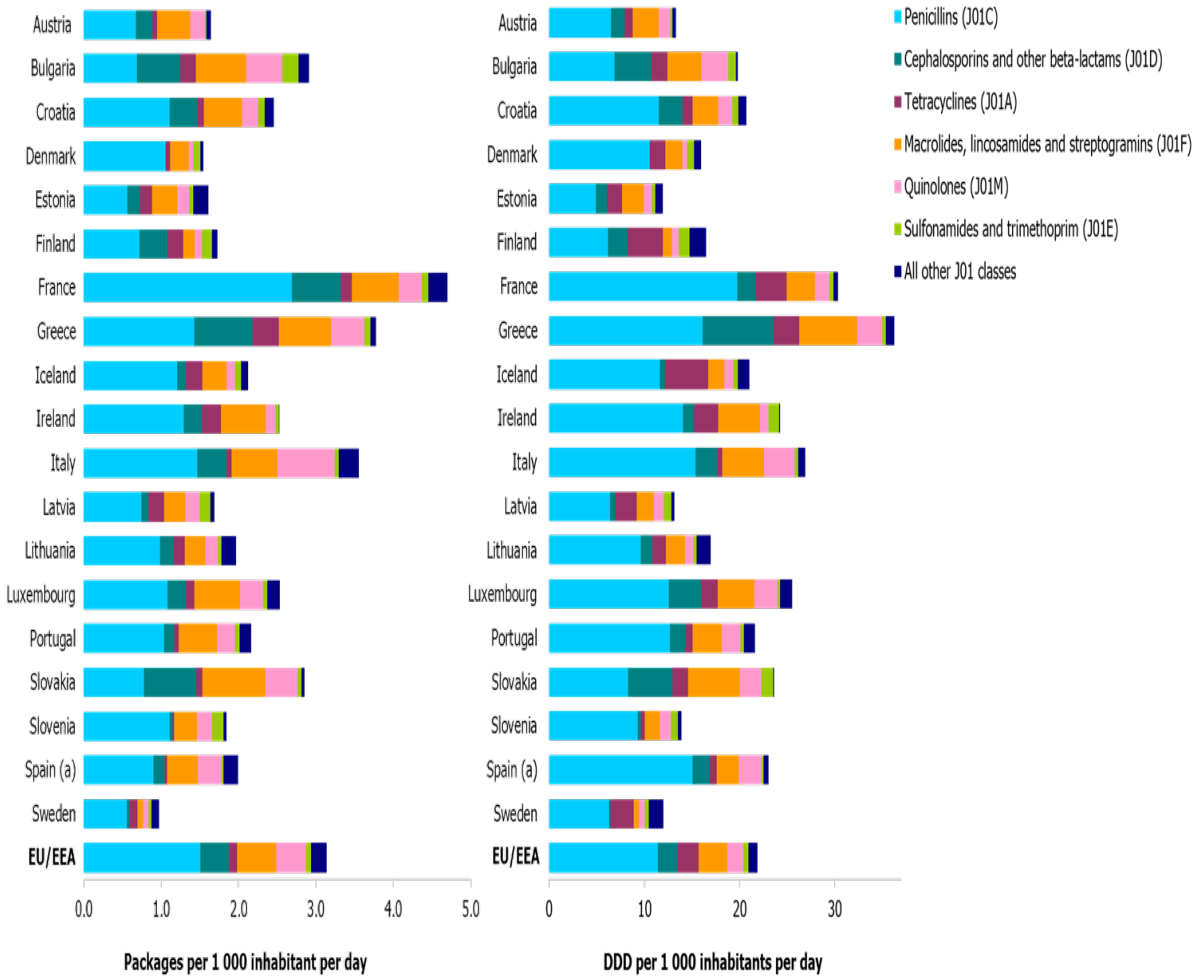
Packages

In 2016, the EU/EEA population-weighted mean consumption of antibiotics for systemic use in the community (i.e. outside hospitals) was 3.1 packages per 1 000 inhabitants per day, ranging from 1.0 in Sweden to 4.7 in France.

Figure 3 presents community consumption of antibiotics at the third ATC group level for those countries that additionally reported number of packages consumed for oral administration. The two graphs show differences in the ranking of countries when antibiotic consumption is expressed with two different indicators (number of DDD per 1 000 inhabitants per day versus number of packages per 1 000 inhabitants per day).

Differences in the ranking of countries may reflect differences in the number of items or the dose per item of antibiotics in antibiotic packages.

Figure 3. Consumption of antibiotics for systemic use in the community by antibiotic group, EU/EEA countries, 2016 (at ATC group level 3, expressed as the number of packages per 1 000 inhabitants per day and number of DDD per 1 000 inhabitants per day)



(a) Spain provided reimbursement data (i.e. not including consumption without a prescription or other non-reimbursed courses).

EU/EEA refers to the corresponding population-weighted mean consumption based on 20 countries that provided data on packages.

Trends in community antibiotic consumption expressed as packages per 1 000 inhabitants per day for the period 2012–2016 are presented in Table 2. The EU/EEA population-weighted mean consumption did not show any significant trend during the period 2012–2016. No country showed a significant increasing trend. A significant decreasing trend was observed for Denmark, Estonia, Finland and Sweden. The decrease in community antibiotic consumption expressed as packages per 1 000 inhabitants per day in these countries likely reflects a decrease in antibiotic prescriptions between 2012 and 2016, although this should be confirmed with national data from other sources.

Table 2. Trends in consumption of antibiotics for systemic use in the community, EU/EEA countries, 2012–2016 (expressed as packages per 1 000 inhabitants per day)

Country	2012	2013	2014	2015	2016	Trends in consumption of antibiotics, 2012–2016	Average annual change 2012-2016	Statistically significant trend
Sweden	1.14	1.05	1.00	0.99	0.98		-0.04	↓
Denmark	1.70	1.67	1.62	1.58	1.55		-0.04	↓
Estonia	1.77	1.74	1.68	1.68	1.61		-0.04	↓
Austria	1.76	2.03	1.73	1.73	1.64		-0.05	
Latvia	1.70	1.76	1.65	1.71	1.69		-0.01	
Finland	2.04	1.91	1.89	1.79	1.73		-0.07	↓
Slovenia	1.96	1.97	1.91	1.94	1.85		-0.03	
Lithuania	1.99	2.24	1.94	1.98	1.97		-0.03	
Spain	2.01†	1.99†	1.93†	1.95†	1.99†		-0.01	
Iceland			2.06	2.09	2.12		N/A	
Portugal	2.33	1.99	2.04†	2.14†	2.16†		N/A	
Croatia	2.67	2.61	2.64	2.65	2.46		-0.04	
Ireland	2.52	2.55	2.36	2.53	2.52		0.00	
Luxembourg	2.68	2.67	2.53	2.48	2.53		-0.05	
Slovakia	2.53	3.02	1.94	3.05	2.85		0.07	
Bulgaria	2.78	2.90	3.04	3.01	2.91		0.04	
EU/EEA	**3.14**	**3.18**	**3.05**	**3.13**	**3.14**		**-0.01**	
Italy	3.70	3.83	3.70	3.65	3.56		-0.05	
Greece	3.48	3.51	3.60	3.89	3.78		0.10	
France	4.86	4.85	4.59	4.74	4.70		-0.04	
Belgium	2.54	2.51	2.42				N/A	
Czech Republic	1.84	1.99	1.98	2.00			N/A	

† Reimbursement data (i.e. not including consumption without a prescription or other non-reimbursed courses).

N/A = not applicable; linear regression was not applied due to missing data, changes in the type of data or changes of sector for which data were reported (community versus total care data) between 2012 and 2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

EU/EEA refers to the corresponding population-weighted mean consumption based on countries that provided data.

Indicator DDD (or packages) per 1 000 inhabitants per day indicate the percentage of the population that on average receives an antibiotic in one day. Thus the figure of 21.9 DDD per 1 000 inhabitants per day for the EU/EEA indicates that 2.19% of the EU/EEA population on average receives a DDD of an antibiotic every day. Similarly, the figure of 3.1 packages per 1 000 inhabitants per day for the EU/EEA indicates that 0.31% of the EU/EEA population on average receives a package of an antibiotic every day.

Since patients are not treated with antibiotics continuously every day of the year, perhaps a more understandable way to illustrate the meaning of the indicator DDD per 1 000 inhabitants per day is the 'number of DDD (or packages) per person (inhabitant) per year'.

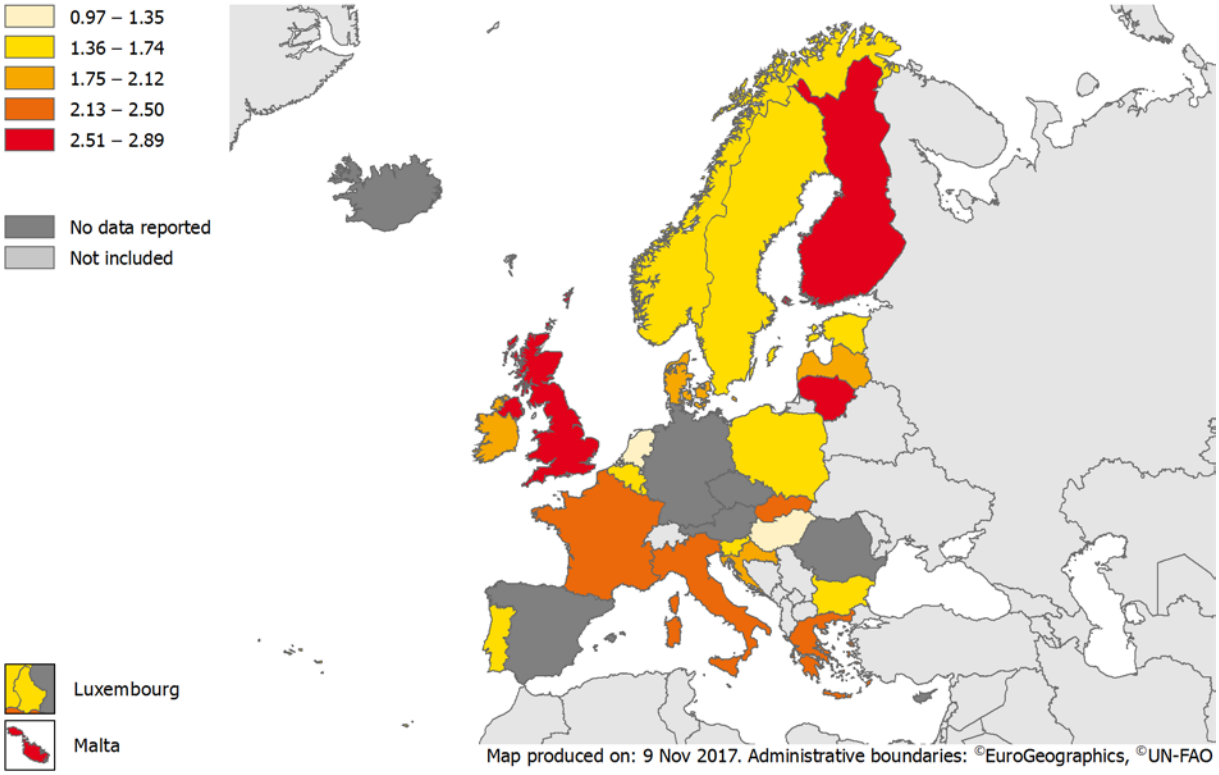
An estimate of the average number of days for which a person is treated with an antibiotic annually can easily be calculated from the indicator 'DDD per 1 000 inhabitants per day' by dividing the figure by 1 000 (population) and multiplying it by 365 (days in a year), or by multiplying the figure by 0.365. For the EU/EEA it is 8.0 DDD per person per year. In other words, in 2016 each EU citizen was treated with an antibiotic for eight days which in most cases corresponds to one course of antibiotics per year.

Similarly, presenting consumption as the number of packages per person (inhabitant) per year gives an estimate of the average number of packages which each person has consumed in a year. For the EU/EEA countries reporting consumption in packages it is 1.1 packages per person per year.

Consumption of antibiotics in the hospital sector

Consumption of antibiotics for systemic use in the hospital sector in EU/EEA countries in 2016 expressed in DDD per 1 000 inhabitants per day is shown in Figure 4.

Figure 4. Consumption of antibiotics for systemic use in the hospital sector, EU/EEA countries, 2016 (expressed as DDD per 1 000 inhabitants per day)

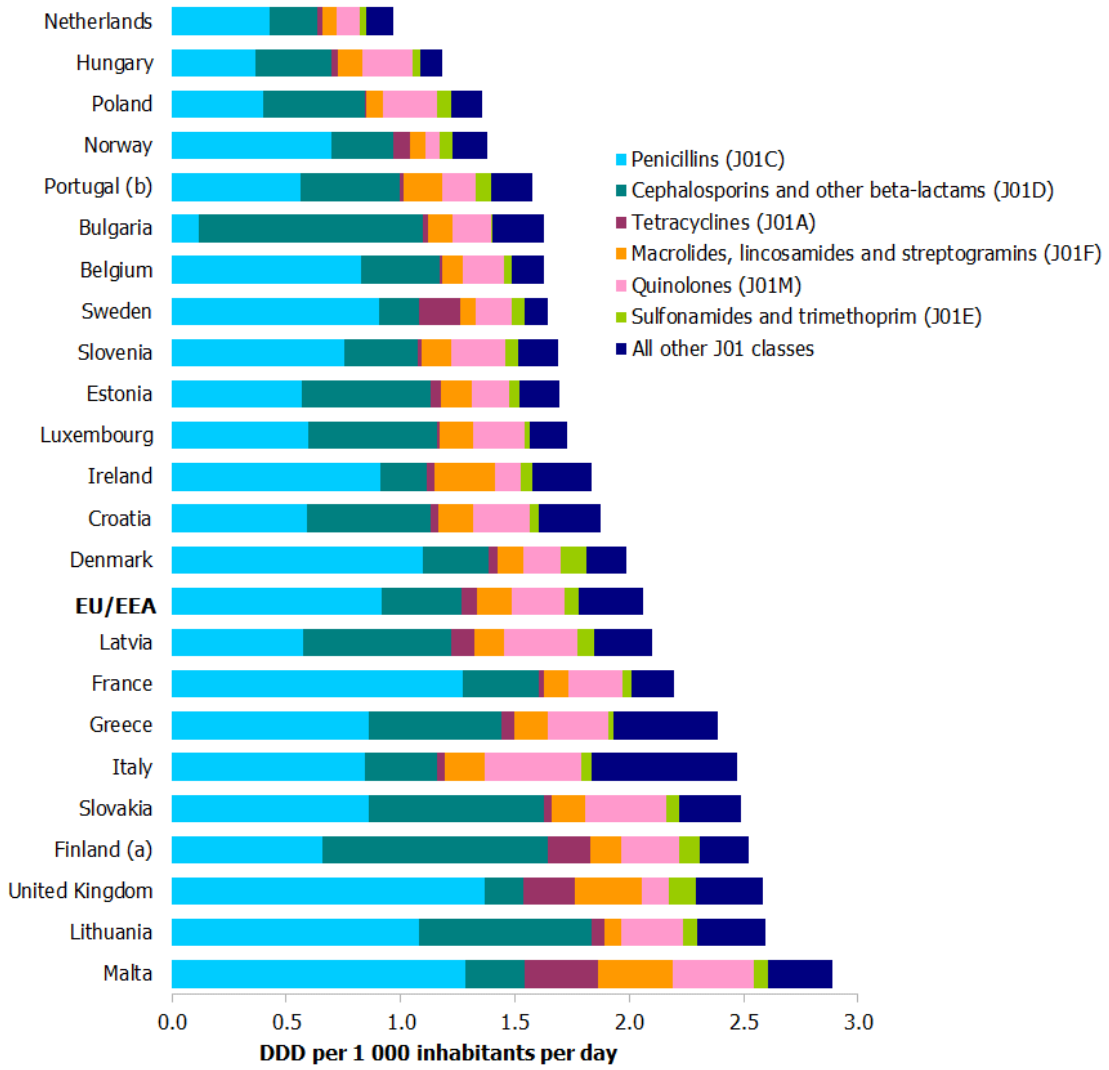


Finland: data include consumption in remote primary healthcare centres and nursing homes.

Portugal: data relate to public hospitals only.

In 2016, the EU/EEA population-weighted mean consumption of antibiotics for systemic use in the hospital sector was 2.0 DDD per 1 000 inhabitants per day, ranging from 1.0 in the Netherlands to 2.9 in Malta (Figure 5). The data from Finland are not exclusively reported from hospitals and include consumption in remote primary healthcare centres and nursing homes.

Figure 5. Consumption of antibiotics for systemic use in the hospital sector by antibiotic group, EU/EEA countries, 2016 (at ATC group level 3, expressed as DDD per 1 000 inhabitants per day)



(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

(b) Portugal: data relate to public hospitals only.

EU/EEA refers to the corresponding population-weighted mean consumption based on 23 countries that provided data.

In contrast to prescribing practices in the community, penicillins were not the most frequently prescribed antibiotic group in the hospital sector for all countries (Figure 5). The proportions of cephalosporins, other beta-lactams (including carbapenems), and other groups of antibiotics were generally higher than in the community. However, substantial variations were reported across countries: consumption of cephalosporins and other beta-lactams including carbapenems ranged from 6% in the United Kingdom to 60% in Bulgaria; consumption of macrolides, lincosamides and streptogramins from 4% in Sweden to 14% in Ireland, and consumption of quinolones from 4% in Norway to 18% in Hungary.

Trends in the consumption of antibiotics for systemic use in the hospital sector expressed as DDD per 1 000 inhabitants per day for the period 2012–2016 are presented in Table 3. The EU/EEA population-weighted mean consumption did not show any statistically significant trend during the period 2012–2016. An increasing trend was observed for Greece, Malta and Slovenia, and a decreasing trend for Estonia, Finland and Luxembourg.

Table 3. Trends in consumption of antibiotics for systemic use in the hospital sector, EU/EEA countries, 2012–2016 (expressed as DDD per 1 000 inhabitants per day)

Country	2012	2013	2014	2015	2016	Trends in antimicrobial consumption, 2012–2016	Average annual change 2012–2016	Statistically singificant trend
Netherlands	0.96	0.95	0.95	0.98	0.97		0.00	
Hungary	1.23	1.20	1.25	1.23	1.18		-0.01	
Poland			1.43	1.43	1.36		N/A	
Norway	1.44	1.39	1.41	1.40	1.38		-0.01	
Portugal (b)	1.46	1.64	1.55	1.57	1.58		0.02	
Belgium	1.71	1.67	1.60	1.67	1.63		-0.02	
Bulgaria	1.37	1.38	1.40	1.37	1.63		0.05	
Sweden	1.65	1.67	1.57	1.67	1.65		0.00	
Slovenia	1.56	1.55	1.61	1.68	1.69		0.04	↑
Estonia	2.00	1.79	1.81	1.74	1.70		-0.07	↓
Luxembourg	2.02	2.00	1.81	1.78	1.73		-0.08	↓
Ireland	1.76	1.79	1.66	1.91	1.83		0.03	
Croatia	1.97	1.79	1.85	1.90	1.87		-0.01	
Denmark	1.78	2.02	2.13	2.34	1.99		0.07	
EU/EEA	**1.95**	**2.03**	**2.00**	**2.04**	**2.06**		**0.02**	
Latvia	2.24	2.28	2.24	2.24	2.10		-0.03	
France	2.12	2.17	2.20	2.18	2.19		0.02	
Greece	1.90	2.00	2.11	2.14	2.39		0.11	↑
Italy	2.40	2.16	2.15	2.36	2.47		0.04	
Slovakia	2.02	2.30	2.47	2.40	2.49		0.10	
Finland (a)	2.79	2.77	2.64	2.50	2.52		-0.08	↓
United Kingdom		2.45	2.59	2.55	2.58		N/A	
Lithuania	2.39	2.39	2.35	2.54	2.59		0.06	
Malta	1.44	1.75	2.18	2.86	2.89		0.40	↑

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

(b) Portugal: data relate to public hospitals only.

N/A = not applicable; linear regression was not applied due to missing data, changes in the type of data or changes of sector for which data were reported (community versus total care data) between 2012 and 2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

EU/EEA refers to the corresponding population-weighted mean consumption based on countries that provided data.

Consumption of specific antibiotic groups used for the treatment of patients infected with multidrug-resistant bacteria

The spread of multidrug-resistant bacteria in hospitals and other healthcare facilities has become a public health threat. One significant driver for the selection of multidrug-resistant bacteria responsible for healthcare-associated infections in hospitalised patients is extensive use of antibiotics (selective pressure), including the use of specific, mostly reserve or last-line antibiotics in hospitals. Patients receiving antibiotics are more likely to become colonised with multidrug-resistant bacteria and therefore are at greater risk of developing subsequent infections with these bacteria than patients who do not receive antibiotics. Additionally, antibiotic pressure due to high levels of antibiotic use in hospitals can be a risk factor for the acquisition of multidrug-resistant bacteria.

Carbapenems and polymyxins are antibiotic groups used for treating serious infections caused by multidrug-resistant gram-negative bacteria. In addition, penicillins combined with beta-lactamase inhibitors (e.g. piperacillin/tazobactam) represent another group of antibiotics to treat infections caused by extended-spectrum-beta-lactamase (ESBL)-producing gram-negative bacteria.

Carbapenems are a last-line group of antibiotics and are mainly used in hospitals for treatment of patients with confirmed or suspected infections involving a multidrug-resistant bacteria. Use of a carbapenem antibiotic is a risk factor for subsequent infection with carbapenem-resistant bacteria such as carbapenem-resistant *Enterobacteriaceae* (CRE, often through production of a carbapenemase enzyme), carbapenem-resistant *Acinetobacter baumannii* or carbapenem-resistant *Pseudomonas aeruginos*a. Carbapenem-resistant bacteria are highly drug-resistant and only a few antibiotic groups, such as polymyxins, are available for the treatment of patients infected with such bacteria.

In 2017, a second joint JIACRA report by ECDC, the European Food Safety Authority (EFSA) and the European Medicines Agency (EMA) showed a strong association between human carbapenem consumption and the percentage of carbapenem-resistant invasive *Klebsiella pneumoniae* isolates from humans in EU/EEA countries reporting these data for the years 2013–2015[*]. In 2016, consumption of carbapenems in the EU/EEA overall was 0.05 DDD per 1 000 inhabitants per day (Table 4). Assuming that the average duration of treatment is 10 days, this corresponds to more than one million carbapenem treatment courses administered in the EU/EEA each year. Trends in the consumption of carbapenems for the period 2012–2016 are presented in Table 4. During this period, the EU/EEA population-weighted mean consumption of carbapenems did not show a statistically significant change. Among the countries reporting comparable data for all years during 2012–2016, an increasing trend was observed for ten countries (Bulgaria, Croatia, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Romania and Slovakia) and a decreasing trend for only one country (Portugal).

Polymyxins - mainly colistin in parenteral form - have been used in hospitals as last-resort antibiotics to treat infections caused by multidrug-resistant gram-negative bacteria that are resistant to carbapenems. Trends in polymyxin consumption in the hospital sector for the period 2012–2016 are presented in Table 5. The EU/EEA population-weighted mean consumption of polymyxins did not show a statistically significant change during this period. In 2016, the hospital consumption of polymyxins in the EU/EEA overall was 0.016 DDD per 1 000 inhabitants per day. Among the countries reporting comparable data for all years during 2012–2016, an increase was observed for nine countries (Bulgaria, Denmark, Greece, Italy, Hungary, Malta, Romania, Slovakia and Slovenia) and a decrease for two countries (France and Ireland). In some countries, polymyxins are also used for inhalation at community level for the management of chronic pulmonary infections due to *Pseudomonas aeruginosa* in patients with cystic fibrosis.

Piperacillin/tazobactam is a wide-spectrum antibiotic active against *Pseudomonas aeruginosa* and *Enterobacteriaceae* mostly used in hospitals. Increased consumption of this antibiotic may indicate increased rates of ESBL-producing isolates or antimicrobial stewardship measures recommending piperacillin/tazobactam as a first-line agent for empiric treatment of serious infections presumed to be caused by ESBL-producing microorganisms (e.g. to avoid overuse of carbapenems). The EU/EEA population-weighted mean consumption of piperacillin/tazobactam showed a significant increasing trend for the period 2012-2016, as did most of the countries reporting hospital sector data.

In the EU/EEA, consumption of carbapenems and polymyxins is still at a low level compared to the overall consumption of antibiotics for systemic use in the hospital sector, but statistically significant increasing trends in the consumption of these antibiotic groups were reported from several countries.

[*] ECDC (European Centre for Disease Prevention and Control), EFSA (European Food Safety Authority), and EMA (European Medicines Agency), 2017. ECDC/EFSA/EMA second joint report on the integrated analysis of the consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals – Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA) Report. EFSA Journal 2017;15(7):4872,135. doi:10.2903/j.efsa.2017.4872. Available at: https://www.efsa.europa.eu/en/efsajournal/pub/4872

Table 4. Trends in consumption of carbapenems in the hospital sector, EU/EEA countries, 2012–2016 (expressed as DDD per 1 000 inhabitants per day)

Country	2012	2013	2014	2015	2016	Trends in consumption of carbapenems, 2012–2016	Average annual change 2012–2016	Statistically significant trend
Bulgaria	0.013	0.014	0.020	0.019	0.028		0.004	↑
Poland			0.024	0.020	0.022		N/A	
Netherlands	0.019	0.020	0.019	0.021	0.020		0.000	
Latvia	0.019	0.022	0.027	0.033	0.034		0.004	↑
France	0.021	0.033	0.033	0.035	0.033		0.003	
Norway	0.045	0.046	0.047	0.039	0.040		-0.002	
Hungary	0.032	0.037	0.042	0.046	0.048		0.004	↑
Lithuania	0.026	0.026	0.033	0.046	0.053		0.007	↑
Slovakia	0.027	0.034	0.042	0.048	0.055		0.007	↑
Romania	0.024*	0.024*	0.032*	0.049*	0.059*		0.010	↑
Estonia	0.036	0.033	0.043	0.050	0.064		0.007	↑
Sweden	0.053	0.056	0.053	0.050	0.051		-0.001	
EU/EEA	**0.053**	**0.060**	**0.058**	**0.054**	**0.052**		**-0.001**	
Italy	0.073	0.076	0.081	0.056	0.040		-0.009	
Finland (a)	0.074	0.088	0.081	0.065	0.090		0.001	
Belgium	0.062	0.062	0.063	0.065	0.063		0.001	
Slovenia	0.074	0.061	0.066	0.072	0.071		0.000	
United Kingdom		0.064	0.071	0.071	0.068		N/A	
Croatia	0.065	0.060	0.073	0.079	0.084		0.006	↑
Denmark	0.063	0.087	0.085	0.083	0.079		0.003	
Luxembourg	0.101	0.095	0.087	0.089	0.102		0.000	
Ireland	0.061	0.088	0.109	0.091	0.081		0.004	
Malta	0.052	0.066	0.101	0.107	0.113		0.016	↑
Cyprus	0.102*	0.118*	0.121*	0.132*	0.141*		0.009	↑
Portugal (b)	0.143	0.146	0.139	0.133	0.124		-0.005	↓
Greece	0.133	0.135	0.143	0.137	0.180		0.010	

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

(b) Portugal: data relate to public hospitals only.

** Total care data, including consumption in the community.*

N/A = not applicable; linear regression was not applied due to missing data, changes in the type of data or changes of sector for which data were reported (community versus total care data) between 2012 and 2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

EU/EEA refers to the corresponding population-weighted mean consumption based on 23 countries that provided data separately for the community (data from Cyprus and Romania not included).

Table 5. Trends in consumption of polymyxins in the hospital sector, EU/EEA countries, 2012–2016 (expressed as DDD per 1 000 inhabitants per day)

Country	2012	2013	2014	2015	2016	Trends in consumption of polymyxins, 2012–2016	Average annual change 2012–2016	Statistically significant trend
Finland (a)	0	0	0	0	0		0.000	
Lithuania	0	0	0	0	0		0.000	
Norway	0.001	0.001	0.001	0.001	0.001		0.000	
Sweden	0.001	0.001	0.001	0.001	0.001		0.000	
Latvia	0.003	0.002	0.001	<0.001	0.002		0.000	
Netherlands	0.002	0.003	0.002	0.003	0.002		0.000	
Bulgaria	0	0	0.002	0.004	0.004		0.001	↑
Estonia	0.002	0.001	0.002	0.003	0.005		0.001	
Luxembourg	0.005	0.006	0.003	0.005	0.005		0.000	
Denmark	0.002	0.003	0.006	0.005	0.006		0.001	↑
Ireland	0.015	0.015	0.013	0.008	0.006		-0.002	↓
United Kingdom		0.005	0.006	0.006	0.006		N/A	
France	0.008	0.008	0.008	0.007	0.007		0.000	↓
Belgium	0.006	0.008	0.008	0.007	0.008		0.000	
Slovenia	0.003	0.003	0.005	0.005	0.008		0.001	↑
Hungary	0.005	0.006	0.007	0.008	0.010		0.001	↑
EU/EEA	**0.014**	**0.012**	**0.012**	**0.015**	**0.016**		**0.001**	
Malta	0.002	0.006	0.011	0.020	0.016		0.004	↑
Croatia	0.029	0.003	0.019	0.018	0.017		-0.001	
Cyprus	0.013*	0.023*	0.023*	0.023*	0.019*		0.001	
Portugal (b)	0.019	0.020	0.019	0.022	0.022		0.001	
Romania	0.020*	0.026*	0.027*	0.034*	0.026*		0.004	↑
Italy	0.019	0.023	0.025	0.027	0.027		0.002	↑
Poland			0.001	0.020	0.034		N/A	
Slovakia	0.020	0.023	0.025	0.024	0.035		0.001	↑
Greece	0.085	0.084	0.095	0.095	0.102		0.004	↑

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

(b) Portugal: data relate to public hospitals only.

** Total care data, including consumption in the community.*

N/A = not applicable; linear regression was not applied due to missing data, changes in the type of data or changes of sector for which data were reported (community versus total care data) between 2012 and 2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

EU/EEA refers to the corresponding population-weighted mean consumption based on 23 countries that provided data separately for the community (data from Cyprus and Romania not included).