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Analysis of citizens' subjective perception of safe antibiotic use in European Union countries

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ABSTRACT

Objectives: Antibiotic consumption is high and varies between different European Union countries. One of the reasons could be different subjective perception of safe antibiotic use. The aim of our study was to analyse citizens' subjective perception of safe antibiotic use in the European Union countries in the context of different antibiotic policies. Some countries are prepared comprehensive national strategies and action plans and implement many activities in different areas while other countries implement actions only in particular fields and even do not have prepared strategy or action plan.
Methods: This article is based on conception of security by Barry Buzan. Variables collected from the Special Eurobarometer public opinion on Antimicrobial Resistance in European Union countries in 2016 were used for creation the factor of subjective perception of safe antibiotic use. Six contextual factors were selected from the scientific literature and their impact on subjective perception of safe antibiotic use was investigated.
Results: High differences in subjective perception of safe antibiotic use were observed in countries despite general European Union recommendations on antibiotic policy. The highest subjective perception of safe antibiotic use was in Netherlands, Finland, Sweden, Luxembourg, and Denmark. Significant negative correlation was observed between factor of subjective perception of safe antibiotic use and antibiotic consumption ($r = -0.41$, $p < 0.05$). Created factor of information and communication technology (ICT) development, gross domestic product (GDP) and health expenditure had impact on subjective perception of safe antibiotic use ($t = 4.69$, $p < 0.01$). Consumption of antibiotics also had influence on subjective perception of safe antibiotic use ($t = -2.43$, $p < 0.05$).
Conclusions: Individuals' subjective perception of safe antibiotic use which is related to antibiotic consumption highly varies between different EU countries despite general EU recommendations on antibiotic policies and depends on ICT development, GDP, health expenditure and consumption of antibiotics.

Introduction

Nowadays antibiotic-resistant bacteria are the relevant problem of public health which raises the threat for community. The overuse of antibiotics is the main force driving the increase of bacterial resistance [1].

During 2010–2014, overall antibiotic consumption in the EU countries significantly increased [2]. In 2015, antibiotics for systemic use in the community of EU/European Economic Area varied from 10.7 defined daily doses (DDD) per 1000 inhabitants and per day in the Netherlands to 36.1 DDD per 1000 inhabitants and per day in Greece [3]. These data show that antibiotic consumption still remains high and varies between different EU countries.

One of the reasons of varying antibiotic use among countries could be different subjective PSAU. Scientists investigate subjective perception of safe antibiotic use (PSAU) and factors which can affect this perception. They analyse the subjective PSAU in different groups of individuals and investigate impact of socio-demographic factors on this perception [4–9].

Increase of antibiotic consumption raises concern and intention to make its use safe and effective. Important factor is subjective and intuitive assessment of threats caused by irresponsible antibiotic

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use. According to scientific literature, individuals recognise antibiotic resistance as a serious public health threat but express low perceived susceptibility to being personally affected by antibiotic resistance [10]. In order to reduce the threats of antibiotic resistance World Health Organisation (WHO), European Commission and governments of European countries take action and introduce a policy packages to combat antimicrobial resistance [11–13]. The main goals of such policies are to raise awareness of health care workers and the whole community, to strengthen surveillance and laboratory capacity, to ensure uninterrupted access to essential medicines of assured quality, to regulate and promote rational use of medicines, to enhance infection prevention and control and promote innovations, research and development for new tools [12,13].

Health policy of EU countries contributes to subjective PSAU. That is why it is necessary to analyse citizens' from EU countries subjective PSAU. Different scientists analysed antibiotic policies in different aspects [1,14–16]. Scientific literature shows that such policies can help to reduce antibiotic use [17,18]. The main object of this study is relation between implementation of antibiotic policies and subjective PSAU. Our study aimed to analyse citizens' subjective PSAU in EU countries in the context of different antibiotic policies. This article is based on conception of security by Buzan [19,20].

Theory

Theoretical background

Buzan presents proposition that security at the individual level is the beginning for studies about subjective perception of security. Attention to the security at the individual level shows need to determine threats for security perceived by individuals.

According to Buzan, individual represents the irreducible basic unit to which the concept of security can be applied [19]. Objective security (danger) concept and subjective security (feeling security) concept are distinguished at the individual level. Distinction between subjective and objective security creates assumptions for analysis security from subjective perspective avoiding a view of security that is given objectively and emphasize that security is determined by actors and in this respect is subjective [21].

Buzan indicates that security can be considered as freedom from threat and the ability of states and societies to maintain their independent identity and their functional integrity against forces of change which they see as hostile [20]. Two aspects of security reveal in this definition: perception of threats and response to threats. So the first aspect of security is closely related to real and supposed threats and their perception. The second aspect of security is related to the response to perceived threats, because, according to Buzan, security relates directly to survival [21].

Buzan's theoretical insights can be implemented for investigation of perception of threats and response to threats at individual level. According to Buzan, threats occur because people live in social environment, which generate unavoidable social, economic and political pressure [19]. We assume threats of antimicrobial resistance as social threats which raise danger for current individual and society.

Public policies on antibiotic use in EU

Decrease of irresponsible antibiotic consumption is important goal of health policy. Implementation of this goal requires considered antibiotic policy. These policies can be formed and implemented at national or international level. Different interventions can be used for solving the problem of irresponsible antibiotic use and antibiotic resistance: educational interventions, managerial strategies, regulatory interventions and economic interventions [22]. Among the educational strategies that promote the appropriate use of antibiotics and raise public awareness of bacterial resistance, public campaigns are one of the most widely used [1].

The EU Council, European Parliament, European Commission and its Agencies have identified the need to establish a common European strategy in order to evaluate and confront the problem of development of antimicrobial resistance [23]. To address the threat of antimicrobial resistance, the Council recommendation of 15 November 2001 (2002/77/EC) on the prudent use of antimicrobial agents in human medicine [24] asked Member States to develop strategies comprising measures in relation to surveillance, education, information, prevention and control, and research. One of the most important strategies is raising awareness of the problem of antimicrobial resistance and encouraging realistic public expectations for the prescription of antimicrobial agents [25]. Integral part of Community strategy against antimicrobial resistance is communication, education and training forms. Common strategy was confirmed on the 17th of November, 2011, when EU put in place an Action Plan against antimicrobial resistance for the period 2011–2016 [26]. Government of every EU country make decisions on implementation of these documents independently and this determines different antibiotic policies. There are huge differences between countries in the governance and the scope of national strategies and action plans, and in the way measures were implemented and assessed. Some countries have implemented most of the provisions of the Council recommendation of 2001, while other countries have developed activities in only some areas covered by this recommendation [27].

Until 2016 eighteen countries of EU have established national strategy targeted to contain the problem of antimicrobial resistance and promote the prudent use of antimicrobial agents. A national action plan to contain the problem of antimicrobial resistance and promote the prudent use of antimicrobial agents was produced in 19 EU countries and was under preparation in two countries [27].

The European Centre for Disease Prevention and Control has coordinated the European Antibiotic Awareness Day (EAAD) on the 18th of November, a European health initiative that provides a platform for and supports national campaigns to raise awareness on prudent use of antibiotics [25]. This day is dedicated for encouraged public information campaigns on prudent antibiotic use in its member countries. Support of government is essential for EAAD campaigns.

Material and methods

Study material

This study is based on aggregated data about levels of public use and knowledge about antibiotics in EU countries. Measurement of citizens' subjective PSAU was performed using data from the Special Eurobarometer public opinion on Antimicrobial Resistance [28] in the 28 EU countries published in February, 2016. In order to measure citizens' PSAU use in EU countries, factor from these five variables was established:

1. Percentage of individuals who obtained the last course of antibiotics from a medical practitioner (code: AFMP, question no. QB2).
2. Percentage of individuals who answered correctly about antibiotics features and use (code: ACAA, question no. QB4).
3. Percentage of individuals who think they should stop taking antibiotics when they have taken all of the antibiotics as directed (code: STAD, question no. QB5).
4. Percentage of individuals who have changed their views on using antibiotics after the information that they received about rational antibiotic use (code: CVAI, question no. QB8).

Table 1
Characteristics of respondents by EU countries.

Countries	Number of Respondents	Gender		Age				Education (end of)			
		Men	Women	15–24	25–39	40–54	55+	15-	16–19	20+	Still studying
Belgium	1007	489	518	139	226	249	393	117	384	396	100
Bulgaria	1040	497	543	120	245	240	435	81	612	263	61
Czech Republic	1047	507	540	128	274	241	404	36	696	209	93
Denmark	1010	495	515	149	214	250	397	16	105	668	133
Germany	1563	760	803	194	329	426	614	282	735	401	145
Estonia	1004	454	550	127	242	232	403	72	457	379	78
Ireland	1016	497	519	144	290	261	321	133	413	375	92
Greece	1008	487	521	119	236	242	410	275	357	282	85
Spain	1053	511	542	116	262	279	396	389	287	252	91
France	1045	498	547	147	229	252	417	145	434	363	95
Croatia	1057	500	557	138	238	246	434	123	678	138	77
Italy	1033	494	539	112	215	270	436	310	435	159	94
Republic of Cyprus	500	240	260	83	138	117	162	87	175	169	62
Latvia	1032	457	575	130	238	245	419	78	518	359	65
Lithuania	998	445	553	148	210	248	392	73	426	370	93
Luxembourg	501	248	253	70	131	136	164	68	131	227	69
Hungary	1058	492	566	141	258	238	420	200	564	221	68
Malta	501	248	253	73	122	108	198	115	227	100	53
Netherlands	1041	511	530	147	219	271	404	81	306	513	136
Austria	1011	488	523	135	224	270	382	209	465	204	106
Poland	1015	482	533	143	274	224	374	62	444	363	87
Portugal	1010	474	536	124	235	261	390	417	270	190	73
Romania	1014	486	528	131	252	238	392	183	507	226	68
Slovenia	994	486	508	113	241	247	393	118	489	264	91
Slovakia	1038	497	541	150	291	245	352	62	653	211	102
Finland	1008	489	519	139	219	225	425	87	252	505	151
Sweden	1035	520	515	120	227	237	451	62	207	673	87
United Kingdom	1330	653	677	207	321	333	469	235	606	350	125
Total EU 28	27696	13405	14564	3687	6600	6831	10847	4116	11833	8830	2580

Source: EU Open Data Portal. Special Eurobarometer 445: Antimicrobial Resistance, http://data.europa.eu/euodp/en/data/dataset/S2107_85_1_445_ENG/resource/3b3f5710-9478-4029-81c4-b50376e1084c; 2016 [accessed 20 October 2017].

5. Percentage of individuals who know that using antibiotics to stimulate growth in farm animals is banned within the EU (code: ABFA, question no. QB14) [28].

Contextual factors

Six contextual factors were selected from scientific literature which may have impact on subjective PSAU: (1) ICT development index in 2015 [29], (2) real volume indices for GDP per capita in purchasing power standards (PPS) in 2015 [30], (3) consumption of antibiotics in DDDs per 1000 inhabitants per day in 2015 [3], (4) health expenditure per capita in Euro PPS in 2015 [31], (5) expenditure on retail pharmaceuticals per capita in 2015 or nearest year [31] and (6) practicing physicians per 100 000 inhabitants in 2015 or nearest year [32]. It should be mentioned that Malta did not provide data about expenditure on pharmaceuticals and, Greece, Portugal and Slovakia did not provide information about number of practicing physicians. That is why we applied method of impute missing data values in SPSS.

Clusters of countries according to the implemented policies based on the Council recommendation of 2001 and The Action Plan of 2011

Comparison of factors score between four clusters of countries which were constituted according to the implemented policies based on the Council recommendation of 2001 and The Action Plan of 2011 was performed. Countries were divided into four clusters based on the reported implementation of measures in five areas: organisation and governance, surveillance systems, prevention, educational activities and system set up for evaluation:

1. Belgium, France, Ireland, Netherlands and United Kingdom from the first cluster had implemented a comprehensive policy, comprising various activities in all areas.
2. Denmark, Greece, Croatia, Hungary, Lithuania, Portugal, Sweden and Slovakia from the second cluster had developed or were in the process of developing strategies and action plans. Majority of countries differed in the number and type of activities implemented regarding prevention and education. More than half of countries covered nursing home and long term care facilities sector, but less than half of countries used rapid diagnostic tests in ambulatory.
3. Austria, Cyprus, Germany, Luxembourg, Malta and Slovenia from the third cluster had implemented activities in two or more areas. Majority of countries implemented strategies linked to healthcare-associated infection, nursing homes and long-term care facilities.
4. Czech Republic, Estonia, Spain, Finland, Italy, Latvia, Poland and Romania from the last cluster had the lowest level of implementation. This cluster included the three countries with no strategy or action plan and three countries without an intersectoral coordinating mechanism. Half of countries had implemented activities in one main area [27].

Statistical analysis

Statistical analysis was performed using Statistical package for the social sciences (SPSS) 13. Methods of statistical analysis were selected after performance of Kolmogorov–Smirnov test. For quantitative data assessment descriptive analysis method were used. Relations between variables of subjective PSAU were investigated using Pearson correlation coefficient. Factor analysis was performed for creation of factor which showed individuals' subjective PSAU in different EU countries. Countries of EU were ranked according to the value of this factor.

Table 2
Descriptive analysis of variables.

	Mean (%)	Median (%)	Standard deviation	Minimum (%)	Maximum (%)	Skewness	Kurtosis
AFMP[a]	92.54	94.00	4.56	79.00	98.00	−1.33	1.55
ACAA[b]	62.64	61.50	8.16	48.00	79.00	0.21	−0.82
STAD[c]	82.29	84.00	7.56	67.00	94.00	−0.33	−0.89
CVAI[d]	41.93	43.00	11.68	23.00	70.00	0.32	−0.04
ABFA[e]	36.50	37.50	8.96	20.00	60.00	0.32	0.30

[a] Percentage of individuals who obtained the last course of antibiotics from a medical practitioner.
[b] Percentage of individuals who answered correctly about antibiotics features and use.
[c] Percentage of individuals who think they should stop taking antibiotics when they have taken all of the antibiotics as directed.
[d] Percentage of individuals who have changed their views on using antibiotics after the information that they received about rational antibiotic use.
[e] Percentage of individuals who know that using antibiotics to stimulate growth in farm animals is banned within the EU.

Table 3
Ranking of countries of EU according to the results of factor analysis.

Rank	Country	Score	Rank	Country	Score
1	Netherlands	1.86	15	Malta	−0.05
2	Finland	1.76	16	Spain	−0.18
3	Sweden	1.54	17	Poland	−0.44
4	Luxembourg	0.90	18	Croatia	−0.46
5	Denmark	0.84	19	Lithuania	−0.49
6	Germany	0.80	20	Estonia	−0.59
7	Belgium	0.78	21	Italy	−0.67
8	France	0.67	22	Portugal	−0.73
9	Ireland	0.58	23	Hungary	−1.03
10	Czech Republic	0.57	24	Latvia	−1.18
11	United Kingdom	0.54	25	Republic of Cyprus	−1.40
12	Slovakia	0.44	26	Romania	−1.47
13	Slovenia	0.39	27	Bulgaria	−1.50
14	Austria	0.18	28	Greece	−1.66

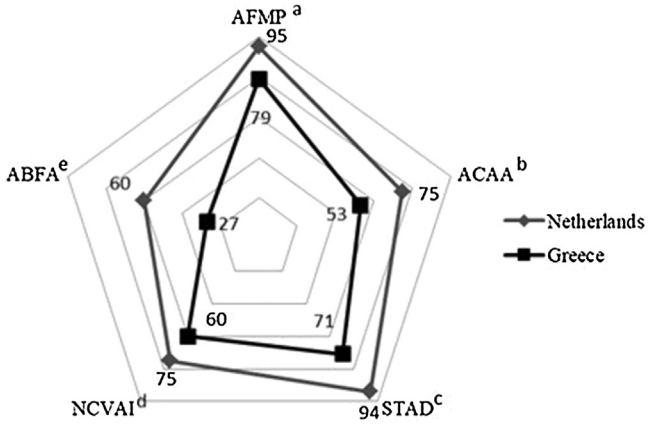

Fig. 1. Citizens' subjective perception of safe antibiotic use between countries which have the highest and the lowest rank (%). (a) Percentage of individuals who obtained the last course of antibiotics from a medical practitioner. (b) Percentage of individuals who answered correctly about antibiotics features and use. (c) Percentage of individuals who think they should stop taking antibiotics when they have taken all of the antibiotics as directed. (d) Percentage of individuals who have not changed their views on using antibiotics after the information that they received about rational antibiotic use. (e) Percentage of individuals who know that using antibiotics to stimulate growth in farm animals is banned within the EU.

Pearson correlation was used for investigation the relation between contextual factors and factor of subjective PSAU. Further linear regression analysis was performed in order to evaluate impact of contextual factors on subjective PSAU. Factor of subjective perception of safe antibiotic use was chosen as dependent.

ANOVA method was used for comparison of factors score between four clusters of countries according to the implemented policies based on the Council recommendation of 2001 and The Action Plan of 2011 [27]. Data are presented as mean ± SEM. A value of $p < 0.05$ was considered statistically significant.

Results

Descriptive analysis and ranking of countries

27,969 respondents were involved in survey of the 28 Member States [28]. Respondents' characteristics are presented in Table 1. Descriptive analysis of studied variables is presented in Table 2. Correlation analysis revealed that all variables showing subjective citizens' PSAU closely related to each other ($p < 0.05$ or $p < 0.001$). Strong correlations and other parameters allowed performing factor analysis (Kaiser-Mayer-Olkin (KMO) was 0.79 and Bartlett's Test was 63.69). Factor analysis showed that only the one factor should be considered. This factor explained 65.24% of the total variance of the original variables.

All countries of EU were ranked according to the factor analysis results (Table 3). This table shows high differences of subjective PSAU between countries. The highest score was observed in Netherlands whereas the lowest score was estimated in Greece. The Fig. 1 shows variables of these two countries. In order to present the level of citizens' subjective PSAU more clearly, the variable "individuals who have changed their views on using antibiotics after the information that they received about rational antibiotic use (CVAI)" was changed into "individuals who have not changed their views on using antibiotics after the information that they received about rational antibiotic use (NCVAI)". Differences between variables were 15% and higher.

Analysis of subjective PSAU between clusters

After analysis of subjective PSAU between clusters of countries according to the implementation of policies based on the Council recommendation of 2001 and The Action Plan of 2011, we found that the highest score of factor was in the cluster 1 (0.88 ± 0.25) whereas the lowest score was estimated in the cluster 4 (-0.41 ± 0.35). However ANOVA test did not show statistical significance of mean factor score between four clusters. Countries from the first cluster had implemented a comprehensive policy, comprising various activities in all areas covered by the Council recommendation, whereas the last cluster comprised countries where the overall level of implementation of the Council recommendation was rather low. The tendency of higher score of factor in the first cluster could be explained by comprehensive policy at national level.

Analysis of link between subjective PSAU and contextual factors

Significant positive correlation was estimated between factor of subjective PSAU and ICT development index, GDP per capita and health expenditure per capita. Significant negative correlation was

Table 4
Results of correlation and regression analysis between contextual factors and factor of subjective perception of safe antibiotic use.

Correlation analysis (Pearson coefficient)	
Contextual factors	Factor score
ICT development index	0.81**
GDP per capita	0.61**
Consumption of antibiotics	−0.41*
Health expenditure per capita	0.80**
Expenditure on retail pharmaceuticals per capita	0.33
Practicing physicians	0.05

Regression analysis

Contextual factors	Standartized coefficient beta	t	Sig.	95,0% Confidence interval for B		VIF
				Lower bound	Upper bound	
Factor consisted of (1) ICT development index, (2) GDP per capita and (3) health expenditure per capita	0.68**	4.97	**0.00**	0.398	0.965	1.37
Consumption of antibiotics	−0.33*	−2.43	**0.02**	−0.087	−0.007	1.31
Expenditure on retail pharmaceuticals per capita	0.08	0.60	0.56	−0.002	0.003	1.37
Practicing physicians	−0.14	−1.06	0.30	−0.007	0.002	1.23

* $p < 0.05$.
** $p < 0.01$.

observed between factor of subjective PSAU and consumption of antibiotics (Table 4).

Regression analysis was performed in order to evaluate impact of contextual factors on factor of subjective PSAU. Significant impact of factor consisted of ICT development index, GDP per capita and health expenditure per capita and consumption of antibiotics on factor of subjective PSAU was estimated (Table 4).

Discussion

This study revealed that subjective PSAU varies highly across the EU countries. Citizens from Netherlands, Finland, Sweden, Luxembourg, and Denmark had the highest subjective PSAU whereas individuals from Cyprus, Romania, Bulgaria and Greece showed the lowest subjective PSAU. According to the latest data on antibiotic consumption, Netherlands, Sweden, Denmark and Finland are the countries where consumption of antibiotics for systemic use is one of the lowest. On the contrary, citizens from Cyprus, Romania and Greece take the highest amount of antibiotics for systemic use [3]. We can notice that the highest subjective PSAU was observed in Northern and Western countries while the lowest score was estimated in Southern and Eastern countries. According to the data on antibiotic consumption and results of research performed by Goossens et al. the lowest consumption of antibiotics is observed in Northern and Western Europe [3,33]. Consequently, we can hypothesize that subjective PSAU is related to antibiotic consumption. Our study revealed negative correlation between subjective PSAU and antibiotic consumption which means that when subjective PSAU is higher consumption of antibiotics is lower. These results are in agreement with other authors who investigate knowledge and subjective PSAU [4,6–9]. For example, according to questionnaire-based survey performed by Giannitsioti et al. only 16% of participants knew about the EAAD in Greece population where consumption of antibiotics is very high [8]. However other scientists present that knowledge about safe antibiotic use not always affect the individual's perception. For example the research performed by Carter et al. indicated that over 90% of participants recognized that inappropriate antibiotic use fosters the development of antibiotic-resistant bacteria and about 75% of respondents also agreed that resistance to antibiotics was a problem in United States hospitals and that resistant bacteria could infect them or a family member, but only 30% of respondents agreed that antibiotic resistance is a significant problem [34]. That is why in our study we created factor of subjective PSAU which was consisted of variables showing knowledge and behaviour regarding antibiotics.

One of the measures that may affect subjective PSAU is antibiotic policies. We compared mean score of subjective PSAU factor between clusters constituted according to the implemented policies based on the Council recommendation of 2001 and The Action Plan of 2011 and noticed tendency that the highest score was in the first cluster while the lowest score was in the last cluster. This tendency could be explained by comprehensive policy in the first cluster of countries and low implementation of policy in the fourth cluster at national level. Results of our study show positive impact of policy on PSAU. We did not succeed to find studies which analyse link between antibiotic policies and subjective PSAU. Whereas we estimated relation between subjective PSAU and antibiotic consumption we quote the data of other studies which investigated antibiotic policies and antibiotic use in discussion. There are evidences that policies can reduce consumption of antibiotics. Countries with tighter regulatory conditions tend to have lower levels of antibiotic consumption; for example, Latvia has high levels of regulation and low levels of antibiotic consumption [3,35]. In France, the government launched an awareness campaign "Antibiotics are not automatic" in 2002 which achieved a reduction in antibiotic prescribing of 27% over five years [18]. However, France has one of the highest antibiotic consumption rates from 1997 until 2016 despite active antibiotic policy and high score of subjective PSAU [3,27,36]. Moreover, despite general Council recommendation of 2001 for all EU countries, differences between subjective PSAU and antibiotic consumption still remain between countries. These data show that active antibiotic policies of the countries not always affect subjective PSAU and antibiotic consumption. So there are more factors which can affect subjective PSAU and antibiotic consumption. Mueller and Östergren are in agreement with this hypothesis; they state in their article that although national regulatory conditions correlate with antibiotic consumption, this association is potentially influenced by a wide range of contextual aspects [35], for example, by variations in incidence of community acquired infections, culture and education, and differences in drug regulations and in the structure of the national pharmaceutical market [33]. According to Deschepper et al., national cultural factors also could be important on subjective PSAU. Studies have

shown that European countries with particular cultural characteristics defined by Hoftede use more antibiotics [37].

We analysed link between six different contextual factors and subjective PSAU and found positive correlations between subjective PSAU and the GDP, ICT, health expenditure per capita and consumption of antibiotics. Moreover, regression analysis showed significant impact of these factors on subjective PSAU.

In our opinion, higher GDP and health expenditure of countries allow them to provide more funds for implementation of antibiotic policies, in particular for consultation and education of healthcare workers and citizens. Other authors also suggest that the income of a country might have an effect on antibiotic use [37,38]. High-income countries tend to use more antibiotics per capita than low- and middle-income countries, but consumption appears to be stabilizing or decreasing whereas the highest rates of increase are in middle-income countries [11].

We found that ICT development increase subjective PSAU. ICT provide opportunity to access information, education and consultation about responsible antibiotic consumption for many citizens. Chaintarli et al. are in agreement with our opinion, as they indicate that social media and the websites are very important source of information about antibiotics, especially among individuals 12–18 years old. 18–24 years old persons were influenced by social media twice less frequently. Colleagues' opinion was the most important for them. Importance of social media increased for 25–44 years old individuals, but did not reach the level of 12–18 years individuals [39].

To our knowledge there are no studies which analyse subjective PSAU in all EU countries. However, our study has some limitations. We used questionnaire from other study to create factor of subjective PSAU. We lacked some questions which could describe this perception more accurately. Moreover, there are more contextual factors which can be important for subjective PSAU, but we could not investigate them because data was not available.

Conclusions

To conclude, this study showed that individuals' subjective PSAU which is related to antibiotic consumption highly varies between different EU countries despite general EU recommendations on antibiotic policies and depends on ICT development, GDP, health expenditure and consumption of antibiotics.

This study revealed the need to increase subjective PSAU. This would lead to reduction of discrepancy in antibiotic use among EU countries. More attention should be paid on spreading information and knowledge about safe antibiotic consumption using ICT. Moreover, adequate financial investments should be made to promote perception of rational drug consumption and research in this field. EU countries should develop and implement previously mentioned policy tools taking into account their epidemiological and socioeconomic backgrounds. However there is a clear need to coordinate development and implementation of policy tools at EU level. Moreover, mechanisms of regional collaboration should be developed. We think that increase of PSAU would lead to lower expenditure on treatment, reduced risk of development of antibiotic-resistant bacteria and reduced frequency of toxic effects, which can occur when choosing alternative antibiotics.

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