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Knowledge, Attitudes And Practices Regarding The Use Of Antibiotics. Study On The General Population Of Mureș County, Romania

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Background: Currently, antibiotic resistance is a complex issue that affects the whole of society. This resistance is influenced by the irrational and excessive use of antibiotics by the general population. This study aimed to gather information about the knowledge, attitudes and behaviours regarding the issues related to antibiotic consumption in the general population of Mureș County in the Central Region of Romania.

Methods: This was a cross-sectional study using a questionnaire as its research instrument, which consisted of 33 questions analysing the respondents' attitude and their knowledge about the use of antibiotics and antibiotic resistance.

Results: A total of 996 respondents were eligible for the study. Of the total respondents, 62.65% (624 respondents) considered that antibiotics are used to treat a bacterial infection and 61.45% (612 respondents) used an antibiotic at least once in the previous year, with a distribution of 68.7% and 56.8% of the respondents from rural and urban areas, respectively. Antibiotics were taken by 10.34% of the respondents, following recommendations from family/friends, and 22.9% used antibiotics left over from their last prescription. Of those who consumed antibiotics (868 respondents), 65.9% consulted their physician every time before taking the medication. Furthermore, 82.3% of the total of 996 respondents considered that the use of non-prescription antibiotics has a negative effect, and 85.14% had heard about the antibiotic resistance of bacteria.

Conclusion: The majority of respondents had adequate knowledge of antibiotics and their use and were aware of the fact that non-prescription antibiotics can have repercussions both on them as individuals and on the population as a whole.

Keywords: antibiotics, bacterial resistance, self-medication, questionnaire

Introduction

For over 60 years, antibacterial medication has been considered a panacea for the treatment of numerous infections which, before the discovery of antibiotics, contributed to the high rates of morbidity and mortality worldwide.[1,2] Modern medical breakthroughs, such as major surgical procedures, organ transplant, therapy for premature infants or chemotherapy for cancer, would not have been possible without effective antimicrobial treatments.[3] Lately, antimicrobial resistance has become an ever-growing threat for the efficient treatment of infections caused by bacteria, parasites, viruses and fungi. Numerous antibacterial, anti-parasitic, antiviral and antifungal drugs have become ineffective, making treatment difficult, costly or even impossible, especially for vulnerable patients, which resulted in prolonged

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infectious diseases and increased mortality rates. The global magnitude of the issue and the impact of antimicrobial resistance on human health, as well as its health-care costs and social impact, are still largely unknown. Over time, the development of each new antibacterial drug was subsequently followed by the emergence of antibiotic resistance.[4] The development of antibiotic resistance by microorganisms is a natural phenomenon, but one that is sped up by excessive use and abuse of antimicrobial agents in humans. The current lack of new forthcoming antimicrobial medication that could replace those which have become inactive also highlights an urgent need to protect the efficacy of existing drugs. Resistant strains are able to propagate and spread rapidly among hospitalized patients, especially if infection prevention and control measures are not complied with.[5] The increase in antibiotic resistance rates is mainly attributed to inadequate prescriptions of antibiotics and their excessive use in the community, mainly in primary care. Other factors include patient perceptions of the patient–physician interaction, including self-medication, knowledge regarding antibiotics, and the lack of adequate policies for the restriction and control of prescribed antibiotics.[4–7] The general population can play an important role in reducing the inappropriate and excessive use of antibiotics. Thus, it is useful to understand the knowledge, attitudes and behaviours regarding the use of antibiotics, and to possibly identify any unmet educational needs.[4,5] Developing and implementing effective strategies to reduce the emergence and spread of antibacterial resistance and to assess the effects of the applied interventions is dependent on the collection of accurate, representative data with regard to the magnitude of the problem and its impact on the general population.[8]

A literature search identified numerous articles published worldwide on studies evaluating knowledge, attitudes, behaviour and perceptions among patients about the use of antibiotics and antimicrobial resistance;[9–16] however, we found a few articles concerning these issues that were conducted on subjects from Romania.[17–19] According to the latest WHO data,[20] Romania is one of the states worldwide in which antibiotics are consumed in excess. According to a recent Cult Market Research study, 1 out of 6 Romanians has taken antibiotics without a prescription in the previous year,[21] inadequate administration of antibiotics being one of the major factors that contribute to an increase in bacterial resistance. We therefore considered it necessary to carry out such a study on a local population.

This study aims to collect information on the knowledge, attitudes and behaviours regarding the problems of antibiotic consumption in the general population of Mureş County in the Central Region of Romania. We hoped that a study like this can help in identifying the segments of population with an abusive consumption of antibiotics, which might in turn aid the subsequent development of appropriate programs to improve attitudes and knowledge concerning antibiotics, the ultimate goal being the control of antibiotic resistance.

Materials And Methods

We used a cross-sectional study design with a questionnaire as the research instrument. This consisted of 33 questions and was developed based on other similar questionnaires from the relevant literature.[4,9,22,23]

The study questionnaire was adapted to be suitable for the local population as well as to ensure its applicability. Furthermore, the value and contents of the adapted questionnaire were established using a study group at the University of Medicine, Pharmacy, Sciences and Technology of Târgu Mureş. The study's sample size was determined by using the Raosoft sample size calculator,[24] with a margin of error of $\alpha = 5\%$, a confidence interval of 95% and a frequency of antibiotics consumption without a prescription in Romania set at 16.6%. Thus, the estimated minimum size of the sample was of 213 individuals. In order to increase the statistical power of the study, and considering the questionnaire's response rate, we increased this number 6 times, so the study set out to enrol 1278 individuals.

Before applying the final questionnaire on a larger population, we conducted a pilot study in order to check the clarity and readability of the questionnaire. This included 50 subjects with characteristics similar to those of the study population. Results from the 50 participants were not included in the final statistical analysis. The final version of the questionnaire was corrected and refined based on feedback from the participants.

The questionnaire was distributed systematically (using a sampling step of 3) to patients in the waiting rooms of family physician offices. Every third patient presenting to each office was asked to fill out the questionnaire, regardless of the reason they consulted their physician. Another source of eligible respondents were individuals buying various medications in pharmacies, including antibiotics. The same sampling step of 3 was used in these situations: every third person who entered the pharmacy was asked to fill out the questionnaire. Of the four geographic regions (north, south, west, east) of Mures County, several family physician offices (n:

25) and pharmacies (n: 15) were randomly chosen to obtain the study sample – these were both in the urban and rural areas. Located in the Central Region of Romania, Mureș County has a population of 540,000 inhabitants (about 2.76% of the total population in Romania), with a similar distribution by gender and the environment of origin.

The aim and intentions of the study were explained at first for all approached individuals. If the person chose to participate, an informed consent was requested. Questionnaires were not handed out to those who did not wish to participate in the study. All the information was collected anonymously and all the information was treated with confidentially. Data were collected between October 2017 and March 2018.

Questionnaires were filled out by individuals aged 20 to 80 years. Of the 1278 persons asked to complete the questionnaire, a total of 996 were eligible for the study; giving us a participation rate of 77.9%. The questionnaire contained items with questions about 1) socio-demographic data of the participants (age, gender, area of residence, occupation, level of education); 2) knowledge about antibiotic use and antibiotic resistance; 3) attitudes toward self-medication with antibiotics; 4) practices related to antibiotic use and 5) means of information and sources regarding antibiotics use.

The questions were either open-ended, closed with ordered answers or closed with unstructured answers, with a few dichotomous or two-point questions. The questionnaire took a maximum of 20 mins to complete. For each question, there was either a request to choose just one answer or the possibility of choosing more answers. The questionnaire's header mentioned the study's aim, as well as information about anonymity and the confidentiality of the answers.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS. version 20. Chicago. IL. USA). Quantitative data were presented as mean and standard deviation for normally distributed data (age). Qualitative data were presented as counts and percentages, and the 95% confidence intervals (95% CI) were calculated for all the estimations. The association between qualitative variables was assessed using the Chi-square test or the Fisher exact test. Statistical analyses were performed in terms of age groups, the area of origin (urban or rural) and education level. We used four age groups to capture different segments of the population: the young adult (18–34 years), the middle classes (35–49 and 50–64 years) and the third-age people (>65 years). We have followed the level of education after primary school (1–8 classes); high school (10–12 classes); post-secondary education (13 classes); graduate or postgraduate education (university, master and doctoral degrees).

All test results were interpreted for statistical significance using a threshold of $p = 0.05$.

Results

Participants' Characteristics

Of the total of 996 people who completed the questionnaire, 63.5% were female respondents and 61.4% residing in an urban area. The average age of respondents was 45 ± 12.5 (SD) years, with a minimum of 20 years and a maximum of 80 years. The level of education was as follows: 10% had only primary school, 28.3% received high school education, 22.0% had post-secondary education, and 39.7% had university and postgraduate degrees.

Basic Practices And Knowledge Regarding The Use Of Antibiotics

Of the respondents (996), 62.65% mentioned that antibiotics are used to treat a bacterial infection and 61.45% have taken antibiotics in the previous year, some even more than once. Before taking antibiotics, 57.43% of the respondents consulted a physician, but there were about 30% of the respondents who either used an old prescription in their home or have taken antibiotics based on the advice of family and friends. Of the respondents, 61.45% used at least once an antibiotic in the last year, prescribed by the family physician (39.66%) or the specialist physician (21.89%). We mention that 10.34% of the respondents took antibiotics in the absence of a specialist recommendation, simply based on advice from family members or friends.

The response rates for the type of disease treated were similar for urinary tract and gynaecological infections (17.87%), ear/eye/gastrointestinal infections (14.06%) and dental infections (17.07%), but many respondents seem to take antibiotics for the treatment of colds or flu (39.26%), disorders that in most cases are of viral aetiology. More than one-fifth (22.89%) of the respondents used antibiotics left over from their previous prescription (Table 1).

Knowledge And Attitudes Regarding Antibiotics Use And Resistance To Antibiotics

Most respondents said they have interrupted antibiotic treatment when instructed by their physician (59.24%),

Table 1 Basic Practices And Knowledge Regarding The Use Of Antibiotics

Statement	n	%	CI 95%
Q7. Which medications do you use more frequently?			
Antibiotics	184	18.47	15.9–21.3
Anti-inflammatory drugs	400	40.16	36.30–44.3
Antidepressants	32	3.21	2.19–4.53
Analgesics	212	21.28	18.5–24.3
I do not use any medication	280	28.11	24.92–31.61
Q8. In your opinion, what are antibiotics used for?			
Viral infections	228	22.89	20.02–26.06
Bacterial infections	624	62.65	57.83–67.76
Other reasons	144	14.46	12.19–17.02
Q9. Do you always consult your physician before taking antibiotics?			
Yes	572	57.43	52.82–62.33
No	296	29.72	26.43–33.30
I do not use antibiotics	128	12.86	10.72–15.28
Q11. How many times have you taken antibiotics last year?			
Never	384	38.55	34.79–42.61
Once	388	38.96	35.18–43.03
2–5 times	180	18.07	15.53–20.91
More than 5 times	44	4.41	3.21–5.93
Q12. Why did you end up using antibiotics?			
I have not used antibiotics	128	12.86	10.72–15.28
My family physician prescribed them	395	39.66	35.84–43.77
A specialist physician prescribed them	218	21.89	19.08–24.99
I used an old prescription I had at home	79	7.93	6.23–9.88
It was recommended by my family or friends	103	10.34	8.44–12.54
Other than the options mentioned above	73	7.33	5.74–9.21
Q13. What disease did you take the antibiotic medication for?			
I have not taken antibiotics	128	12.86	10.72–15.28
Urinary tract/gynaecological infections	178	17.87	15.34–20.70
Cold and flu	391	39.26	35.46–43.35
Ear/eye/gastrointestinal infections	140	14.06	1.82–16.59
Dental infections	170	17.07	14.60–19.84
Other	105	10.50	8.62–12.76
Q15. Did you use antibiotics left over from your last prescription? (YES)	228	22.89	20.02–26.06
Q16. Did you take antibiotics that were prescribed for a different person in your family? (YES)	56	5.62	4.24–7.30

but we also found a number of responses indicating a ceasing therapy when the respondents were feeling better (9.94%), when symptoms disappeared (10.04%) or when they have forgotten to take the medication (6.12%). Most respondents considered the necessary antibiotic treatment length to be less than 7 days and that the duration of treatment or the interval between consecutive administrations has a significant and important role. Many patients are aware of the fact that antibiotics can induce an imbalance of the intestinal and oral flora (59.04%) and that a set of laboratory tests is needed before any antimicrobial therapy (67.47%). Bacterial resistance to antibiotics was acknowledged by 85.14% of the study participants, information they have obtained from either family or specialist physicians, or from the media (Internet, TV, radio). Many respondents (68.67%) considered that antibiotic resistance can be controlled by the use of fewer antibiotics, and only taking the medication when prescribed by a physician (Table 2).

We also assessed the relationship between attitudes, knowledge and good practices regarding the use of antibiotics and respondents' age groups and area of residence (Table 3), as well as their level of education (Table 4). In many of these comparisons, we found difference mainly for the age group of over 65 years, especially when compared with young age groups (18–34 years and 35–49 years). Significant differences were also found among the responses given by individuals from different areas of residence, with a seemingly more appropriate use of antibiotics in the urban environment. When considering the level of education, the difference was most evident between respondents with higher education and those with only primary school, the former showing higher rates of correct knowledge and attitudes regarding antibiotic usage.

Female respondents in our study reported more frequent antibiotic use in the previous year when compared to respondents of the opposite sex. It should also be noted that in our study there was a higher percentage of female respondents who reported consulting a physician before taking antibiotics as compared to men (60.11% vs. 50%).

Discussion

Population plays an important role in the abusive or irrational use of antibiotics, as well as in the spread of perceptions on bacterial resistance. Our findings show a certain degree of superficiality in the knowledge regarding

Table 2 Knowledge And Attitudes Regarding Antibiotics And Resistance To Antibiotics

Statement	n	%	CI 95%
Q17. When do you stop taking the antibiotic therapy prescribed by your doctor?			
When I am feeling better	99	9.94	8.08–12.10
When my physician or pharmacist tells me to	590	59.24	54.55–64.22
When I have no more symptoms	100	10.04	8.17–12.21
After I have finished my antibiotics	88	8.83	7.08–10.88
If I forget to take the medication	61	6.12	4.68–7.86
If I consider that the antibiotics do not have any effect	58	5.82	4.42–7.52
Q18. How long do you think antibiotic treatment should last?			
Less than 7 days	652	65.46	60.53–70.69
Over 7 days	344	34.54	30.98–38.39
Q19. Regarding the role of antibiotic treatment duration - how important do you consider it to be?			
Its role is insignificant	28	2.80	1.86–4.06
Its role is significant	508	51.00	46.66–55.64
It has a very important role	460	46.18	42.06–50.60
Q20. How about the interval between two consecutive administrations of the antibiotic?			
It is insignificant	76	7.63	6.01–9.55
It is significant	412	41.37	37.47–45.56
It is very important	508	51.00	46.66–55.64
Q21. If you've taken antibiotics without a prescription, how did you know what dose to take?			
I have read the information leaflet	300	30.12	26.81–33.73
I have asked family members or other acquaintances	76	7.63	6.01–9.55
From magazines, books, TV	4	0.40	0.10–1.02
From the Internet	4	0.40	0.10–1.02
From previous experiences	84	8.43	6.72–10.44
I have not taken any antibiotics without a prescription	568	57.03	52.43–61.92
Q22. What side effect of antibiotics do you know about?			
Diarrhoea	240	24.10	21.14–27.35
Abdominal pain	164	16.47	14.04–19.19
Vomiting	128	12.85	10.72–15.28
Allergic reactions (itchy skin)	360	36.14	32.51–40.08
Imbalance of the intestinal/oral flora	588	59.04	54.36–64.01
I do not know	184	18.47	15.90–21.34
Q23. Have you experienced any side effects when you have used antibiotics? (YES)	196	19.68	17.02–22.63
Q24. Do you consider it necessary to have a set of laboratory tests done before taking antibiotics? (YES)	672	67.47	62.46–72.77
Q25. Do you consider that the use of antibiotics without prescription can have a negative effect? (YES)	820	82.33	76.79–88.16
Q26. Have you heard about bacterial resistance to antibiotics? (YES)	848	85.14	79.1–91.07
Q27. If you answered yes, where did you hear about it?			
From the media (Internet, TV, radio)	416	49.06	44.46–54.00
From relatives, friends, acquaintances	64	7.54	5.81–9.63
From my family physician or other specialist physicians	464	54.72	49.85–59.93
From my pharmacist	104	12.26	10.02–14.86
Q28. Do you consider that antibiotic resistance can be stopped? (YES)	448	44.98	40.91–49.34
Q29. In your opinion, what are the means to stop antibiotic resistance?			
Using fewer antibiotics and only when prescribed by a physician	684	68.67	63.62–74.02
Scientists discovering new antibiotics	36	3.61	2.52–5.00
Physicians prescribing fewer antibiotics	128	12.85	10.72–15.28
I do not know	208	20.88	18.14–23.92
Q30. Do you consider that antibiotics are a universal antidote? (YES)	272	27.31	24.16–30.76
Q32. Have you combined different antibiotics during the same treatment? (YES)	88	8.83	7.08–10.88
Q33. Would you consider antibiotic resistance to be:			
A minor issue	88	8.83	7.08–10.88
An issue of medium significance	352	35.34	31.75–39.23
A major issue	556	55.82	51.28–60.66

Table 3 Relationship Between Practices, Knowledge And Attitudes Regarding Antibiotics Use/Resistance To Antibiotics Versus Age Groups And Patient Area

Statement	Age Groups				P value	Area		P value
	18–34	35–49	50–64	>65		Rural	Urban	
Q8. In your opinion, what are antibiotics used for?								
Viral infections	9.6%	23.6%	26.9%	**40.0%**	**0.001***	20.8%	**24.2%**	**0.007***
Bacterial infections	**73.1%**	**66.4%**	56.7%	35.0%		60.4%	**64.1%**	
Other reasons	17.3%	10.0%	16.4%	25.0%		**18.8%**	11.8%	
Q9. Do you always consult your physician before taking antibiotics?								
Yes	51.9%	58.2%	55.2%	**75.0%**	**0.0001***	**60.4%**	55.6%	**0.0001***
No	34.6%	26.4%	35.8%	15.0%		32.3%	28.1%	
I do not use antibiotics	13.5%	15.5%	9.0%	10.0%		7.3%	16.3%	
Q11. How many times have you taken antibiotics last year?								
Never	42.3%	42.7%	34.3%	20.0%	**0.0001***	31.2%	**43.1%**	**0.0001***
Once	**46.2%**	32.7%	43.3%	40.0%		**41.7%**	37.3%	
2–5 times	11.5%	23.6%	14.9%	15.0%		18.8%	17.6%	
More than 5 times	0.0%	0.9%	7.5%	**25.0%**		8.3%	2.0%	
Q15. Did you use antibiotics left over from your last prescription?								
Yes	28.8%	16.4%	31.3%	15.0%	**0.0001***	22.9%	22.9%	0.98
No	71.2%	83.6%	68.7%	**85.0%**		77.1%	77.1%	
Q16. Did you take antibiotics that were prescribed for a different person in your family?								
Yes	5.8%	4.5%	6.0%	10.0%	0.26	6.2%	5.2%	0.49
No	94.2%	95.5%	94.0%	90.0%		93.8%	94.8%	
Q17. When do you stop taking the antibiotic therapy prescribed by your doctor?								
When I am feeling better	12.5%	5.7%	10.8%	**23.8%**	**0.0001***	**14.3%**	7.2%	**0.0001***
When my physician or pharmacist tells me to	**60.1%**	64.8%	58.6%	28.8%		56.5%	**60.9%**	
When I have no more symptoms	5.3%	10.0%	10.8%	**20.0%**		7.6%	**11.6%**	
After I have finished my antibiotics	12.5%	8.2%	7.5%	7.5%		8.3%	9.2%	
If I forget to take the medication	4.8%	5.0%	6.3%	**15.0%**		8.9%	4.4%	
If I consider that the antibiotics do not have any effect	4.8%	6.4%	6.0%	5.0%		4.4%	6.7%	
Q18. How long do you think antibiotic treatment should last?								
Less than 7 days	67.3%	60.0%	67.2%	**85.0%**	**0.0001***	66.7%	64.7%	0.52
Over 7 days	32.7%	**40.0%**	32.8%	15.0%		33.3%	35.3%	
Q24. Do you consider it necessary to have a set of laboratory tests done before taking antibiotics?								
Yes	63.5%	70.0%	67.2%	65.0%	0.37	66.7%	68.0%	0.66
No	36.5%	30.0%	32.8%	35.0%		33.3%	32.0%	
Q25. Do you consider that the use of antibiotics without prescription can have a negative effect?								
Yes	84.6%	84.5%	76.1%	85.0%	**0.02***	78.1%	**85.0%**	**0.006***
No	15.4%	15.5%	**23.9%**	15.0%		**21.9%**	15.0%	

(*Continued*)

Table 3 (Continued).

Statement	Age Groups				P value	Area		P value
	18–34	35–49	50–64	>65		Rural	Urban	
Q26. Have you heard about bacterial resistance to antibiotics?								
Yes	80.8%	90.9%	80.6%	80.0%	**0.0001***	78.1%	**89.5%**	**0.0001***
No	19.2%	9.1%	19.4%	**20.0%**		**21.9%**	10.5%	
Q27. If you answered yes, where did you hear about it?								
From the media (Internet, TV, radio)	19.2%	46.2%	27.9%	6.7%	**0.0001***	33.7%	**66.3%**	**0.001***
From relatives, friends, acquaintances	12.5%	56.2%	18.8%	12.5%		37.5%	**62.5%**	
From my family physician or other specialist physicians	19.5%	44.9%	28.8%	6.8%		37.3%	**62.7%**	
From my pharmacist	**42.3%**	30.8%	26.9%	0.0%		**42.3%**	57.7%	
Q28. Do you consider that antibiotic resistance can be stopped?								
Yes	53.8%	50.0%	47.7%	**65.0%**	**0.001***	50.0%	52.3%	0.13
No	46.2%	50.0%	52.3%	35.0%		50.0%	47.7%	
Q29. In your opinion, what are the means to stop antibiotic resistance?								
Using fewer antibiotics and only when prescribed by a physician	53.8%	**72.7%**	55.1%	55.0%	**0.0001***	53.1%	**68.7%**	**0.0001***
Scientists discovering new antibiotics	**15.4%**	0.9%	9.0%	10.0%		6.2%	8.5%	
Physicians prescribing fewer antibiotics	**15.4%**	6.4%	7.5%	10.0%		14.6%	5.2%	
I do not know	15.4%	18.2%	**28.4%**	**25.0%**		**26.0%**	17.6%	
Q30. Do you consider that antibiotics are a universal antidote?								
Yes	15.4%	29.1%	29.9%	**40.0%**	**0.0001***	**35.4%**	22.2%	**0.0001***
No	**84.6%**	70.9%	70.1%	60.0%		64.6%	**77.8%**	
Q32. Have you combined different antibiotics during the same treatment?								
Yes	7.7%	5.5%	11.9%	**20.0%**	**0.0001***	8.3%	9.2%	0.65
No	92.3%	**94.5%**	88.1%	80.0%		91.7%	90.8%	
Q33. Would you consider antibiotic resistance to be:								
A minor issue	11.5%	6.4%	7.5%	20.0%	**0.0001***	**15.6%**	4.6%	**0.0001***
An issue of medium significance	**48.1%**	31.8%	35.8%	20.0%		38.5%	33.3%	
A major issue	40.4%	61.8%	56.7%	**60.0%**		45.8%	**62.1%**	

Note: *Significant values are shown in bold.

antibiotics. For example, 22.89% of the respondents considered antibiotic treatment as effective in case of viral infections, and 14.46% considered antibiotic therapy effective for any type of infection excluding those of viral and bacterial aetiology. It is still possible for patients to obtain antibiotics without a prescription, even if this practice is illegal; 29.72% said they do not consult a physician before taking antibiotics, while 25.57% of the Romanians usually take antibiotics without a prescription from their healthcare professional. Among those surveyed, 42.97% have used antibiotics without a prescription from a specialist. Published studies show that antibiotic self-medication over a set interval (the previous 12 months, the previous 6 months) was higher in Greece (45%), Romania (44%) and Croatia (32%) compared to Western European countries.[25–27] Two main routes of access to antibiotics used for self-medication have been suggested in the literature: the first is direct distribution to the patient with no prescription, which, although illegal, is believed to occur in several EU states; the second is the use of antibiotics left over from previous treatments and kept at home by the patient, facilitated by the release of a larger number of

Table 4 Relationship Between Practices, Knowledge And Attitudes Regarding Antibiotics Use/Resistance To Antibiotics Versus Patient Level Of Education

Statement	Primary School	High School	Post-Secondary Education	Postgraduate Education	P value
Q8. In your opinion, what are antibiotics used for?					
Viral infections	21.0%	30.1%	21.0%	19.2%	**0.006***
Bacterial infections	59.0%	58.5%	61.2%	**67.3%**	
Other reasons	20.0%	11.3%	17.8%	13.4%	
Q11. How many times have you taken antibiotics last year?					
Never	30.0%	40.1%	35.6%	41.3%	**0.0001***
Once	41.0%	35.5%	31.1%	**45.3%**	
2–5 times	21.0%	17.4%	**26.0%**	13.4%	
More than 5 times	8.0%	7.1%	7.3%	0.0%	
Q15. Did you use antibiotics left over from your last prescription?					
Yes	11.0%	26.2%	**32.9%**	18.0%	**0.0001***
No	89.0%	73.8%	67.1%	82.0%	
Q16. Did you take antibiotics that were prescribed for a different person in your family?					
Yes	0.0%	7.1%	13.7%	1.5%	**0.0001***
No	100.0%	92.9%	86.3%	98.5%	
Q17. When do you stop taking the antibiotic therapy prescribed by your doctor?					
When I am feeling better	16.0%	11.0%	14.6%	5.1%	**0.0001***
When my physician or pharmacist tells me to	60.0%	58.2%	48.9%	**65.6%**	
When I have no more symptoms	8.0%	11.3%	13.7%	7.6%	
After I have finished my antibiotics	1.0%	14.2%	6.8%	8.1%	
If I forget to take the medication	12.0%	3.2%	5.0%	7.3%	
If I consider that the antibiotics do not have any effect	3.0%	2.1%	11.0%	6.3%	
Q18. How long do you think antibiotic treatment should last?					
Less than 7 days	**76.0%**	72.3%	53.0%	64.8%	**0.0001***
Over 7 days	24.0%	27.7%	**47.0%**	**35.2%**	
Q24. Do you consider it necessary to have a set of laboratory tests done before taking antibiotics?					
Yes	57.0%	72.7%	68.5%	65.8%	**0.029***
No	**43.0%**	27.3%	31.5%	34.2%	
Q25. Do you consider that the use of antibiotics without prescription can have a negative effect?					
Yes	66.0%	82.3%	74.9%	**90.6%**	**0.0001***
No	**34.0%**	17.7%	25.1%	9.4%	
Q26. Have you heard about bacterial resistance to antibiotics?					
Yes	73.0%	70.6%	90.9%	**95.4%**	**0.0001***
No	**27.0%**	**29.4%**	9.1%	4.6%	
Q27. If you answered yes, where did you hear about it?					
From the media (Internet, TV, radio)	9.4%	25.7%	18.8%	46.2%	**0.001***
From relatives, friends, acquaintances	6.2%	32.8%	10.9%	50.0%	
From my family physician or other specialist physicians	6.1%	23.5%	28.8%	41.5%	
From my pharmacist	4.8%	18.3%	11.5%	65.4%	

(*Continued*)

Table 4 (Continued).

Statement	Primary School	High School	Post-Secondary Education	Postgraduate Education	P value
Q28. Do you consider that antibiotic resistance can be stopped?					
Yes	45.0%	47.2%	**58.5%**	**52.2%**	**0.024***
No	**55.0%**	**52.8%**	41.5%	47.8%	
Q29. In your opinion, what are the means to stop antibiotic resistance?					
Using fewer antibiotics and only when prescribed by a physician	54.0%	62.1%	53.4%	**70.4%**	**0.0001***
Scientists discovering new antibiotics	3.0%	3.3%	12.0%	10.1%	
Physicians prescribing fewer antibiotics	3.0%	8.5%	10.5%	9.6%	
I do not know	**40.0%**	26.2%	25.1%	9.9%	
Q30. Do you consider that antibiotics are a universal antidote?					
Yes	20.0%	29.1%	29.2%	26.8%	0.30
No	**80.0%**	70.9%	70.8%	73.2%	
Q32. Have you combined different antibiotics during the same treatment?					
Yes	10.0%	7.8%	7.8%	9.9%	0.71
No	90.0%	92.2%	92.2%	90.1%	
Q33. Would you consider antibiotic resistance to be:					
A minor issue	**24.0%**	11.3%	8.2%	3.5%	**0.0001***
An issue of medium significance	34.0%	40.4%	36.1%	31.6%	
A major issue	42.0%	48.2%	55.7%	**64.8%**	

Note: *Significant values are shown in bold.

tablets (either for a valid prescription or when bought without prescription) than it would be required for a single treatment.[28,29] Augmentin, Amoxicillin and Ampicillin were the most commonly used antibiotics to treat a variety of minor symptoms, such as sore throat, fever and cough, for the most part with treatments of less than 7 days. Many respondents in our study reported the use of antibiotics to treat sore throat, cold and flu, although it is well known that in most cases these are due to viral infections.

There was, however, a statistically significant association (p=0.045) between those who frequently consume antibiotics and those who have heard of bacterial resistance. The surveyed persons were aware that rational use of antibiotics is a means of stopping bacterial resistance (68.67%). Because they imply enormous costs, pharmaceutical companies do not invest in research on antibiotic resistance and in research programs to develop new antibiotic. In addition, a new compound of this kind would need to undergo a series of tests that may take up to a few years before it could be used in clinical practice; however, new generations of bacteria appear every 20 mins, whereas the research and development of a new antibiotic takes at least 10 years. If new antibiotics appeared on the market, they would only be used to handle the most serious cases; thus, profits from selling the new compound would be minimal. Only 3.61% of our respondents believed that the discovery of new antibiotics would help stop bacterial resistance.

Regarding the use of antibiotics by age group, we noticed significant differences in general consumption among young people, adults or the elderly (p = 0.0001). If we look only at the answers for the previous year, younger people used less antibiotics compared to the older age group: 57.7% for 18–34-year-olds, 57.3% for 35–49-year-olds, 65.7% for 50–64-year-olds and 80.0% for those over 65 years of age.

More of the young individuals among our respondents were using antibiotics without prescription, as opposed to the older age groups (34.6% vs. 15.0%). As opposed to this, according to the Cult Market Research,[22] there are no major differences in consumption among young people, adults and the elderly. Thus, 17% of the people aged

35–49 years use antibiotics without prescription, compared to 15% of the people aged 18 to 34 years and 15% among those aged 50–64 years. In other words, Romanians of all ages take these drugs without a physician's recommendation. Female respondents in our study reported more frequent antibiotic use in the previous year when compared to respondents of the opposite sex, and we found the same discrepancy between individuals from urban and rural areas. In our study, there was a higher percentage of female respondents who reported consulting a physician before taking antibiotics as compared to men (60.11% vs. 50%).

People with less education tend to consume antibiotics more frequently than those with higher education.

Analysis of our results showed that among the basic characteristics of the study population, the level of education, age, residence area and work activity proved to be important indicators for the outcomes of interest. The lack of knowledge regarding antibiotics among those with lower education has already been described in other studies conducted in several countries.[5,30,31] It was also interesting to note the significant link ($p = 0.0001$) between the level of education and the knowledge about bacterial resistance. Respondents with a low level of education (only primary school) have no comprehension of bacterial resistance, whereas those with university studies showed knowledge regarding this phenomenon. Levels of education also seem to play an important role in respondents classifying antimicrobial resistance as a major issue. These findings indicate that it is necessary to strengthen the knowledge regarding antibiotics and bacterial resistance among those with lower levels of education, which could be accomplished through employing information campaigns, involving the family doctor and even the occupational physician, as two pillars of the preventive health systems in most of the countries.

The surveyed individuals obtained information about the rational use of antibiotics and bacterial resistance from their physicians (54.72%) and the media (49.06%). However, only a small number of them mentioned the role of the pharmacists in this respect (12.26%) or that of a family member/friend (7.54%) as a source of information. Our findings were thus in line with those of other studies mentioning these issues.[18,31,32] Depending on the distribution by age group and the environment of origin, we found that a predominance of respondents from the 35–49 age group or the urban environment have learned about bacterial resistance to antibiotics from the Internet, physicians and friends. Still, many people aged 18–34 years or from the rural areas learned about this resistance from pharmacists. According to the opinion of 72.7% of the respondents aged 35–49, 68.7% from urban area, and 70.4% of those with university studies, stopping or reducing bacterial resistance to antibiotics can be achieved by using fewer antibiotics and using them only when prescribed by a physician. However, many older individuals (over 50 years of age), those from rural areas or those with only primary education have no knowledge of the subject.

According to a technical report by the European Centre for Disease Prevention and Control (ECDC), with the participation of experts and stakeholders from the EU Member States, guidelines have been issued for the prudent use of antimicrobial agents in the field of human health care. These guidelines are intended to be used to substantiate and support activities geared towards promoting the prudent use of antimicrobials in humans. They address all social actors with responsibilities in the use of antibiotics or those who play a role in this issue, as well as the ones whose contribution is needed to ensure the proper use of antimicrobial agents. The knowledge, attitudes and behaviour of the public and patients can be of significant importance in establishing and assuring judicious use of antimicrobials, both in terms of the normative expectations and pressures they can exert on health-care professionals and other patients, and their own compliance with the medication program. The general public and patients should inform themselves and, if necessary, require health-care providers to offer them information on the appropriate use of antimicrobials, antimicrobial resistance and adverse reactions to antibiotics; use antimicrobials only if the medication was been prescribed for them; not use antimicrobials that have not been prescribed for them (such as left over antimicrobials, those prescribed for another person, or those obtained without a prescription); return unused antibiotics to the pharmacies and local collection centres, in accordance with local regulations for disposal.[33]

The key findings of this study might contribute to future intervention directed at improving knowledge among people in Tîrgu Mureş and beyond. This study has generated information about the knowledge, attitudes and behaviours regarding antibiotic issues in the general population of Mureş County. An effective public education initiative should not only disseminate information but also provide practical and appropriate means for changing the perceptions and behaviour of patients regarding the use of antibiotics.

As in the case of any public surveys, our results are largely based on reported rather than measured behaviour. Interpretation of the results of this study should take into account potential limitations that could have an impact on the conclusions. Firstly, this study was based on cross-sectional design using a convenience sample, which cannot be representative of the entire population of Romania. Secondly, respondents may have only reported their knowledge regarding the use of antibiotics, and not their real behaviour. There were no means to objectively assess the honesty of respondents' answers to the survey questions. The participation rate was 77.9%, which is reasonable for the investigated community. Despite the limitations described earlier, the results provide important information for assessing and improving the public's understanding of antibiotics and related issues.

Conclusions

The majority of respondents had adequate knowledge of antibiotics and their use and were aware of the fact that non-prescription antibiotics can have repercussions both on them as individuals and on the population as a whole. Thus, we have identified groups of the population (more than half of the respondents) who use antibiotics according to the standard recommendations of specialists, based on antimicrobial spectrum, route and mode of administration, useful dosages and intervals between administration, as well as optimal treatment duration and efficacy of antimicrobial therapy. On the other hand, certain groups seem to be using antibiotics on their own initiative, and this is associated with an inadequate choice of antibiotic due to lack of knowledge of the antimicrobial spectrum, the risk of combining antagonistic antibiotics with regard to the mechanism of action or even the combination of antibiotics with the same spectrum and the use of antibiotics for viral diseases (in patients with influenza). Excessive or inappropriate use of antibiotics in the human health-care sector and the transmission of resistant bacteria contribute to the emergence and spread of antibiotic resistance. In order to minimize these, there is a need for coordinated actions at the national and regional levels, which include a judicious use of antibiotics and proper patient education and counselling.

Ethics Approval And Consent To Participate

The study received a favourable opinion from the Ethics Commission of the University of Medicine, Pharmacy, Sciences and Technology of Tirgu Mures. The questionnaire's header mentioned the study's aim, as well as information about anonymity and the confidentiality of the answers. Verbal consent from each participant was obtained before completing the questionnaire.

Availability Of Data And Materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Author Contributions

All authors contributed towards data analysis, drafting and critically revising the paper, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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