Baratta F, Stura I, Ravetto Enri L, Parente M, Migliaretti G, Brusa P. The knowledge of antimicrobial resistance: a survey in the community pharmacies of north-west Italy. Pharmacy Practice. 2025 Oct-Dec;23(4):3347.
https://doi.org/10.18549/PharmPract.2025.4.3347

Original Research

The knowledge of antimicrobial resistance: a survey in the community pharmacies of north-west Italy

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Received (first version): 17-May-2025 Accepted: 16-Jul-2025 Published online: 13-Nov-2025

Abstract

Background: Antimicrobial Resistance (AMR) occurs in nature, but the inappropriate and excessive use of antimicrobials, and poor infection prevention, have all contributed to the increasing incidence of this phenomenon. As a result of AMR, infections become harder to treat, spread more easily and cause more severe illness and deaths. **Objective:** Community pharmacies, thanks to their widespread distribution, local accessibility and extended opening hours, could play a significant role in the fight against AMR. To test this hypothesis we designed the present study with two objectives. Firstly, to evaluate AMR knowledge and behaviours in a sample of community pharmacy customers in the northwest of Piedmont. Secondly, to obtain information to understand the potential role of the pharmacist. **Methods:** A survey to evaluate the AMR knowledge and behaviours of pharmacy customers was carried out. The work was designed as a survey. Data was collected in 2020-2021 in 46 pharmacies by means of a face-to-face interview using a questionnaire. Each pharmacist attended a training course regarding the administration of the questionnaire to avoid any bias. The course also aimed to enhance pharmacists' communication skills to give evidence-based AMR-related advice to customers. **Results:** 1,883 subjects were interviewed. The investigation showed that there was a significant lack of awareness of AMR among the study population. Only 36.59% of respondents were able to identify the correct definition of this term, the rest of the interviewees had little or no knowledge of the problem and the consequences of this condition. The results also suggest that a health education programme might be helpful in achieving significant results: in the sample, those who demonstrated a previous knowledge of the phenomenon, also demonstrated the best behaviour. **Conclusions:** Community pharmacists could be a useful resource for assessing and improving AMR knowledge and behaviour and potentially take an active role in enhancing information campaigns. This is especially important for elderly populations who are the least informed and are the main users of community pharmacies.

Keywords: AntiMicrobial Resistance, AMR, questionnaire, information campaign, community pharmacies

INTRODUCTION

The WHO defines antimicrobial resistance (AMR) as the acquisition by bacteria, viruses, fungi, and parasites of new characteristics which reduce or stop their susceptibility to medicines. This concept also includes antibiotic resistance (ABR) which is specifically related to antibacterial agents. AMR occurs in nature, but the inappropriate and excessive use of antimicrobials, and poor infection prevention, have all contributed to the growing incidence of this phenomenon[1]. When bacteria are exposed to an antibiotic, they are stimulated to develop structural changes in order to survive the drug itself. Hence, the more antibiotics we use, the higher the probability of inadvertently selecting for resistance. In addition, once a bacterium has become resistant to a certain antibiotic, the genes responsible for resistance can be transferred not only to relatives, but also to other species through mobile genetic elements such as plasmids (Horizontal Gene Transfer - HGT)[2]. AMR infections overall are predicted to grow from 17% in 2015 to 19% in 2030 across the European Union. This growth might seem slow, but we have to consider a serious cause for concern: infections resistant to second- and third-line drugs are expected to grow by 72% in 2030[3].

As a result of AMR, infections become harder to treat, spread more easily and cause more severe illness and deaths. Each year, more than 2.8 million antibiotic-resistant infections occur in the United States, but the number of deaths from AMR infections has been in decline since 2013, suggesting that U.S. efforts are having an effect[4]. In Europe, bacteria with ABR are responsible for more than 670,000 infections and cause about 33,000 deaths each year. There is, however, a great variation in national patterns of antibiotic use. In 2017, the average consumption of broad-spectrum antibiotics in Europe was 10.1 Defined Daily Doses (DDDs) per 1,000 inhabitants per day; however, this ranged from a low of 0.9 DDD in Norway to a high of 23.3 DDD in Greece. The number of deaths *per* nation also varies significantly: according to data from the European Centre for Disease prevention and Control (ECDC), in 2015 the highest number of ABR related deaths was reported in Italy (10,762 cases), and the lowest in Portugal (1,158 cases) [3]. According to data from the ECDC[5], the consumption of human antibiotics by the general population decreased by 23% between 2011 and 2020. This fall was especially marked during the COVID-19 pandemic, when, between 2019 and 2020, a drop of 18% in consumption was recorded. The use of antibiotics in livestock farming decreased by 43% over the same period. Nevertheless, in the year of 2018 alone, in the 29 countries of the EU/EEC, 4,264 tonnes of antibiotics for human treatment were consumed, and 6,358 tonnes for animal use: this underlines the fact that there is still a long way to go in reducing the use of antibiotics.

Another important factor leading to the rise in AMR is the inappropriate use of antibiotics in agriculture and livestock farming. The resistant bacteria that arise in this context can easily be transferred to humans via direct contamination

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www.pharmacypractice.org (eISSN: 1886-3655 ISSN: 1885-642X)

from biological substances, (such as urine, faeces, milk, saliva), or indirectly via contact or ingestion of contaminated animal-derived food products[6]. It has been demonstrated that the abuse of antibiotics in agriculture and livestock is harmful and not useful from an economic point of view: in countries such as Denmark and Sweden, prohibitions and restrictions on the use of antibiotics in livestock have effectively led to negligible productivity losses[7].

AMR is not only a health issue, but also has economic consequences. In Europe, AMR has been correlated with total costs of more than 9 billion euros per year. In the USA, antimicrobial resistance is responsible for 20 billion dollars in direct healthcare costs and 35 billion dollars in lost productivity annually[8].

The growing severity of AMR has forced national and international organizations to review the strategies to combat this phenomenon. In 2015 WHO adopted a global action plan on antimicrobial resistance, which aims:

1. to improve awareness and understanding of antimicrobial resistance through effective communication, education and training;
2. to strengthen the knowledge and evidence base through surveillance and research;
3. to reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures;
4. to optimize the use of antimicrobial medicines in human and animal health; and,
5. to develop the economic case for sustainable investment that takes account of the needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines and other interventions[9].

It has been estimated that, in Europe alone, such combined intervention plans could save about 27,000 lives per year[2].

Community pharmacies, thanks to their widespread distribution, local accessibility and extended opening hours, could play a significant role in the fight against AMR. Regarding points 1 and 4 of the WHO plan, considering the close relationship that they develop with their customers, they could take an active role in enhancing information campaigns. This could lead to a better use of antibiotics by their customers.

Several campaigns have already involved Italian community pharmacies in the health education of the general population and in secondary and tertiary prevention campaigns[10-20]. These campaigns have covered various conditions such as diabetes, headaches, chronic obstructive pulmonary disease, and hypertension. Regarding hypertension[17,19], the data collected highlighted that for half of the interviewed costumers between 31 and 65 years of age, blood pressure values were higher than the reference values. Subjects in this age group reported feeling generally healthy and therefore do not usually visit a medical doctor. In this context, the potential role of an adequately trained pharmacist could be particularly significant both to educate its users regarding cardiovascular risk, and to refer them to a medical doctor when appropriate. Interesting results were also obtained in relation to migraine[12-16]: the majority of subjects (49% of men, 63% of women) suffering from migraine, probable or certain, intercepted by community pharmacists according to the study protocol, were not usually in care with a specialist or a general practitioner. Regarding the studies conducted on type 2 diabetes[18] in community pharmacies, it is important to underline that 53% of the interviewed subjects were at risk of developing the disease: excluding the number of expected cases based on the incidence rate of diabetes in the Italian population, 51 additional cases were identified, one every 117 interviews.

The satisfactory results obtained in these previous studies allowed us to hypothesize the role of the pharmacist also in the context of AMR. To test this hypothesis, we drew on previous studies relating to the incidence of AMR in Italy and to the usefulness of data collection through questionnaires in community pharmacies [13,15,21,22]. Then, we designed the present study as a survey using a questionnaire with two objectives. Firstly, to evaluate AMR knowledge and behaviours in a sample of community pharmacy customers in the northwest of Piedmont. Secondly, to obtain information to understand the potential role of the pharmacist in this area.

METHODS

The work herein was designed as a survey. The data were obtained by means of a face-to-face interview using a questionnaire administered by pharmacists. The data collection was carried out from 16 November 2020 to 16 January 2021 in 46 pharmacies recruited on a voluntary basis, all within the province of Turin, which were chosen from a panel of pharmacies with experience in data gathering by means of questionnaires [11, 13-18, 23-29]. Each pharmacist attended a specific on-line training which included a narrated slideshow. The training has been monitored by verifying that the pharmacists remained connected for the entire duration of the course. The explanations concerned both the pharmacology related to the issue of AMR and the correct methodology for the administration of the questionnaire to avoid any bias and influences on the interviewee's answers. The course also enhanced pharmacists' communication skills to give evidence-based AMR-related advice to customers. In fact, at the end of the questionnaire administration, some pharmacists reported that they had addressed inappropriate antibiotic use reported by customers through proper counselling and using educational material based on documents from the Italian Ministry of Health.

The questionnaire

The questionnaire used in our survey (Figure. 1) was adapted and translated into Italian from the original WHO questionnaire "Antibiotic resistance: multi-country public awareness survey"[19]. In order to facilitate understanding by the general population, the terminology used in the questionnaire was in common use. The survey was piloted on a small group of pharmacy customers for readability, comprehensibility, and reliability before starting the study. The questionnaire included twenty questions (thirteen with multiple-choice options, five polar questions, and two open questions).

ANTIBIOTIC RESISTANCE PROJECT - CUSTOMER QUESTIONNAIRE	
PHARMACY POST CODE	
Gender	○ Male ○ Female ○ Prefer not to answer
Age	
Occupation	○ Health worker ○ Non-health worker ○ Retired ○ Student in a health faculty ○ Student in a non-health faculty ○ Other
Haw many members are there in your family (including yourself)?	

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When did you last take antibiotics?	○ In the last month ○ More than a month ago ○ In the last six months ○ More than a year ago ○ Don't know
Have you ever taken antibiotics without a doctor's prescription'	○ Yes ○ No ○ No, but I would in some circumstances ○ Don't know
Do you have a pet?	○ Yes ○ No
If so, have you ever purchased antibiotics without a vet's prescription?	○ Yes ○ No
Does your doctor/pharmacist give you instructions/directions on antibiotics when you are prescribed them?	○ Yes, my doctor does. ○ Yes, my pharmacist does ○ Yes, both of them do ○ No ○ Not always
Have you ever advised a family member or friends to take antibiotics?	○ Yes ○ No
Have you ever been advised to take antibiotics by a family member of friends?	○ Yes ○ no
Do you keep used or sealed packages of antibiotics at home?	○ Yes ○ No
When do you stop taking antibiotics once you have started?	○ When I feel better ○ Sometimes when I feel better, and other times according to when the doctor told me to stop ○ Don't know
Which of these illnesses/diseases are antibiotics recommend for?	○ Cold ○ Cystitis ○ Flu ○ HIV/AIDS ○ Skin infections ○ Herpes ○ Dry cough ○ SARS-CoV-2 (new Coronavirus)
Would you take antibiotics for toothache?	○ Yes ○ Only in specific cases (abscess) ○ Never ○ Don't know
Do you think that antibiotics are widely used in food farming in Italy?	○ Yes ○ No ○ Don't know
Have you heard of antibiotic resistance?	○ Yes ○ No ○ Don't know
What does antibiotic resistance mean?	○ It is when antibiotics are changed to make them more effective against resistant bacteria ○ It is when our bodies become resistant to an antibiotic used regularly ○ It is when bacteria become resistant to the action of an antibiotic ○ Don't know
Is there a risk of being affected by antibiotic resistance if you take antibiotics according to your doctor's directions?	○ Yes ○ No ○ Don't know
Does antibiotic resistance only affect people who take antibiotics?	○ Yes ○ No ○ Don't know

Figure 1. QUESTIONNAIRE

Subjects enrolment

The subjects were enrolled in the study according to the following criteria:

- During the first and third week of each month, the pharmacists asked the first customer at the morning opening time, and the first at 4.00pm to participate in the study.
- During the second and fourth week of each month, the pharmacists asked the first customer at 11.00 am, and the first at 6.30 pm to participate in the study.
- All the subjects enrolled had to be over 18 years old.

These inclusion and exclusion criteria were chosen to interview subjects with different sociodemographic characteristics: retirees and non-working people are more likely to enter a pharmacy at the morning opening time, while workers enter a pharmacy more often after 6.00 pm.

Sample Size

Given the exploratory nature of the study, all the subjects who respected the inclusion criteria were recruited, who frequented the pharmacies in the Turin area considered in the study during the period 16 November 2020 to 16 January 2021, in 46 pharmacies recruited on a voluntary basis, within the province of Turin. Based on the study design (survey) assuming a reference population of 1,000 people with an expected rate of unawareness of AMR equal to 12%, the estimated sample size is approximately 1,800 subjects. For this reason, the number of cases included in the study, equal to 1,883, is largely sufficient.

Statistical analysis

The classic descriptive statistics indicators are used to present the main information collected in the study. Knowledge of AMR was identified using two questions: "Have you ever heard of it of antimicrobial resistance?" and "What does antibiotic resistance mean?" considering the answers "I don't know" or "no" as negative.

The analyzes were conducted to highlight any factors that could be more linked to correct knowledge of AMR, taking into consideration some factors that could influence the association such as education or employment status. For this purpose, logistic regression models have been estimated, and the results are presented in terms of crude and adjusted Odds Ratios (OR) for work/studying in the healthcare sector accompanied by the relevant 95% Confidence Intervals (CI). Comparisons between secondary variables were performed using Chi-square or Fisher's test. All statistical analyses were carried out with SAS® Statistical Software v.9.4.

RESULTS

The collected data are reported in Table 1. From a global analysis of the data, very little knowledge of the AMR phenomenon can be noticed: less than half of the interviewed subjects have heard of it and even fewer know its meaning and are able to correctly identify the pathologies for which a treatment with antibiotics is necessary. Many doubts also arise in relation to the population's ability to correctly manage antibiotic therapies, even in relation to the care of their pets. The details of the obtained results are reported below.

Table 1. Results

Variable	Options	n (%)
Zone: rural/urban	Rural	415 (22.24%)
	Urban	1451 (77.76%)
Zone: Turin/province	Turin	727 (38.96%)
	Province	1139 (61.04%)
Gender	Female	1079 (57.30%)
	Male	794 (42.17%)
	Not answered	10 (0.53%)
Occupation	Health care worker	164 (8.71%)
	Not health care worker	664 (35.26%)
	Retired	512 (27.19%)
	Health care student	37 (1.96%)
	Not health care student	100 (5.31%)
	Other	406 (21.56%)
Family members	1	281 (14.92%)
	2	572 (30.38%)
	3	453 (24.06%)
	4	355 (18.85%)
	5	95 (5.05%)
	6	26 (1.38%)
	7	6 (0.32%)
	8	5 (0.27%)
	9	1 (0.05%)
	Not answered	89 (4,73%)

Ever heard about AMR	Yes	923 (49.02%)
	No	650 (34.52%)
	I don't know	310 (16.46%)
What is "antibiotic resistance"	It consists of changing antibiotics to ensure greater efficacy against resistant bacteria	76 (4.04%)
	It consists in the phenomenon whereby our body becomes resistant to a habitually used antibiotic	377 (20.02%)
	It consists in the ability of a bacterium to resist the action of an antibiotic drug often acquired as a result of incorrect and excessive use	689 (36.59%)
	I don't know	738 (39.19%)
Know when use antibiotics	Not answered	3 (0,16%)
	Among those listed, all the correct pathologies to be treated with antibiotics have been indicated	449 (23.84%)
	At least 1 error	1434 (76.16%)
Antibiotics should use for toothache	Yes	374 (19.86%)
	In particular cases	1137 (60.38%)
	Never	116 (6.16%)
	I don't know	256 (13.60%)
Know that they could incurring in the AMR phenomenon	Yes	254 (13.49%)
	No	826 (43.87%)
	I don't know	801 (42.54%)
	Not answered	2 (0,11%)
Only people that use many antibiotics could incur in AMR	Yes	300 (15.93%)
	No	601 (31.92%)
	I don't know	981 (52.10%)
	Not answered	1 (0,05%)
Last antibiotics taken	<1 month	245 (13.01%)
	1-6 months	307 (16.30%)
	6-12 months	308 (16.36%)
	>12 months	789 (41.90%)
	I don't know	233 (12.37%)
	Not answered	1 (0,05%)
Stop to take antibiotics when…	I feel better	164 (8.71%)
	I follow prescription	1321 (70.15%)
	sometimes the first option, sometimes the second	293 (15.56%)
	I don't know	105 (5.58%)
Keeping packages of antibiotics at home (including unfinished packages)	Yes	1043 (55.39%)
	No	839 (44.56%)
	Not answered	1 (0,05%)
Recommending antibiotics to friends	Yes	1123 (59.67%)
	No	759 (40.33%)
	Not answered	1 (0,05%)
Antibiotics recommended by friends	Yes	998 (53.03%)
	No	884 (46.97%)
	Not answered	1 (0,05%)
Take antibiotics without prescription	Yes	467 (24.80%)
	No	1175 (62.40%)
	No but I could do it	156 (8.28%)
	I don't know	85 (4.51%)

Someone says to me how to take the antibiotics	Yes, the doctor	1035 (54.97%)
	Yes, the pharmacist	180 (9.56%)
	Yes, both	533 (28.31%)
	No	42 (2.23%)
	Not always	91 (4.83%)
	Not answered	2 (0,11%)
A lot of antibiotics are used in food farming	Yes	898 (47.67%)
	No	241 (12.80%)
	I don't know	738 (39.19%)
	Not answered	6 (0,32%)
Have pets	Yes	896 (47.58%)
	No	985 (52.31%)
	Not answered	2 (0,11%)
Buy vets antibiotics without prescription yes *vs* not*	Yes	135 (15,03%)
	No	740 (82,41%)
	Not answered	23 (2,56%)

* 985 subjects answered that they did not have a pet and therefore they did not answer this question.

A total of 1,883 subjects were interviewed, most of them in an urban area (77.76%) and in the province of Turin (61.04%). Females made up the majority (57.30%). Most of the interviewed subjects (35.26%) do not work in the healthcare sector and their family members are more frequently 2 (30.38%) or 3 (24.06%).

Regarding the knowledge of the phenomenon of AMR, less than half the interviewees (49.02%) had heard of AMR, and only 36.59% were able to provide the correct definition of this term. The percentage of subjects able to choose correctly the pathologies treated with antibiotics among those proposed in the questionnaire was even lower at 23.84%. In contrast, the percentage of respondents who correctly answered the question regarding the use of antibiotics for the treatment of toothache was higher at 60.38%. Approximately 44% of the interviewees (43.87%) believed that they were at no risk of encountering this phenomenon provided that they adhered to the recommended prescribed dosage, or had no opinion on the subject (42.54% "I don't know). Moreover the 15.93% of respondents believed that the phenomenon only affected people taking antibiotics, or had no opinion on the subject (52.10% "I don't know").

About 42% (41.90%) said they took their last antibiotic more than 12 months ago. Most interviewees (70.15%) declared that they use antibiotics for the entire course prescribed by their doctor, even though 24.27% declared that, on at least one occasion, they had terminated the treatment when they felt better. More than half of the interviewees keep unused antibiotics (55.39%), recommended antibiotics to friends or family (59.67%), or are recommended antibiotics by friends or family members (46.97%). 53% of those who keep unused antibiotics at home then do not use them; those who do not keep unused antibiotics are more likely to use them correctly (73% "do not use them", $p < 0.001$). In addition, 33.08% of interviewees stated that they had used or would use antibiotics without a prescription.

To the question "Does your doctor/pharmacist give you instructions/directions on antibiotics when you are prescribed them?" the majority of respondents who selected "yes" stated that they had received instructions for taking antibiotics from a health professional: 54.97% from a medical doctor, but only 9.56% from a pharmacist.

Nearly half of the interviewees (47.67%) own a pet, and 15.03% have purchased veterinary medicine without a prescription. Furthermore, 51.99% do not know, or do not believe, that antibiotics are used widely in agriculture, or livestock farming in Italy.

Heard and aware of AMR

To better understand the knowledge of the AMR phenomenon and the awareness of the consequences of this problem among the population, specific questions were included in the questionnaire: Have you ever heard of AMR?" and "What does antibiotic resistance mean?". Table 2 relates the fact of having heard about AMR ("heard of AMR") or knowing its real meaning ("aware of AMR") with the sociodemographic variables.

In reply to the question "Have you ever heard of AMR?", the groups with the highest probability of being familiar with the issue were women, young people, and workers. Moreover, have in particular heard about AMR those studying or employed in the healthcare sector. In addition groups with a lower probability of having heard of AMR were those respondents who stated that they keep unused antibiotics, those who do not adhere to the prescription, and those who take antibiotics without a prescription. Finally, the group of respondents who correctly identified the pathologies treated with antibiotics among those proposed in the questionnaire had a higher probability of having heard of AMR.

Awareness of AMR was explored through the question "What does antibiotic resistance mean?". Even in this case, respondents with a background in healthcare (health workers or students in health faculties) showed a greater awareness of the issue of AMR. Significant differences were also recorded based on occupation: students were better informed compared with employees, who are, in turn, better informed with respect to retired people. Females were more likely to have heard about AMR, but when asked what this actually means, females and males responded without any significant statistical differences. Moreover, the analysis revealed lower awareness of AMR among respondents who keep unused antibiotics, those who do not adhere to the prescribed course of antibiotics as well as those who take antibiotics without a prescription. In addition, urban dwellers are slightly more confident in their awareness of what AMR is (OR=1.45, 95% CI 1.15-1.84). Finally, respondents who correctly identified the pathologies treated with antibiotics among those proposed in the questionnaire, were more aware of the risks of AMR, and the abuse of antibiotics in agriculture, and were better informed of the issue of AMR. Whether the interviewees have heard of AMR or know its meaning, no statistically significant differences were evident between Turin and the province of Turin, or on the basis of the number of family members.

Consultation with a healthcare professional

The results related to having received instructions/directions on antibiotics from healthcare professional are reported in table 3. No difference in knowledge of AMR was found between those respondents who were informed by a medical doctor and/or a pharmacist, and those who were not (OR=1.35, 95% CI 0.92-1.97). The same result is found if we consider being informed by a pharmacist alone, a medical doctor alone, or both. It is important to note that those who were informed by a medical doctor (or medical doctor and pharmacist) tend to adhere to the prescribed course more faithfully, and not to take drugs without a prescription. However, being informed by a pharmacist alone is not a sufficient

Table 2. Heard and of AMR aware

Variable	OR	95%CI		**OR** adjusted for occupation: working or studying in healthcare vs not	95%CI	
Heard of AMR						
female vs male*	1.232	1.026	1.481	1.153	0.955	1.393
age*	0.978	0.973	0.984	0.984	0.978	0.99
health care occupation *vs* not health care occupation*	6.25	4.251	9.188			
alone *vs* family with more than one component	0.807	0.626	1.042	0.849	0.654	1.103
family with two *vs* more components	0.898	0.732	1.101			
do not takes antibiotics without medical prescription *vs* take them*	1.267	1.051	1.527	1.244	1.026	1.508
follow *vs* do not follow the medical prescription*	2.31	1.883	2.835	2.055	1.667	2.532
keep *vs* not keep packages of antibiotics at home *	1.303	1.086	1.564	1.248	1.035	1.506
followed *vs* not followed by medical doctors/pharmacists	1.219	0.857	1.734	1.196	0.807	1.773
recommend antibiotics to friends yes *vs* not	0.97	0.807	1.166	0.992	0.821	1.2
friends recommend antibiotics yes *vs* not	1.024	0.855	1.227	0.989	0.821	1.191
know exactly the pathologies for which antibiotics are indicated among those listed*	1.826	1.472	2.266	1.647	1.317	2.058
aware of AMR (knowing its real meaning of AMR)*	8.598	6.884	10.737	7.56	6.032	9.475
knowledge of the risk to incur in AMR*	2.216	1.68	2.923	2.004	1.506	2.667
only people that use many antibiotics could incur in AMR: yes *vs* not*	2.258	1.744	2.922	2.302	1.768	2.996
a lot of antibiotics are used in food farming: yes *vs* not*	2.524	2.096	3.039	2.416	1.997	2.924
have pet yes *vs* not*	1.454	1.212	1.744	1.39	1.153	1.676
buy vets antibiotics without prescription yes *vs* not*	0.598	0.413	0.866	0.608	0.415	0.89
Aware of AMR						
female *vs* male	1.045	0.864	1.264	0.96	0.788	1.169
age*	0.98	0.974	0.986	0.987		0.992
health care occupation *vs* not health care occupation*	5.567	4.016	7.717			
alone *vs* family with more than one component	0.804	0.614	1.053	0.851	0.645	1.123
do not takes antibiotics without medical prescription *vs* take them*	1.359	1.117	1.654	1.339	1.093	1.641
follow *vs* do not follow the medical prescription*	2.676	2.131	3.36	2.36	1.87	2.978
keep *vs* not keep antibiotics at home*	1.208	1	1.46	1.146	0.942	1.394
followed *vs* not followed by medical doctors/pharmacists	1.351	0.924	1.974	1.307	0.884	1.933
recommend antibiotics to friends yes *vs* not	0.91	0.752	1.102	0.93	0.763	1.133
friends recommend antibiotics yes *vs* not	0.936	0.776	1.13	0.894	0.736	1.086
know exactly the pathologies for which antibiotics are indicated among those listed *	2.151	1.734	2.669	1.947	1.557	2.435
knowledge of the risk to incur in AMR*	2.284	1.749	2.984	2.058	1.559	2.718
only people that use many antibiotics could incur in AMR: yes *vs* not*	1.57	1.223	2.015	1.576	1.217	2.039
a lot of antibiotics are used in food farming: yes *vs* not*	1.881	1.555	2.274	1.761	1.447	2.142
have pet yes *vs* not*	1.237	1.025	1.492	1.163	0.958	1.413
buy vets antibiotics without prescription yes *vs* not*	0.48	0.318	0.725	0.474	0.307	0.732

* variables with statistically significant values are indicated with an asterisk

Table 3. Consultation with a healthcare professional (medical doctor or pharmacist)

Variable	Options	OR	95%CI	
	Received instructions/directions on antibiotics from			
Aware of AMR	medical doctor vs pharmacist	1.195	0.854	1.672
	medical doctor vs medical doctor and pharmacist	0.91	0.734	1.129
	medical doctor vs not followed	1.336	0.906	1.969
	pharmacist vs medical doctor and pharmacist	0.762	0.533	1.088
	pharmacist vs not followed	1.118	0.691	1.809
	medical doctor and pharmacist vs not followed	1.467	0.978	2.202
Keep antibiotics at home	medical doctor vs pharmacist	0.859	0.623	1.184
	medical doctor vs medical doctor and pharmacist	0.978	0.792	1.207
	medical doctor vs not followed	1.177	0.822	1.685
	pharmacist vs medical doctor and pharmacist	1.138	0.808	1.603
	pharmacist vs not followed	1.37	0.874	2.148
	medical doctor and pharmacist vs not followed	1.204	0.825	1.757
Know exactly the pathologies for which antibiotics are indicated among those listed	medical doctor vs pharmacist	1.051	0.719	1.537
	medical doctor vs medical doctor and pharmacist	0.835	0.656	1.062
	medical doctor vs not followed	1.097	0.71	1.696
	pharmacist vs medical doctor and pharmacist	0.794	0.532	1.186
	pharmacist vs not followed	1.044	0.608	1.793
	medical doctor and pharmacist vs not followed	1.315	0.835	2.069
Knowledge of the risk to incur in AMR	medical doctor vs pharmacist	1.059	0.654	1.714
	medical doctor vs medical doctor and pharmacist	0.873	0.645	1.182
	medical doctor vs not followed	0.757	0.463	1.238
	pharmacist vs medical doctor and pharmacist	0.825	0.497	1.369
	pharmacist vs not followed	0.715	0.378	1.354
	medical doctor and pharmacist vs not followed	0.867	0.517	1.454
Follow the medical prescription	medical doctor vs pharmacist	2.834	2.044	3.93
	medical doctor vs medical doctor and pharmacist	1.459	1.155	1.844
	medical doctor vs not followed	4.267	2.949	6.174
	pharmacist vs medical doctor and pharmacist	0.515	0.364	0.728
	pharmacist vs not followed	1.505	0.961	2.358
	medical doctor and pharmacist vs not followed	2.924	1.986	4.305
Does not take antibiotics without prescription	medical doctor vs pharmacist	2.626	1.904	3.621
	medical doctor vs medical doctor and pharmacist	1.576	1.267	1.961
	medical doctor vs not followed	4.697	3.207	6.881
	pharmacist vs medical doctor and pharmacist	0.6	0.427	0.843
	pharmacist vs not followed	1.789	1.127	2.84
	medical doctor and pharmacist vs not followed	2.981	2.003	4.435

incentive to adhere to the prescription (OR=1.51, 95% CI 0.96-2.36), while it is for not taking antibiotics without a prescription (OR=1.79, 95% CI 1.13-2.84). Another important fact is that non-urban respondents stated more frequently that they were being informed by both a medical doctor and a pharmacist (1,767, 1.191-2.621) with respect to urban residents.

DISCUSSION

Antibiotic resistance is a global phenomenon that represents a health emergency. This threat has prompted governments all over the world to curb the use of antibiotics and to review the treatment protocols. Among the possible measures to promote the safe and appropriate use of antibiotics, it is certainly correct to include educational initiatives catering for the general public[30].

Our investigation evidenced the fact that there was a significant lack of awareness of AMR among the study population: only 36.6% of respondents were able to identify the correct definition of this term and had little or no knowledge of the consequences of this condition: the 15.9% believed that

only people that use many antibiotics could incur in AMR. The results also suggest that a health education programme might be helpful in achieving significant results: in the sample of interviewees, those who demonstrated a knowledge of the phenomenon of antibiotic resistance also demonstrated the best behaviour, i.e., the same group of respondents also stated that they did not keep unused antibiotics at home and adhere most closely to the course prescribed by their doctor. Consequently, proper health education - both in relation to the establishment of the AMR phenomenon, and regarding the appropriate methods of taking the prescribed antibiotic therapy- could have a positive impact on the informed and safe use of antibiotics.

Factors such as local accessibility, extended opening hours, and their close relationships with their users, make the community pharmacy and the community pharmacist a potentially useful source for health education among of local area residents[16]. This consideration takes on even greater significance in light of the fact that highest consumption of human antibiotics takes place in communities (90% of the DDD), while the hospital sector accounts for the remainder. Therefore, since the pharmacy is the only place at the community level where antibiotics can be supplied with a medical prescription, it would be important that community pharmacists to ensure that the correct information is transferred to the population. However, our study data indicates that, at the time of the survey, community pharmacists infrequently serve as an information point on the use of antibiotics. In fact, only a small percentage of the interviewees (9,6%) declared receiving information from the pharmacist regarding the correct use of antibiotics.

Based on this consideration, the national Project "Antimicrobial resistance: it is time for action", coordinated by the University of Turin and promoted by the National Association of Young Pharmacists (Fe.N.A.Gi.Far,) the Federation of Pharmacists' Orders (FOFI) and the National Association of Pharmacy Owners (Federfarma), has been recently carried out in Italy. This project, which took place in 2024, involved the standardised training of Italian community pharmacists and then their coordinated action on their customers in order to investigate and improve awareness of AMR.

CONCLUSION

In the AMR context, a rapid significant intervention to reduce the incidence of the phenomenon would be important. Based on our results on AMR awareness in the north-west of Italy, and given that community pharmacies are among the most easily accessible health services assisting for the public, not only for dispensing medicines but also for general health advice, we consider that it could have a significant impact if community pharmacies were more actively involved in the campaign against antibiotic resistance. An active role of the pharmacist should be strengthened, also taking into consideration that the possibility of carrying out information campaigns at the community pharmacy level is provided for by the legislation in force in Italy[31]. The community pharmacies could represent a useful resource on a national level for assessing and spreading AMR knowledge and correct behaviours among the general population and potentially take an active role in disseminating information campaigns. This is especially important for elderly populations who are the least informed and are the main users of community pharmacies. Naturally, in order to maximise the benefits of the actions undertaken by community pharmacies in the fight against AMR, it would be appropriate to coordinate their activities at national level. This would ensure that the correct information reaches the customers in a standardised manner.

Limitations of the study

The performed study involved customers from a restricted area of northern Italy and made it possible to investigate the population belonging to community pharmacies rather than the general population.

AUTHOR CONTRIBUTIONS

Francesca Baratta: conceptualization, investigation, data curation, writing – original draft preparation

Ilaria Stura: investigation, data curation

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Giuseppe Migliaretti conceptualization, data curation, writing – review & editing

Paola Brusa conceptualization, funding acquisition, writing – review & editing

ACKNOWLEDGEMENT

The authors would like to thank the "A.Gi.Far. Torino - Associazione Giovani Farmacisti di Torino (Turin Young Pharmacists Association)" for its contribution in the extension of the project and for the invaluable work of all its associated pharmacists who participated in carrying out the survey. The authors also wish to thank Dr. Tom O Byrne for the linguistic revision of the text.

CONFLICTS OF INTEREST

The authors report no conflicts of interest in this work

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