Original Research

Preferences based interventions to address the use of antibiotics without prescription: A discrete choice experiment

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Abstract

Background: In many countries, concerns have arisen over the population using antibiotics without consulting a physician. This practice can place patients at risk and increase antibiotic resistance in the community.

Objective: To evaluate individuals' preferences regarding the use of antibiotics. The study also assessed the likely effectiveness of interventions aimed at reducing inappropriate use of antibiotics.

Methods: A discrete choice experiment (DCE) was conducted in Bogotá, Colombia. The attributes were determined by a systematic literature review and four focus group sessions. The DCE included nine factors – cost, time to get attention, level of symptoms, efficacy, safety, among others- and one label -using or not antibiotics. Data analysis was carried out using a generalized multinomial logit (GMNL) model. Marginal probabilities of different sets of attributes' levels were compared to estimate the likely effectiveness of interventions.

Results: The survey was administered to 222 participants from diverse socioeconomic backgrounds. The results suggest that participants preferred not taking antibiotics and having a physician as an advisor, but the probability of inappropriate antibiotic use increased as the waiting time or the cost of receiving advice rose. The pharmacy was the preferred source of antibiotics, and participants chose the pharmacy worker (nonprofessional) as an advisor over the nurse on the phone. In the absence of any interventions aimed at reducing the use of antibiotics, approximately 47.3% of people would misuse antibiotics. This reduces to 26.5% when people perceive the efficacy of the antibiotics as low and the potential risks of self-medicating as high. An alternative model using a nursing service would likely lower inappropriate use of antibiotics.

Conclusions: Even though people prefer not using antibiotics or visiting a physician in case of disease rather than self-medicating, current access conditions might discourage them from appropriately use antibiotics. The results suggest that interventions that informing people about the risks of self-medication and the low efficacy might significantly reduce inappropriate use of antibiotics. Our results also suggest that programs that empower other health professionals to provide access to antibiotics would likely further lower inappropriate use.

Keywords

Anti-Bacterial Agents; Self Medication; Drug Utilization; Pharmacies; Patient Preference; Patient Acceptance of Health Care; Attitude to Health; Health Knowledge, Attitudes, Practice; Waiting Lists; Socioeconomic Factors; Focus Groups; Surveys and Questionnaires; Colombia

INTRODUCTION

The use of antibiotics without a prescription can place patients at risk of serious illness due to misdiagnosing their conditions, drug side effects, and delays in receiving the correct treatments.[1] Improper use of antibiotics also creates a risk of antibiotic resistance that can hamper the control of infectious diseases and increase the cost of healthcare.[1,2]

Antibiotic misuse can be understood as the use of antibiotics without the proper diagnosis and prescription of a physician or a trained health professional, regardless this drug was obtained in an authorized pharmacy or ended up resulting effective and free of adverse events. The extent of this practice varies worldwide. In Europe, 4% of people obtained their last course of antibiotics without a prescription, but rates range from 3% in Northern Europe to nearly 30% in Eastern Europe.[3,4] In contrast, studies have reported much higher rates of antibiotic self-medication in lower-income and developing countries, including Argentina (53%), India (54%), and Colombia (56%).[5-7] So while antibiotic misuse is a global problem, it is particularly acute in lower-income and developing countries.[8]

Previous studies have identified some factors that contribute to self-medication with antibiotics. One of the main drivers is the availability of drugs without a prescription.[3] Despite the legal framework stating that pharmacies should not dispense antibiotics over-the-counter, many South American pharmacies sell antibiotics without a prescription.[9] The temptation of using antibiotics without prescription is exacerbated by the problems accessing affordable healthcare, waiting times for medical treatment, and lack of awareness of antibiotic resistance.[3,8,10] Even high-income countries like the United States face challenges from immigrants who do not trust physicians and prefer to self-medicate.[11]

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Health authorities worldwide have proposed different interventions to combat antibiotics misuse, including regulations that strictly avoid antibiotic sales without prescription.[9,12] While increased regulations can effectively reduce inappropriate antibiotic consumption, implementation barriers and problems with enforcing the norms undermined their effectiveness.[13,14] On the other hand, educational interventions have mixed evidence of effectiveness to modify this behavior.[15] However, previous studies have found that allowing other trained health professionals (e.g., nurse practitioners) to prescribe antibiotics can reduce inappropriate antibiotic consumption.[16] While these interventions have been useful, antibiotic use rates without a prescription remain high in low-income countries.

Since 1993, new regulations in Colombia caused that healthcare coverage may be differential by payment capacity. Depending on the working status and socioeconomic conditions of a person or a family, health service extent and quality may differ.[17,18] Commonly, the low-income population also has poorer access to quality health services. This has undermined the general population's trust in health services.[19] In addition, and given the current pharmacists' shortage, authorities have permitted that non-professional personnel manages the communitarian pharmacies. This has caused that Colombians get easy access to different kinds of drugs, including antibiotics, by purchasing them without prescription. Even though this is forbidden according to local regulations, some pharmacy workers find a way to sell drugs without a prescription.[20]

Because regulatory measures to reduce antibiotics misuse have had only limited success in many countries (9), there is a need to find new approaches that address the underlying reasons why people choose to use antibiotics without a prescription. Developing new strategies requires understanding the tradeoffs that people are making when they decide to self-medicate using antibiotics. Individuals who perceive a need for antibiotics choose to go to a physician to obtain a prescription or self-medicating. Some factors influence this choice, including the relative cost of getting the prescription, the amount of time required to obtain the medication, and the willingness to self-medicate, among others.[10] Understanding the factors that people consider necessary when making this choice and their importance can provide policymakers with information about the likely effectiveness of policy options.

Information on the factors that influence an individual's decisions and the likely effectiveness of policies aimed at reducing inappropriate use of antibiotics is difficult to obtain from observational studies due in part to underreporting of self-provided medicine use.[21] An alternative methodology for understanding the tradeoffs is a discrete choice experiment (DCE). DCEs involve identifying the factors that individuals report as important when making a healthcare decision and then presenting them with a series of choices between two or more alternatives. The options have a different mix of attributes' levels, such as cost or waiting times, and the individuals' choices can reveal the relative importance of each factor when making their decision.[22] The results can then be used to estimate the likely impact of various policy options (such as reducing the waiting times for obtaining medications or allowing other health professionals to prescribe medications). The goal of the study was to evaluate individuals' preferences regarding the use of antibiotics. The study also assessed the likely effectiveness of interventions aimed at reducing inappropriate use of antibiotics.

METHODS

Selection of factors

The factors were selected in a previous study reported elsewhere.[19] First, the study developed a literature review to identify papers on people's declared reasons to self-medicate with antibiotics. A semi-structured focus group guideline was then written to explore the factors likely to influence the decision to use antibiotics. Researchers interviewed twenty-one volunteers of different socioeconomic characteristics in four focus groups.[19] The guided discussion about the decision of self-medicating with antibiotics or avoiding this practice resulted in two categories of factors (Table 1):

Conditions required to get advice and antibiotics:

- Waiting time to get advice and antibiotics: The number of days between the symptoms onset and receiving advice about taking medications and obtaining the medications.

- Time required to get advice and antibiotics: the amount of time that people need to spend receiving the advice and the antibiotics, when needed.

- Total cost: This includes the transportation, co-pay on advice/appointment and/or the medications and lost wages.

- Source of antibiotics: Options include using leftover medication found at home, from a pharmacy or an unauthorized shop.

- Source of advice: Options include physician, nurse, website, relative, or a pharmacy worker (a nonprofessional employee of a pharmacy recognized by the community because of his honorability and experience)

Health impacts:

- Symptoms or level of pain/ discomfort: The severity of the conditions underlying the need to take antibiotics.

- Probability of improving health: The likely effectiveness of the option (either taking antibiotics or not) in improving the health of the individual.

- Risk of adverse outcomes from taking the antibiotics: Risk from either an adverse reaction to the medication or chance of developing antimicrobial resistance in the future.

- Risk of resistance to the community. Risk of the antimicrobial-resistant strains

The levels of the nine factors, shown in Table 1, emerged from the focus group sessions.

Table 1. Factors and levels assessed in the discrete choice experiment	
Labels	**Take antibiotics** **Do not take antibiotics**
Factors	**Levels**
Conditions required to get advice and antibiotics (if any):	
(1) How long do you have to wait until you get the advice and antibiotics (if any)?	Same day Tomorrow Four days One week Two weeks
(2) Time away from your daily activities to get the advice and antibiotics (if any)	5 minutes 1 hour 4 hours 10 hours
(3) Total cost to you to get the advice and antibiotics (if any)	0 COP 5,000 COP ($1.7 USD) 15,000 COP ($5 USD) 50,000 COP ($17 USD) 150,000 COP ($50 USD) 250,000 COP ($85 USD)
(4) Where do the antibiotics come from?	Leftover pills that were previously prescribed to you Leftover pills that were previously prescribed to parents/ siblings Leftover pills that were previously prescribed to a friend Buy the antibiotics at a non-authorized store Buy the antibiotics online Buy the antibiotics at a pharmacy
(5) Who offered the advice?	You Family member or friend Doctor Nurse in person Nurse on the phone. Website Non-professional pharmacy worker
Health impacts:	
(6) Your current symptoms or level of pain/ discomfort	Only mild symptoms and no pain, no impact on your daily activities Some symptoms and mild pain, but does not impact your daily activities Clear symptoms and moderate pain, some daily activities can be affected Severe symptoms and pain, can't do normal activities
(7) Chance of getting better	Low chance (10%) Medium chance (50%) High chance (90%)
(8) Risk of serious effects to your health because of adverse event or resistance	No risk (0%) Low risk (10%) Medium risk (50%) High risk (90%)
(9) Risk of resistance to community	No risk (0%) Low risk (10%) Medium risk (50%) High risk (90%)
COP: Colombian Pesos; USD: United States Dollars.	

Instrument design

Sawtooth Software Version 8.2.4® (Sawtooth Software, Inc.) generated the choice sets, by using the Balanced Overlap method. In total, 160 random choice tasks were generated, each one consisting of three options, two labeled with 'using antibiotics' and one with 'not using antibiotics'. All levels were included proportionally, but the attribute 'Source of antibiotics' was constrained to zero when the label was "not taking antibiotics" to seek consistency of choice sets. This affected orthogonality. No other constrain was deemed necessary to avoid impossible choice sets. The 160 choice sets were allocated in 10 survey versions with 16 tasks each.

The survey began with questions exploring participants' knowledge about antibiotics use risks. Participants then received a written explanation about antibiotics - indications, use in infections, and differences with other kinds of drugs; a sample task for practice, and a description of each attribute. They were asked to imagine that they felt sick, may suspect that this was an infection, possibly they would need and antibiotics. Then they had to choose between three options: two suggested taking antibiotics and a third one that suggested not taking antibiotics. Table 2 presents a task example. All options were possible, even though some combinations were not probable. In the task example, option 1 represents the case of a physician giving

Table 2. Choice set example			
Feature	**Take antibiotics**	**Take antibiotics**	**Do not take antibiotics**
Your current symptoms or level of pain/ discomfort	Some symptoms and mild pain, your daily activities are not affected	Clear symptoms and pain. Some of your daily activities can be affected	Severe symptoms and pain. You cannot do your normal activities
Who offered the advice?	Doctor	Nurse at phone	Yourself, based on your experiences.
How long do you have to wait until you get the advice?	Today	Two weeks from today	Tomorrow
Time away from your daily activities to get the advice	1 hour	4 hours	5 minutes
Total cost to you to get the advice	COP250,000	COP50,000	COP15,000
Where do the antibiotics come from?	Relative's leftovers	Your leftovers	-
Chance of getting better	High probability (90%)	Medium probability (50%)	Low probability (10%)
Risk of resistance or serious adverse effects to you after taking the antibiotics	Low risk (10%)	High risk (90%)	No risk (0%)
Risk of resistance to community	Low risk (10%)	No risk (0%)	No risk (0%)
	Choose option 1	Choose option 2	Choose option 3
	☐	☐	☐

a piece of advice that cost COP 250,000 (USD 83), but the antibiotics that the person would take belonged to a relative. In option 3, getting the person's advice of not taking antibiotics costs COP 15,000 (USD 5). Even though this is unlikely, it could be possible. For example, the individual may need to pay some money to access a personal health record, which confirmed that the health condition did not need antibiotics to be solved. A survey copy can be provided upon request to the authors.

Each participant was presented with randomized 16 choice sets. The questionnaire concluded with demographic information and questions about the cost and time spent to get antibiotics in a pharmacy and when approaching the health system.

The survey was pilot tested with seven participants to assess the clarity and cognitive burden. The survey was "paper and pencil" administered in person by a member of the research team. Two different people typed data, and the differences were solved by comparing it with the original document.

Sampling strategy

The sample size was calculated to minimize measurement error and ensure that each level would be available for choice at least 1000 times, as recommended in the literature.[23] This resulted in a minimum of 220 participants, which means that each survey version would be answered 22 times. Sampling included a variety of people of different socioeconomic groups, even though the representativeness of the local population was not expected. Recruitment took place in Bogotá, Colombia, and included street markets, public schools, public and private universities, small and large companies, and governmental institutions, to ensure different socio-economic characteristics. In each location, members of the research team approached people and invited them to participate. They informed the objective of the research and explained that participation was voluntary. Inclusion criteria were 18 years or older and literate.

Surveys took about one hour, and participants received a COP 20.000 (USD 7) thank-you gift card at the end of the study. Universidad Nacional de Colombia Ethics Committee approved this research. Subjects signed a written consent form before starting the survey.

Statistical analysis

The strength of preferences was analyzed with a conditional logit model and a generalized multinomial logit (GMNL) model. The software STATA 14 (StataCorp LP, College Station, TX, USA) was used. The statistical significance level was p<0.05. The two models were tested through Walt's test and the likelihood ratios test.

Willingness-To-Pay (WTP) provides a means of comparing attributes in terms of cost. In other words, this analysis uncovers the participants' trade-offs. Since WTP estimates provide information on each factor's relative importance compared to the cost, these can be compared across variables. WTP and the standard errors were calculated using the following equations.[24]

$$WTP = -\frac{\beta_x}{\beta_{cost}}$$

$$SE[WTPx] = -\frac{\sqrt{Var[\beta_x] + WTPx^2 \times Var[\beta_{cost}] - 2WTPx * Cov[\beta_{cost}, \beta_x]}}{\beta_{cost}}$$

Where β_{cost} and β_x are the coefficients of cost and the corresponding level, $Var[\beta_{cost}]$ is the variance of the coefficient cost, $Var[\beta_x]$ is the variance of the level coefficient and $Cov[\beta_{cost}, \beta_x]$ is the covariance between the two estimates.

Finally, the likely impact of potential interventions was assessed using the marginal probabilities of choosing between appropriate use (this is using antibiotics with medical prescription) and misuse of antibiotics when introducing the intervention. . These probabilities were calculated as follows:

First, three options that people may choose for using antibiotics in case of disease were defined. Two common options of misusing antibiotics -taking own leftovers and getting antibiotics without prescription in a pharmacy- were compared against the appropriate way of getting

antibiotics -visiting a physician to get a diagnosis and prescription.

Secondly, the attribute values of the three options were chosen to reflect the situation the individual would encounter, including:

- Option 1 – Taking own leftovers – Assumes zero cost and wait time but some risk of antibiotic resistance.

- Option 2 – Getting antibiotics without prescription in a pharmacy – Assumes some additional cost and wait time and risk of antibiotic resistance. The estimated cost and time spent to visit a pharmacy were based on participants' self-report.

- Option 3 – Visiting a physician to get diagnosis and prescription– Assumes a longer wait and higher cost, but higher efficacy and lower chance of antibiotic resistance. The estimated cost and time spent to visit a physician were based on participants' self-report.

Third, the calculation of marginal probabilities of choosing among these options follows, by using the following equation.

$$P_i = \frac{e^{Yi}}{\sum_{i=1}^{n} e^{Yi}}$$

$$Yi = \beta_j x_{ji} \quad j = 1, \ldots, J ; i = 1, \ldots, I$$

And x_{ji} is the vector of attribute values of options i, and β_j is the vector of coefficients of J attributes in the GMNL model.

Next, four potential and hypothetical interventions were selected:

1. To guarantee same-day access to a physician

2. To guarantee no cost to access a physician

3. An effective educational intervention that manages to change the optimism about antibiotic misuse, so that;

- The perceived efficacy of the medications is lowered to 50%

- The perception of a higher risk to them is raised to 50%

- The risk to the community because of resistant strains is raised to 10%.

4. To give an additional option for appropriately use antibiotics, by visiting a trained nurse at a lower cost and waiting time than going to a physician but with similar efficacy and risk of antibiotic resistance. The estimated cost and time spent to visit a nurse were assumed to be about 25% lower than the cost and wait for a medical physician. Table 3 presents the values of the attributes of this fourth option.

Finally, attribute values were altered to reflect the introduction of each hypothetical intervention, and the new marginal probabilities were calculated according to the last equation.

The 95% confidence intervals of marginal probabilities were calculated through Montecarlo simulation, considering the normal distribution of DCE model coefficients, taking 100000 samples, and a sampling rate per expected value/trial. The software TreeAge Pro 2019 was used for these calculations.

RESULTS

Two hundred twenty-two participants completed the survey. Two participants withdrew after signing the consent but before answering the questionnaire, citing time constraints. Three choice tasks were left blank among all questionnaires. The sample included diverse demographic and socioeconomic characteristics. Table 4 presents the participants' characteristics, and Colombia demographic information was included for comparison purposes. About 11% of participants do not know any risk related to using antibiotics, and 10.8% thought that there is no risk when using these drugs.

The results of the Conditional Logit and GMNL models (Table 5) suggest that participants seemed to understand the task as coefficients had the expected signs according to preferences already identified in the literature review and focus groups.

The results suggest that participants would prefer not to take antibiotics, all else being equal. Similarly, their interest in taking antibiotics decreased as the risk of adverse outcomes or community-acquired resistance increased. They preferred options with a higher chance of getting better, lower cost, and a lower number of days to receive attention. All advice sources were preferred over websites, and the only preferred sources of antibiotics over online purchases were the pharmacy and their leftovers. Participants liked the physician over a nurse in person and a nurse over a non-professional pharmacy worker. Finally, participants did not consider either the symptom levels or the spent time to get the recommendation.

Table 3. Marginal analysis options and scenarios	'Taking my own leftovers'	'Going to the pharmacy.'	'Visiting a doctor.'	'Visiting a nurse.'
	1	2	3	4
Who advice	Yourself	Non-professional pharmacy worker	Doctor	Nurse
Antibiotics source	Leftovers	Pharmacy	Pharmacy	Pharmacy
Days until getting the appointment	Same day	Same day	3	1
Hours spent to get the advice and antibiotics	Immediately=0	0.5	4	2
Cost (thousand COP)	0	20	40	30
Probability of improving health	Slightly below high=70%	Slight below high=70%	High=90%	High=90%
Risk of adverse outcome	Slightly above low=20%	Slightly above low=20%	Low=10%	Low=10%
Risk of resistance to community	No risk=0%	No risk = 0%	No risk=0%	No risk=0%

Table 4. Sample characteristics	Survey Data	Colombia Data*
Age in years; Mean (SD)	34.6 (11.0)	40.8
Gender; % (95% CI)		
Male	43.7 (37.2-50.7)	48.2
Educational level; % (95%CI)		%
Less than high school	3.6 (1.6-7.0)	39.9
High school	43.7 (37.1-50.5)	34.7
Technical education	25.2 (19.7-31.5)	9.8
Professional	13.1 (8.9-18.2)	12.3
Post-graduate	14.4 (10.1-19.7)	3.3
Monthly income; COP/USD		
Mean (Minimum-Maximum)	1,889,769/ 620 (0-21,000,000)/ (0-7,000)	908,526/ 301 (minimum monthly wage)
Health insurance system; % (95%CI)		
Contributory	79.7 (73.8-84.8)	49.9
Subsidized	17.6 (12.8-23.2)	45.3
None	2.7 (1.0-5.8)	4.8
Occupation	% (95% CI)	%
Employed	53.2 (46.4%-59.9)	45.8
Independent	15.8 (11.2-21.2)	
Unemployed	6.8 (3.8-10.9)	13.5
Student	16.7 (12.0-22.2)	18.1
Housewife	7.2 (4.2-11.4)	19.0
Retired	0.5 (0.0-2.5)	3.6
Which of the following problems do you acknowledge when using antibiotics? % (95%CI)		
Resistance to me	30.3 (24.2-36.7)	N/A
Resistance to others	28.4 (22.5-34.8)	N/A
Minor adverse effects	21.2 ((16.0-27.1)	N/A
Serious adverse effects	20.8 (15.6-26.7)	N/A
No efficacy	19.4 (14.4-25.2)	N/A
Do not know	11.3 (7.4-16.2)	N/A
No risk	10.8 (7.1-15.7)	N/A
Self-reported mean values (minimum-maximum) of costs and time		
Cost of visiting a doctor and getting antibiotics	38,257COP/ 12.75 USD (0-200,000)/ (0-67)	N/A
Cost of buying antibiotics in a pharmacy	21,258 COP/ 7USD (0-150,000) (0-50)	N/A
Days from the symptoms onset until seeing a doctor	3.3 (0-14)	N/A
Hours spent in the medical service	3.8 (0-24)	N/A
Hours spent in the pharmacy to get the antibiotics	0.5 (0-24)	N/A
N	222	N/A

SD: Standard deviation; CI: Confidence interval; COP: Colombian Pesos; USD: United States Dollars.
* This information corresponds to the national statistics reported for Colombian population older than 14 years in 2018. Source: Departamento Administrativo Nacional de Estadísticas – DANE (www.dane.gov.co).

Table 5 also reports the WTP estimates for each variable. The results suggest that participants valued getting a prescription from a physician (USD 168) rather than deciding based on their own experiences (USD 43). However, they placed a high value on being cured (USD 150 for 90% chance) and on timely care (USD -47 for a 14-day delay) in comparison to no chance of getting better and same-day attention, respectively. This suggests that they might use antibiotics without prescription if they are sure these would work and should the healthcare system be too difficult to access.

The likely impact of the hypothetical interventions were calculated by comparing the marginal probabilities of the options shown in Table 3. The results (Figure 1) from comparing the first three options under base conditions (Taking own leftovers, Getting antibiotics without prescription in a pharmacy, or Visiting a physician to get diagnosis and prescription) suggests that most participants would visit the physician (52.7%), but there is a high chance that the individual would misuse antibiotics, either buying

in a pharmacy without prescription (26.2%) or taking leftovers that they have at home (21.1%). The interventions 'same day access' to the physician and 'no cost to access' to the physician would slightly increase the likelihood of using a physician (from 52.7% to 54.0% and 54.8%, respectively), but the probability of misusing antibiotics use remains high (using leftovers and buying antibiotics without prescription add up to 45%).

When an educational intervention is introduced, the probability of going to a physician rise to 63%. Further decreases in the probability of antibiotics misuse could be obtained by having the trained nurse option (using leftovers and buying antibiotics without prescription only add up to 35.2%), and the probability could be reduced by almost a half relative to the base case scenario (using leftovers and buying antibiotics without prescription down from 47.3% to 26.5%) using a combination of educational intervention and the trained nurse-led option.

Table 5. Discrete choice analysis results		Main model		
	Decision	**Categorical**	**Linearized**	**WTP (SE)***
		Coefficient (SE)	Coefficient (SE)	US Dollars
Label (do take antibiotics =1)		**-0.48 (0.10)**	**-0.39 (0.08)**	**-65 (16.2)**
Symptoms or pain/ discomfort	Some symptoms and mild pain	0.08 (0.06)	0.07 (0.06)	12 (9.5)
(Omitted: Only mild symptoms and no pain)	Clear symptoms and moderate pain	-0.01 (0.06)	-0.02 (0.06)	-3 (9.4)
	Severe symptoms and pain	0.001 (0.06)	-0.01 (0.06)	-2 (9.4)
Who offered the advice?	You	**0.26 (0.08)**	**0.26 (0.08)**	**43 (14.2)**
(Omitted: Website)	Family member or friend	**0.29 (0.08)**	**0.28 (0.08)**	**47 (14.3)**
	Doctor	**1.00 (0.08)**	**1.01 (0.08)**	**168 (23.3)**
	Nurse in person	**0.53 (0.08)**	**0.52 (0.08)**	**87 (16.1)**
	Nurse on the phone	**0.24 (0.09)**	**0.24 (0.09)**	**40 (15.0)**
	Non-professional pharmacy worker	**0.39 (0.08)**	**0.37 (0.08)**	**62 (14.9)**
Where do the antibiotics come from?	Your leftovers	**0.25 (0.10)**	**0.21 (0.10)**	**35 (17.9)**
(Omitted; Online)	Relative's leftovers	0.14 (0.10)	0.12 (0.10)	20 (16.6)
	Friend's leftovers	0.09 (0.10)	0.09 (0.10)	15 (16.2)
	Non-authorized store	0.07 (0.10)	0.06 (0.10)	10 (16.3)
	Pharmacy	**0.38 (0.10)**	**0.36 (0.10)**	**60 (18.2)**
How long you have to wait until you get the advice and antibiotics (if any)	1 day	0.01 (0.06)	-	-
(Omitted: Same day)	4 days	-0.07 (0.06)	-	-
	7 days	**-0.14 (0.06)**	-	-
	14 days	**-0.22 (0.06)**	-	-
	Linear	-	**-0.02 (0.001)**	-47 (5.4)*
				(14 days)
Time away from your daily activities to get the advice and antibiotics (if any)	1 hour	-0.01 (0.05)	-	-
(Omitted: 5 minutes)	4 hours	-0.01 (0.06)	-	-
	10 hours	-0.09 (0.06)	-	-
	Linear	-	-0.0001 (0.00008)	-2 (0.01)*
				(2 hours)
The total cost to you to get the advice and antibiotics (if any)	5000 COP	0.11 (0.07)	-	-
(Omitted; 0 Colombian pesos)	15,000 COP	0.13 (0.07)	-	-
	50,000 COP	0.11 (0.07)	-	-
	150,000 COP	**-0.24 (0.07)**	-	-
	250,000 COP	**-0.44 (0.07)**	-	-
	Linear	-	**-0.002 (0.0002)**	1 (0)
Chance of getting better	**Medium (50%)**	**0.24 (0.05)**	-	-
(Omitted: Low chance 10%)	**High (90%)**	**0.43 (0.05)**	-	-
	Linear	-	**0.01 (0.0005)**	150 (17.4)*
				(90% chance)
Risk of serious adverse events, including resistance	**Low risk (10%)**	0.03 (0.07)	-	-
(Omitted: No risk)	**Medium (50%)**	**-0.15 (0.08)**	-	-
	High (90%)	**-0.42 (0.08)**	-	-
	Linear	-	**-0.005 (0.0008)**	-8 (1.0)*
				(10% chance)
Community resistance risk (%)	**Low risk (10%)**	-0.01 (0.08)	-	-
(Omitted: No risk)	**Medium (50%)**	-0.08 (0.08)	-	-
	High (90%)	**-0.40 (0.08)**	-	-
	Linear	-	**-0.004 (0.0007)**	-7 (0.8)*
				(10% chance)
/tau			-0.16 (0.26)	-
Number of observations		10,644	10,644	
Wald test probability (>CHI2)		0	0	
Degrees of freedom		35	21	
Log likelihood		-3495.21	-3502.44	

Notes: Bold p<0.05 SE: standard error; CHI2: Chi-square distribution
*Willingness to pay. Report WTP estimates for the linearized variables use the most common responses reported by the participants in the post-survey questionnaire: 14 days wait until receive advice; 2 hours required to obtain antibiotics, a 90% chance of getting better, and a 10% chance of risk of adverse events and resistance to you and the community.

DISCUSSION

The purpose of this study was to examine the relative importance of factors that people consider when determining whether to use antibiotics without prescription or not. The results suggest that people would prefer not to take antibiotics, avoid adverse outcomes and community-acquired resistance, receive a prescription from a physician, obtain their medications from a pharmacy, and not have to wait too long to get advice. The marginal analysis suggests that in the absence of any policies aimed
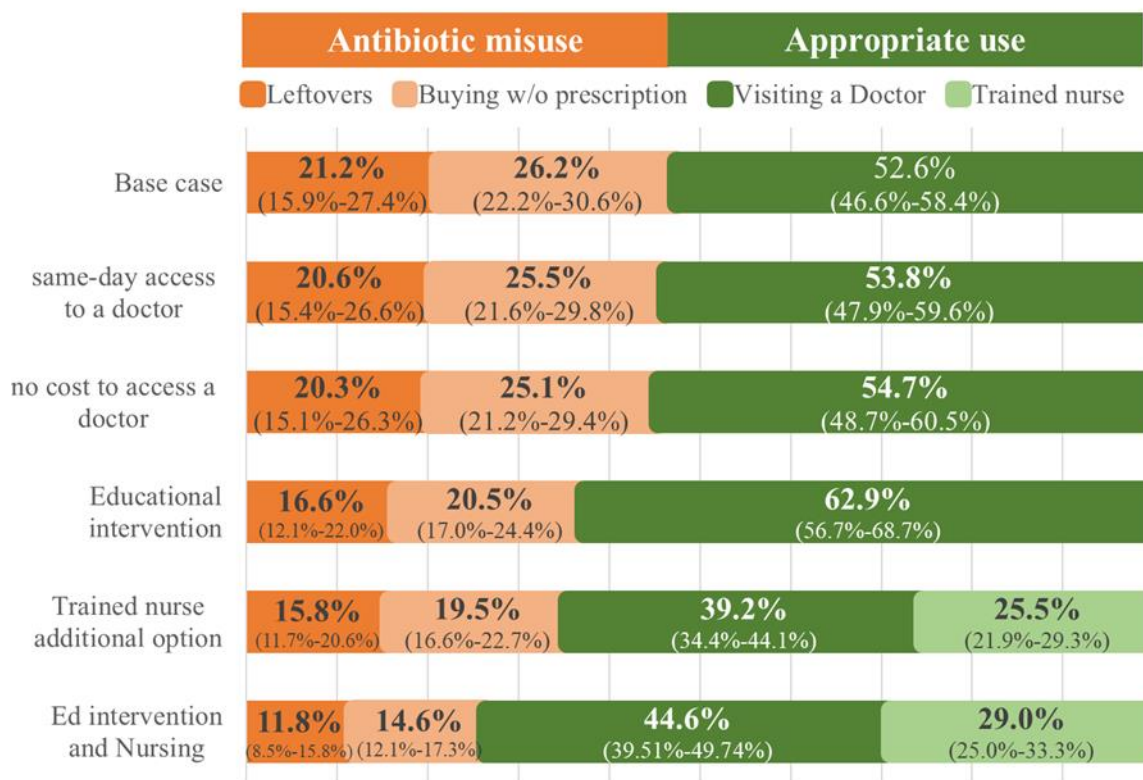
Figure 1. Marginal analysis probabilities

at reducing the use of antibiotics, approximately 47.3% of the people would self-medicate. This reduces to 26.5% when people are aware of low efficacy and potential risks of self-medicating, and an alternative nursing service is available.

Our study managed to include a very diverse sample, through a communitarian sampling strategy. In this way, youths, middle-aged, men, women, employees, independent workers, housewives, among other groups could take part in the survey. Even though the sample was not expected to be representative, its diversity supports the application of these results to the analysis of antibiotics misuse in Colombia. Also, attributes and levels are based on both population ideas and health system conditions. In consequence, interventions that consider the people´s preferences identified in this paper have a great chance of success.

This study assessed the rational process that people follow to decide whether misusing antibiotics or not. While analyzing different factors that influence this decision, the preference for each of them was rational, favoring options that imply the highest effectiveness and safety. Taking this into consideration, the decision of misusing antibiotics is not always irrational. Misusing antibiotics when skipping the medical prescription and using effective and secure leftovers or antibiotics bought in a pharmacy are rational decisions. However, these are not appropriate behaviors, since taking an effective course of antibiotics is very unlikely when patients do not receive a complete assessment of their health condition to accurately diagnose and treat the disease. In addition, antibiotic overuse is another important threat to public health that is closely

related to antibiotic use without a prescription. For this reason, this study focused on antibiotic misuse, as a practice that needs to be avoided to promote appropriate treatments and avoid the spread of antibiotic resistance.

The results suggesting that individuals prefer not to take antibiotics is consistent with previous studies that have reported a general reluctance of patients to take medications, especially when they are aware of the therapy's risks, like the adverse effects.[25,26] However, studies have found that patients consider that antibiotics are effective treatments for diverse symptoms and sometimes they demand that physicians prescribe these drugs.[19,27,28] Given the design of this DCE, the preference for antibiotics was assessed independently from their efficacy. Additionally, the options without antibiotics were also free of risks to individual health or community resistant strains. This suggests that once people are made aware that the use of antibiotics implies some risks and may not be effective, their preferences for this group of drugs may be reduced.

In this study, being prescribed by a physician is the most preferred option. We found in the WTP analysis that participants valued getting a prescription from a physician (USD 168) more than deciding based on their own experiences (USD 43). However, studies have reported that some patients self-medicate because their relationship with physicians has been affected by factors like the extended availability of medical information online and successful medical experiences that make patients more confident in their own opinion.[29,30] Others think that physicians do not take their health needs seriously, and only provide mild treatments.[31] The results here suggest that the physician's

advice is still valued when making rational decisions about using antibiotics. This preference can be supported by the exhaustive education and the experience of these health professionals.

While most of the factors had a statically significant coefficient, the time required to get advice and antibiotics was not significant for participants. This result is not consistent with previous studies that have found 'time' to be one of the most frequent reasons to self-medicate with antibiotics.[7,8,32,33] One explanation for this is that, unlike the DCE methodology, these previous studies did not capture the tradeoffs that individuals make when assessing a decision. Thus, time constraints resulted important in previous studies, but this DCE found that its importance relative to other factors is low.

The probability of improving health and the risks of adverse outcomes and resistant strains in the community resulted important to the participants. However, it should be noticed that the levels of these attributes were defined within a very wide range. Even though these probabilities were not based on the efficacy and safety of antibiotic courses reported in clinical trials, the logical plausibility of selected values among the general population was tested during the focus groups interviews. In addition, we planned to include extreme values, even unrealistic, to ensure that the participant would tell the difference and state their preferences. While actual efficacy probabilities may be close the 100% and safety risks to 1%, attribute levels around these ranges would not vary in such a way that participants could have clear different options to choose from. Conversely, this study disclosed the efficacy and safety values that result of interest to the general population and helped to understand their rationality when using antibiotics.

The cost of medical attention and the delays to have a medical appointment are reasons to self-medicate reported in other studies.[7,32] The findings of this DCE agreed with those results and give more insight into these two factors. Even though the cost and the number of days to get an appointment were statistically significant in the linearized model, the categorical model showed that costs below 50.000 COP (17 USD) and a number of days until the appointment of 4 or less, were not statically different than zero. In consequence, these factors only affect the rational decision when reaching high values. On the other hand, participants reported that the mean cost of consulting a physician to get antibiotics and the number of days to get attention are low (7 USD and 4 days, respectively). Then, when cost and days to get attention are around the mean values, these have a little influence on the decision to misuse antibiotics.Patient's elections are affected only when these factors rise over normal values. This could be also observed in the marginal analysis. The probabilities of choosing the physician under the interventions ' physician's attention the same day' and ' physician's attention at no cost' were very close to the base case. According to this, reductions in the cost and the number of days to get advice may have a little impact on discouraging antibiotics misuse.

This study found that the probability of misusing antibiotics can be reduced if an educational interventions inform that this practice may not be effective, may be risky to their health (adverse events and resistance), and may cause resistant strains. These findings support the importance of educational interventions, even over other interventions like easing the access to physician's attention. Changing people's optimism about antibiotic self-medication is critical to avoid that practice. However, this assumes there will be effective educational campaigns. The campaigns must overcome a tendency of people who have previously inappropriately used antibiotics since experiences with inappropriate antibiotics use are associated with a greater risk of self-medicating again in the future.[11,27,30,31] Some interventions have improved the community's knowledge about antibiotics, but this information may not prevent people from self-medicating with them.[34-36] Interventions need to make people permanently aware of the low benefits and high risks of antibiotic misuse.

Nurses' right to prescribe certain medications, including antibiotics, is granted in different countries to ease access to healthcare.[16,35,36] In countries like Colombia, where only physicians can prescribe antibiotics and pharmacy owners sell antibiotics under-the-counter, an alternative nursing service for infectious-like diseases can compete against the purchase of antibiotics recommended by the non-professional pharmacy worker.[20] In different countries, antibiotics can be bought in pharmacies without prescription, and the non-professional pharmacy worker's advice is embraced by the community.[11,27,37] The DCE coefficients suggest that people would decide to see a nurse instead of a non-professional pharmacy worker or using leftovers, the other conditions being equal. In addition, if people are informed about antibiotic self-medication risks and inefficacy, the probability of using the nursing alternative service increases. Then, an educational intervention to change people's ideas about antibiotic misuse added to a new service provided by a health professional like a nurse, may produce an important reduction in the self-medication practices among the community.

The results of this study have important implications not only for Colombia but for many other countries that are dealing with the use of antibiotics without prescription. People's preferences can inform educational interventions. Also, this supports the convenience of having other health professionals with the right of prescribing antibiotics. Lowering costs or time to access physicians may not be as effective as expected. Latin American policymakers may benefit from this information to plan effective interventions based on sounded evidence about population acceptability.

While the DCE methodology does overcome some of the problems with other methods, it has limitations. First, the hypothetical nature of the decisions raises the question of the extent to which the preferences predict behavior. While the results suggest that people were consistent in their reported preferences (and thus were not merely randomly making choices), additional studies are required to identify the extent to which the differences in preferences translate into differences in behavior. While this type of research can be difficult, given that taking antibiotics without prescription often goes underreported, it would provide evidence on the extent to which the preferences predict behavior.

On the other hand, the phenomenon explored in this study is very complex, and the DCE design demands to reduce it to some attributes and levels. In other to avoid excluding important factors that influence decisions, the design of our study resulted somehow complicated. Even though the methodological design was based on basic standards of conjoin analysis and DCE, the large number of attributes and levels can affect the results. Future research is needed to clarify if a reduced number of attributes should have impacted the participants' preferences.

Thirdly, according to the method, attributes were assessed independently by participants, even though some of them may be related. For example, a high 'Change of getting better' in the real world would be affected by a high 'Risk of serious effects to your health'. However, along with the survey the participants had to assess them independently. This needs to be taken into account when translating the results into actual decisions.

Fourth, while the sampling method attempted to recruit participants from a wide range of socioeconomic backgrounds, the sample was not representative of any population. The results should be interpreted as representing this group's preferences, underrepresented of retired, very-low socioeconomic level, and very-low educational level individuals. Future studies should explore the stability of preferences in other groups.

Finally, while the study did include factors suggested by the literature and respondents in the focus groups, other essential attributes might not be included. DCEs have a restricted number of factors so that the results are reliable.[38] In addition, it was not possible to identify whether some attributes were not significant because the participants did not care about them, or because they only could focus on a subset of attributes. The current study suggests some avenues for developing a more general theory of behavior related to taking antibiotics with or without a prescription.

CONCLUSIONS

This study helped to understand the problem of antibiotic self-medication from the community's standpoint. In general, participants did not like to take antibiotics and like a physician's advice. They also cared about effectiveness and risks, even the threat of resistance to the community. However, they were discouraged from waiting many days to receive attention or paying too much money. Informing people about antibiotic misuse problems may favor better decisions and prevent this practice. Our results support health policymakers in launching interventions that educate people and dispose other health professionals to assist the community.

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