

## ORIGINAL ARTICLE

# The general public's perceptions and use of antimicrobials in Mexico

Percepciones y uso de antimicrobianos por parte del público en general en México

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## ABSTRACT

Bacterial resistance to multiple antibiotics is a growing global problem, due in large measure to extensive and inappropriate usage of antibiotics. That resistance occurs in hospitals and their intensive care units and increasingly in the community setting as well. This prospective study surveyed 824 randomly selected households listed in the telephone directory, from November 2018 to January 2019. Through telephone interviews we determined knowledge about antibiotics and beliefs concerning their safety and efficacy. We studied the influence of age, gender, education, and having private or public health insurance on knowledge, self-medication, storing medication at home for emergency use ("hoarding"), and asking a private doctor to prescribe antibiotics ("demand prescribing"). For the 824 telephone calls that the interviewers completed, 753 of the households agreed to participate (91.4% response rate). Of those 753 participants, 699 of them (93 %) knew the term "antibiotic," 29 % (206/699) said it was a drug for bacterial infections, and 25 % (170/690) had asked a doctor for an antibiotic prescription. Penicillin was correctly identified as an antibiotic across age, gender, and education categories, but 36 % of respondents incorrectly said Benadryl (diphenhydramine), a common over-the-counter cough and cold formulation, was an antibiotic. Gender was not significantly associated with knowledge of antibiotic safety, with self-medication, or with hoarding antibiotics. On the other hand, completion of tertiary (university) education was significantly associated with correct knowledge of the safety of antibiotics and whether or not they could cure all infections. Of the various antimicrobials, beta-lactams were the ones that survey respondents had used most frequently in the preceding year, and 20% of antibiotics users had used multiple antibiotics in that period. In comparison to persons with private health insurance, more individuals without private health insurance said that antibiotics are safe and do not have side effects, and more of them also incorrectly called aspirin and Benadryl antibiotics. In México, inappropriate use of antimicrobials results from self-medication, over-the-counter availability at the community pharmacy, prescribing on demand, and lack of regulatory control. In order to contain antibiotic abuse, both the Drug Inspectorate of the Federal Commission for the Protection against Sanitary Risks (COFEPRIS, for its acronym in Spanish) should exert stricter control on the dispensing of antibiotics at private pharmacies. Further, education of the general public and of health care professionals on antibiotic misuse and appropriate use must be instituted, along with community-based surveillance of antimicrobial resistance trends.

**Keywords:** Antimicrobials, health education, professional education, self-medication

## RESUMEN

La resistencia bacteriana a múltiples antibióticos es un problema mundial creciente, debido en gran medida al uso extenso e inadecuado de antibióticos. Esa resistencia se da en los hospitales y sus unidades de cuidados intensivos y, cada vez más, también en el ámbito comunitario. Este estudio prospectivo encuestó a 824 hogares seleccionados al azar que figuran en la

guía telefónica, desde noviembre de 2018 hasta enero de 2019. A través de entrevistas telefónicas, determinamos el conocimiento sobre los antibióticos y las creencias sobre su seguridad y eficacia. Estudiamos la influencia de la edad, el sexo, la educación y tener un seguro de salud público o privado en el conocimiento, la automedicación, el almacenamiento de medicamentos en el hogar para uso de emergencia ("acaparamiento") y la solicitud de un médico privado para recetar antibióticos ("prescripción a demanda"). De las 824 llamadas telefónicas que completaron los entrevistadores, 753 de los hogares aceptaron participar (tasa de respuesta del 91.4 %). De esos 753 participantes, 699 de ellos (93 %) conocían el término "antibiótico", el 29 % (206/699) dijeron que era un medicamento para las infecciones bacterianas y el 25 % (170/690) le había pedido a un médico un antibiótico. La penicilina se identificó correctamente como un antibiótico en todas las categorías de edad, género y educación, pero el 36% de los encuestados dijo incorrectamente que Benadryl (difenhidramina), una formulación común para la tos y el resfriado de venta libre, era un antibiótico. El sexo no se asoció significativamente con el conocimiento de la seguridad de los antibióticos, con la automedicación o con la acumulación de antibióticos. Por otro lado, la finalización de la educación terciaria (universitaria) se asoció significativamente con el conocimiento correcto de la seguridad de los antibióticos y si pueden o no curar todas las infecciones. De los diversos antimicrobianos, los betalactámicos fueron los que los encuestados habían utilizado con mayor frecuencia durante el año anterior, y el 20 % de los usuarios de antibióticos había utilizado varios antibióticos en ese período. En comparación con las personas con seguro médico privado, más personas sin seguro médico privado dijeron que los antibióticos son seguros y no tienen efectos secundarios, y más de ellos también denominaron incorrectamente aspirina y antibióticos Benadryl. En México, el uso inadecuado de antimicrobianos se debe a la automedicación, la disponibilidad de venta libre en la farmacia comunitaria, la prescripción a pedido y la falta de control regulatorio. Para contener el abuso de antibióticos, tanto la Inspección de Medicamentos de la Comisión Federal de Protección contra Riesgos Sanitarios (COFEPRIS) debe ejercer un control más estricto sobre la dispensación de antibióticos en las farmacias privadas. Además, se debe instituir la educación del público en general y de los profesionales de la salud sobre el uso indebido y apropiado de los antibióticos, junto con la vigilancia comunitaria de las tendencias de resistencia a los antimicrobianos.

*Palabras clave:* Antimicrobianos, educación sanitaria, educación profesional, automedicación

## INTRODUCTION

Bacterial resistance to multiple antibiotics is a growing global problem, due in large measure to extensive and inappropriate usage of antibiotics (Williams and Heymann, 1998; Levy, 1998). That resistance occurs in hospitals and their intensive care units and increasingly in the community setting as well.

Antibiotic resistance may be more widespread in lesser-developed countries, where there are fewer controls on the use of antimicrobial drugs (Hart and Kariuki, 1998) and where the higher incidence of infectious disease in the population fuels the demands for the drugs (Kunin, 1993.). In developing countries such major community pathogens as *Neisseria gonorrhoea*, *Streptococcus pneumoniae*, *Salmonella* Typhi, and *Shigella* spp. have already demonstrated their resistance to the first-line, less-expensive broad-spectrum antimicrobials (Brown *et al.*, 1982; Appelbaum *et al.*, 1977; Sack *et al.*, 1997; Bennish *et al.*, 1992.). Gram-negative pathogens that cause hospital-acquired infections have developed resistance to extended-spectrum beta-lactam antimicrobials, which until recently demonstrated high cure rates for these infections (Jones, 1998; Jones and Pfaller, 1998). In the central and sud-america infections due to resistant pathogens are frequent in hospitals and also occur in the family practice setting. The reported rates of penicillin-resistant *Pneumococci* and chloramphenicol-resistant *Haemophilus influenzae* in the North America are low, but high rates of resistance

to ampicillin, co-trimoxazole, and gentamicin by common gram-negative pathogens that cause urinary tract infections have been reported (Prabhakar, 2000).

Various factors contribute to this resistance problem in developing countries around the world (Hart and Kariuki, 1998). These include indiscriminate and widespread use of antimicrobials for community-acquired infections, self-medication, incomplete treatment courses, and the unregulated use of antibacterial drugs. Antibiotic use without physician consultation occurs not only in developing nations but also in the United States of America (Richman *et al.*, 2001). In the United Kingdom, concerns have been raised regarding deregulation and shifting antimicrobials for topical or oral use from the "prescription-only medicine" status (to be dispensed only on a physician's prescription) to the "pharmacy medicine" category (pharmacists can dispense without a prescription) (Reeves *et al.*, 1999).

This study was undertaken to examine how the public at large in Mexico perceives and uses antibiotics. Mexico is a developing country with 128.9 million inhabitants. Divided into 32 states, between 2018 and 2020, the percentage of the population living in poverty went from 41.9% to 43.9%, Mexico is a developing country with 128.9 million inhabitants.

Between 2018 and 2020, the percentage of the population living in poverty went from 41.9% to 43.9%, and 34% of the population aged 15 or over will

not have completed secondary school in 2020, according to the INEGI census.

Medical care in Mexico is available free through public sector health care facilities. At these centers, patients can consult specialist physicians, undergo recommended investigations and procedures, and receive prescribed medication from the country's restricted drug list, all at no cost. Other than these centers, there are no free pharmacies. At these public centers, however, patients often encounter long waiting periods and find that drugs are available erratically or not at all. To receive expeditious advice and treatment, many patients consult a private doctor at their own expense, and that cost may be covered by private health insurance. Patients can also go to a private pharmacy and directly approach the pharmacist for advice and treatment. Talking to the pharmacist has the advantage of avoiding doctor consultation fees, and much of the population utilizes this approach.

The General Law of health classifies antibiotics as controlled drugs, to be dispensed only with a prescription. An anomaly in the law is its strict application only to those drugs defined by the term "antibiotics" *per se* and not to all antimicrobials; therefore, agents such as co-trimoxazole and the quinolones, which do not fall under this regulation, are available without prescription. Nevertheless, it is widely known that antimicrobial agents can be obtained at pharmacies without a prescription, and pharmacists simply dispense these drugs as over-the-counter medications in response to requests from customers.

Prior to this study, no data had been available on the general public's perceptions and use of antibiotics in Mexico.

### **Purpose of the study**

We studied the influence of age, gender, education, and having private or public health insurance on knowledge, self-medication, storing medication at home for emergency use ("hoarding"), and asking a private doctor to prescribe antibiotics ("demand prescribing").

## **MATERIALS AND METHODS**

### **Study design**

We conducted a cross-sectional population-based study in Mexico by interviewing study subjects over the telephone. We calculated a sample size of 800 households with a working telephone, based on 80 % power to detect a difference of at least 3 % in perception and use of antibiotics, given an alpha of

0.05. As we did not know in advance what the telephone-survey participation rate would be for answered calls nor the number of busy or unanswered calls, we selected 1 600 households at random from the listed 22 million households in the telephone directory of the Telecommunication Services of Mexico. It is estimated that about 75 % of households in the country have landline phone (landline).

### **Interview**

Six interviewers were trained to conduct structured interviews over the telephone. Prior to interviewing members of the general public, the interviewers practiced administering the questionnaire, to be certain that they were conveying identical meanings for the questions. The interviewers rehearsed with each other and also with some adult friends and relatives, both face-to-face and on the telephone. Based on that pilot-testing experience, the survey instrument was modified.

With the general public, the questionnaire was administered to a responsible adult household member who was at least 18 years old and who had to take care of family members when they were ill. The objective of the study and its format were explained to participants at the start of the interview. When persons refused to participate in the study, the interviewer asked if there was any specific reason for not complying, and recorded any reason that was given. Respondents who said they knew the term "antibiotic" were asked to explain their understanding of it, and those who had not heard the term were offered the following explanation: "Antibiotics are drugs that are prescribed for the treatment of diseases caused by germs."

Respondents were asked to identify antibiotics from a presented list of common drugs and also to answer questions on antibiotic safety, curative properties, possible common infectious conditions among household members, and any relevant action taken in those situations. Information was also obtained, for both adult and child patients, concerning storage of antibiotics at home for emergency use ("hoarding"); consulting a private sector physician for a fee; "prescribing on demand" for antibiotics, that is, with a doctor providing a prescription in response to a request from a patient; and self-medication. If antibiotics were consumed, participants were asked if they complied with all recommended instructions, and whether they shared these drugs with other family members or with friends.

In instances where individuals did not answer questions, the questions were repeated in order to prompt an answer. If the persons still failed to answer, that was classed as "no response."

### Data analysis

Data were entered and analyzed using the Epi Info version 6.04 software program (Centers for Disease Control and Prevention, Atlanta, Georgia, United States). The chi-square test (Mantel-Haenszel test and Fisher's exact test) was used to compare categorical variables. Student t test analysis was used to compare the means of continuous data. Analyses for the linear trend in proportions were done by chi-square for trend using the STATCALC function in the Epi Info software.

## RESULTS AND DISCUSSION

Out of 950 calls that the interviewers made, they received a busy signal or no answer in 126 of the cases, resulting in a sample of 824 respondents. Of those 824 persons, 753 agreed to participate, for a 91.4% response rate. Although the 753 was 5.9 % less than the original projected sample size of 800, an analysis showed that the small deficit did not alter the power of the study. The main reasons that persons gave for declining to participate were a lack of interest in the interview or being too busy to answer the questions. In the 32 states of Mexico the respondent participation rates ranged from 78 % to 100 %.

Table 1 shows the demographic characteristics of the survey respondents. All the demographic data were not available for all 753 survey participants; participants for whom particular data were not available are omitted from the respective descriptions shown in Table 1.

Among the survey participants there was a higher female than male representation, 67 % vs. 33 %. The age of the respondents ranged from 18 to 85 years, with 21 % being 51 years of age. Of the survey participants for whom the respective demographic information was available, 49 % (325/ 667) had salaried employee status and 56 % (385/683) had completed secondary education.

### Knowledge and use of antibiotics

Of the 753 persons participating in the study, 699 of them (93 %) had heard of the term "antibiotic." Of those 699 persons, 193 respondents (28 %) provided a nonspecific description such as "something the doctor tells you to buy," leaving a total of 506 persons who offered a more-specific explanation for the term

antibiotic. Out of those 506, 455 persons provided a definition of the term, which we grouped into the following categories: a drug for bacterial infections (206 responses), just a drug (138), and a drug prescribed by the doctor (58), a drug for virus/cold (31), and a drug for pain, fever, or stimulating antibodies (22).

**Table 1.** Demographic characteristics of the survey respondents.

**Tabla 1.** Características demográficas de los encuestados.

Characteristic	No.	%
Gender		
Male	248	33
Female	495	67
Age (years)		
18-30	199	27
31-40	235	32
41-50	137	19
≥ 51	156	21
Refused	12	2
Highest educational level completed		
Primary school	137	20
Secondary school	385	56
Tertiary institution	161	24
Employment status		
Employed for wages	325	49
Self-employed	98	15
Housewife	121	18
Retired or unemployed	123	18
Private health insurance		
Have private health insurance	202	28
No private health insurance	532	72

<sup>a</sup> The total number of participants was 824; 753 of them (91.4%) agreed to participate in the survey; the figures in the table omit missing data (e.g., no answer was given).

The knowledge and use of antibiotics was analyzed using the number of participants who had heard of the term "antibiotics," which was 699. Below we first present information on the overall knowledge and use of antibiotics; later we will present similar information for the various demographic subgroups of the respondents who had heard of the term "antibiotics" and who provided an answer to the respective question. Knowledge was assessed based on the list of common drugs that the telephone interviewers presented to the participants. Penicillin was correctly identified as an antibiotic by 83 % of the respondents, while 80 % could correctly identify tetracycline, and 78% could do that for Augmentin (amoxicillin/clavulanic acid). Ten percent of the respondents incorrectly said that Tylenol (paracetamol, acetaminophen) was an antibiotic, and 9 % did that for aspirin, 36% made that mistake for Benadryl (diphenhydramine), a common over-the-counter cough and cold formulation.

Of the participants answering the question, 24 % of them said they believed that antibiotics could cure all infections. Fifteen percent of responding participants

felt all antibiotics are safe, and only 12 % of respondents said that antibiotics were free from side effects. Twenty-one percent of responding participants said that they hoarded antibiotics, storing them at home for emergency purposes.

Based on recall, 31 % of households (220 of 699) said they had used an antibiotic during the past year, and 20 % of those people (44 of 220) had used more than one antibiotic in that period. The beta-lactams were the most frequently used antibiotics, and amoxicillin was consumed by 37 % (81 of 220) of users. The penicillins were used more frequently than the cephalosporins, 7 % (15 of 220) vs. 4 % (8 of 220), respectively. Among the cephalosporins, only Ceclor (cephalothin) and Zinnat (cefuroxime) had been used.

Out of the 699 respondents, 136 of them (19 %) reported they self-medicated with antibiotics obtained from private pharmacies, without a doctor's

prescription. Out of 690 persons, 170 of them (25 %) admitted to demanding a prescription, which is, asking a doctor to provide a prescription even if the physician felt the antibiotic was unnecessary. Although 74 % (520 of 699) of the people said they did not share antibiotics with family and/or friends, 17 % (122 of 699) refused to answer this question.

Table 2 and Table 3 provide details on antibiotic knowledge and use for the various demographic groupings included in the survey. The numbers of respondents shown in those two tables differ from the demographic groupings shown in Table 1 because some respondents did not answer all the questions on knowledge or use and/or because information for those who did answer was not available on gender, age, education, or insurance status. Those respondents for whom data were not available were excluded from the analysis.

**Table 2.** Demographic variables associated with antibiotic identification in study of the general public's perceptions and use of antibiotics.

**Tabla 2.** Variables demográficas asociadas a la identificación de antibióticos en el estudio de la percepción y el uso de antibióticos por parte del público en general.

Variable	Drugs that respondents said were antibiotics																	
	Penicillin			Tetracycline			Augmentin			Benadryl			Aspirin			Tylenol		
	<i>n</i>	No.	%	<i>n</i>	No.	%	<i>n</i>	No.	%	<i>n</i>	No.	%	<i>n</i>	No.	%	<i>n</i>	No.	%
Gender																		
Male	180	146	81	105	83	79	102	80	78	156	58	37	177	16	9	185	24	13
Female	386	321	83	238	193	81	212	164	77	346	121	35	400	36	9	400	32	8
Age																		
18-30	145	109	75	92	68	74	87	67	77	120	53	44	154	17	11	156	25	16
31-40	191	155	81	122	105	86	122	95	78	174	66	38	183	11	6 <sup>b,c</sup>	200	10	5 <sup>b</sup>
41-50	114	103	90 <sup>d</sup>	64	56	88	56	45	80	100	27	27	120	6	5 <sup>b,c</sup>	117	7	6 <sup>b</sup>
≥ 51	106	93	88	58	41	71	55	33	60	230	30	13 <sup>b</sup>	107	16	15	109	12	11
Highest education completed																		
Primary	113	89	79	52	33	64	51	25	49	58	23	40	121	17	14	115	15	13
Secondary	290	235	81	191	157	82	176	139	79	192	73	38	325	26	8	318	35	11
Tertiary	137	125	91 <sup>b</sup>	93	79	85 <sup>b</sup>	77	69	90 <sup>b</sup>	81	17	21 <sup>b</sup>	150	6	4 <sup>b</sup>	133	4	3 <sup>b</sup>
Private health insurance																		
Have	165	137	83	104	94	90 <sup>b</sup>	99	81	82	148	43	29	175	7	4	171	12	7
Don't have	374	314	84	219	164	75	203	148	73	315	123	39 <sup>d</sup>	380	38	10 <sup>d</sup>	411	37	9

<sup>a</sup> This table shows the demographic variables for the respondents who said that the respective drug was an antibiotic. The total numbers of persons in the various groups differ from the ones in Table 1 since the respondents who refused to answer or who did not know were excluded in this analysis.

<sup>b</sup> Chi-square test, 0.01 < P < 0.05.

<sup>c</sup> Chi-square test was significant when comparing 18-30 years versus 31-40 and 41-50 years.

<sup>d</sup> Chi-square test, P < 0.01.

Table 2 shows the demographic characteristics of respondents who said -correctly or incorrectly- that the drugs from the list that the interviewer provided were antibiotics. Significantly more respondents between 41 and 50 years old correctly identified penicillin as an antibiotic. Also, while a significantly higher proportion of the persons in the oldest age group (> 51) correctly said Benadryl was not an antibiotic, this oldest age group was somewhat more likely than those 31 - 50 years old to incorrectly classify aspirin and Tylenol as

antibiotics. Subjects with tertiary education were more likely to correctly identify the antibiotics from among the various drugs presented in the list. In comparison to persons who had private health insurance, a significantly higher proportion of subjects without such insurance wrongly classified Benadryl and aspirin as antibiotics. Significantly more respondents with private health insurance accurately classified tetracycline as an antibiotic as compared with those who did not have the benefit of private health insurance.

Table 3 shows demographic details on respondents answering questions concerning knowledge and use of antibiotics. Gender was not significantly associated with knowledge of their safety, with self-medication, or with hoarding antibiotics. Tertiary education was significantly associated with correct knowledge of antibiotics regarding their safety, their ability to cure infections, and their having no side effects. Relatively more people without health insurance said antibiotics

are free of side effects, as compared with persons who had health insurance.

Education was not a predictor of hoarding (Table 3). However, age was significantly associated with storing antibiotics at home, with older persons being less likely to keep antibiotics at home for emergency purposes. Self-medication was less likely to be undertaken by those with a secondary or tertiary education. Significantly more individuals without health insurance said they do self-medicate with antibiotics.

**Table 3.** Sociodemographic variables associated with antibiotic knowledge, self-medication, and hoarding in study of the general public's perceptions and use of antibiotics.

**Tabla 3.** Variables sociodemográficas asociadas al conocimiento de antibióticos, automedicación y acaparamiento en el estudio de la percepción y uso de antibióticos por parte del público en general.

Factor	Cures all infection <sup>b</sup>			Safe <sup>c</sup>			No side effects <sup>d</sup>			Self-medicates <sup>e</sup>			Hoards <sup>f</sup>		
	n	No.	%	n	No.	%	n	No.	%	n	No.	%	n	No.	%
Gender															
Male	196	45	23	200	30	15	200	24	12	195	39	20	183	44	24
Female	424	106	25	429	64	15	417	50	12	436	96	22	420	84	20
Highest education completed															
Primary	127	42	33	126	26	21	126	29	23	126	34	27	124	26	21
Secondary	320	80	25	320	48	15	308	37	12	323	71	22 <sup>g</sup>	308	74	24
Tertiary	150	18	12 <sup>g</sup>	156	14	9 <sup>h</sup>	133	4	3 <sup>h</sup>	147	25	17 <sup>g</sup>	147	28	19
Age (yrs.)															
18-30	165	38	23	164	23	14	167	15	9	167	45	27	163	49	30
31-40	204	51	25	206	33	16	200	20	10	200	44	22	204	45	22
41-50	125	25	20	125	15	12	123	16	13	121	23	19	121	17	14 <sup>h</sup>
≥ 51	124	36	29	122	22	18	118	13	11	124	21	17 <sup>h</sup>	121	17	14 <sup>h</sup>
Private health insurance															
Have	185	37	20	177	23	13	187	15	8	187	30	16	184	35	19
Don't have	422	114	27	412	66	16 <sup>h</sup>	407	57	14 <sup>h</sup>	422	97	23 <sup>h</sup>	400	88	22

<sup>a</sup> The demographic variables are presented and analyzed for those respondents who answered "Yes" to the respective statement. Respondents who refused to answer or who gave no answer were excluded in this analysis. Thus, the totals in the respective groups (e.g., gender) differ from those in Table 1.

<sup>b</sup> Cures all infections = respondents said that antibiotics cure all infections.

<sup>c</sup> Safe = respondents said that antibiotics are safe.

<sup>d</sup> No side effects = respondents said that antibiotics are free from side effects.

<sup>e</sup> Self-medicates = respondents said that they self-medicate, using antibiotics obtained from a private pharmacy without a doctor's prescription.

<sup>f</sup> Hoards = respondents said they store antibiotics at home for emergency use.

<sup>g</sup> Chi-square test  $P < 0.01$ .

<sup>h</sup> Chi-square test  $P < 0.05$ .

## CONCLUSION

In México, inappropriate use of antimicrobials results from self-medication, over-the-counter availability at the community pharmacy, prescribing on demand, and lack of regulatory control. In order to contain antibiotic abuse, both the Drug Inspectorate of the Federal Commission for the Protection against Sanitary Risks (COFEPRIS, for its acronym in Spanish) should exert stricter control on the dispensing of antibiotics at private pharmacies. Further, education of the general public and of health care professionals on antibiotic misuse and appropriate use must be instituted, along with community-based surveillance of antimicrobial resistance trends.

*Conflict of interest:*

The authors declare that they have no conflict of interest.

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