

PREDICTORS OF ANTIBIOTIC PRESCRIPTION IN RESPIRATORY TRACT INFECTIONS BY AMBULATORY CARE PRACTITIONERS

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Abstract The use of antibiotics in viral respiratory infections (common cold, acute rhinosinusitis and acute bronchitis) promotes the emergence and spread of resistant bacteria. Studies have found that antibiotics are prescribed for 50-70% of respiratory tract infections, despite the fact that most of them have a viral etiology. The objective of the study was to determine predictors of antibiotic use in acute respiratory infections. It was conducted as a cross-sectional study on physicians' practices for antibiotic use. The subjects were internists and otolaryngologists of adult patients in an ambulatory setting in Buenos Aires. The instrument was a questionnaire with 20 clinical vignettes that included relevant variables for making decisions regarding antibiotic use in acute respiratory infections. The vignettes were constructed with a fractional factorial design with nine clinical variables. The absolute and relative weight of each clinical variable that predicted antibiotic use were calculated for each individual practitioner using multiple linear regression. The predictors with the greatest absolute weight in the decision to prescribe antibiotics were nasal discharge and cough (24% and 21% of total weight). The correlation between predictors and individual physician answers was high ($r^2 = 0.73$). The mean probability and the rate of antibiotic prescription were both about 50%. Predictors of antibiotic use for acute respiratory infections among ambulatory physicians in this sample differ from internationally accepted guidelines. The likelihood of prescribing antibiotics for these illnesses is high. Wider implementation of management guidelines for acute respiratory infections could improve cost effective antibiotic use and decrease the development of antibiotic resistance.

Key words: respiratory tract infections, antibiotics, prescription, ambulatory care

Resumen *Predictores de la prescripción de antibióticos en infecciones del tracto respiratorio por médicos de atención ambulatoria.* El uso excesivo de antibióticos promueve la aparición y diseminación de bacterias resistentes. Se ha encontrado una tasa de prescripción de antibióticos en infecciones respiratorias (resfriado común, rinosinusitis aguda y bronquitis aguda) del 50 al 70%, aunque la etiología sea viral en la mayoría de los casos. Esta investigación se condujo con el objetivo de identificar cuáles son los predictores del uso de antibióticos en las infecciones respiratorias agudas. Se realizó un estudio de corte transversal. Los participantes fueron médicos internistas generales y otorrinolaringólogos que atienden pacientes adultos en forma ambulatoria en Buenos Aires. Se utilizó un cuestionario con 20 viñetas sobre casos clínicos, que incluían variables importantes en la toma de decisiones sobre el tratamiento antibiótico en infecciones respiratorias agudas. Las viñetas fueron construidas según un diseño factorial fraccionado con nueve variables clínicas. Se calculó el peso absoluto y relativo de cada variable clínica que predijo el uso de antibióticos, para cada médico, mediante regresión lineal múltiple. Los predictores con mayor peso para la decisión de prescribir antibióticos, fueron la presencia de secreción nasal y tos (24% y 21% de peso total). La correlación entre los predictores y las respuestas individuales fue alta ($r^2=0.73$). La probabilidad media y el índice de prescripción de antibióticos fueron cercanas al 50%. Los predictores del uso de antibióticos para infecciones respiratorias agudas entre médicos de atención ambulatoria en la muestra estudiada difieren de las guías internacionalmente aceptadas. La probabilidad de prescribir antibióticos para estas enfermedades es alta. La puesta en práctica de las recomendaciones internacionales para el uso de antibióticos en infecciones respiratorias agudas podría mejorar el uso de antibióticos y reducir el desarrollo de resistencia bacteriana.

Palabras clave: infecciones de vías respiratorias, antibióticos, prescripción, atención ambulatoria

Excessive use of antibiotics in ambulatory practices has contributed to the emergence and spread of resistant strains of *Streptococcus pneumoniae*, and has in-

creased the risk of community-acquired infections by resistant bacteria¹⁻⁴. Prior antibiotic use for viral respiratory tract infections promotes the selection and dissemination of resistant strains of *S. pneumoniae*¹. Furthermore, the excessive use of antibiotics for respiratory infections contributes to the high cost of healthcare⁴.

Acute infections of the respiratory tract (ARI) are common causes of ambulatory consultations⁵⁻⁸. The preva-

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lence of a bacterial etiology varies from 5-10% for common cold and acute bronchitis to 40% in acute rhinosinusitis. Studies conducted in developed countries^{1-4, 9-13} and in Latin-America¹⁴⁻¹⁸ have found that antibiotics are prescribed in 50-70% of cases of ARI in adults. The use of antibiotics for ARI has not been demonstrated to prevent bacterial superinfection associated complications^{1, 4, 6-9}. In Argentina ARI's account for 2.5% of the ambulatory consultations¹⁹. Data from the Argentinean Health Ministry²⁰ show that 9% of the population of the city of Buenos Aires used antibiotics during 2001.

There are international guidelines on the use of antibiotics for ARI among adults that are generally accepted^{1, 6-8, 21-22}. Judicious use of antibiotics would minimize the rise of resistant strains and would control the cost of medications to both the individual consumer and to the overall healthcare system. It has been demonstrated that educational strategies aimed at prescribing physicians reduce the unnecessary use of antibiotics²³⁻²⁶. Furthermore, it has been shown that patient satisfaction is more dependant on the physician-patient relationship than on whether an antibiotic is prescribed²³.

Physicians' decision to prescribe antibiotics is strongly influenced by relevant clinical factors to their diagnosis^{10-11, 13, 27-29}; patient demand and how it is perceived by the physician³⁰⁻³³; and pharmaceutical industry advertising³⁴⁻³⁶. Determining clinical factors that predict antibiotic utilization will help design educational strategies to reduce its excessive use. Prior studies conducted in various countries have determined certain predictors associated with the prescribing habits of physicians for antibiotic use for ARI^{10-11, 37}. However, no such study has been conducted in Argentina. To examine this topic, the study has been conducted with the objective of identifying predictors of antibiotic utilization by physicians for ARI, the likelihood of antibiotic use, and which antibiotics would be prescribed most frequently.

Materials and Methods

In this cross-sectional study, physicians were asked to indicate whether they would prescribe antibiotics for 20 individual clinical vignettes of patients with respiratory tract infections. The cases were designed such that the physicians' weighting of each clinical finding relative to deciding to use antibiotics could be assessed by regression analysis of the presence of the variable and the answer they gave. The protocol was approved by the Committee of Ethics of the Hospital de Clínicas José de San Martín.

Internists and otolaryngologists who treat adult patients in an ambulatory setting from December 2002 to April 2003 were invited to participate. They were recruited from four health institutions of Buenos Aires, chosen in non-random form but representing different socioeconomic levels in our city: Program of General Internal Medicine and Otorhinolaryngology Ambulatory Clinic of Hospital de Clínicas José de San Martín; Ambulatory Clinic of Centro Medicus; Ambulatory Clinic of Instituto Superior de Otorrinolaryngología; and Ambulatory

Clinic of Hospital Dr. Ignacio Pirovano. The sample was selected using a table of random numbers and was stratified according to center, specialty and position. The sample size was calculated for an expected correlation between predictors and probability of an antibiotic being prescribed in cases of ARI of 0.4, a power of the study (β) of 90% and a two-sided statistical significance (α) of 0.05. We selected 60 participants estimating a non-response rate of 25%.

We constructed 20 clinical vignettes that depicted healthy adult patients with symptoms of ARI (common cold, rhinosinusitis and acute bronchitis), and included important variables for making decisions about antibiotic treatment in these illnesses. For each case, physicians stated the likelihood they would prescribe antibiotics in this patient. The cases were constructed using a fractional factorial design using nine clinical variables^{37, 43}, each expressed at one of two levels (present or absent). A fractional factorial design was used because it allows estimation of the main effects without the large number of cases that would be needed using a full factorial design⁴³⁻⁴⁵.

The domains of study were defined following international guidelines generally accepted for the use of antibiotics in ARI in adults^{1, 6, 7, 8}. These are uncomplicated acute bronchitis, acute rhinosinusitis and nonspecific upper respiratory tract infection, including the common cold. These diagnoses are usually made in the presence of a clinical syndrome with a predominant clinical feature; acute respiratory symptoms in the absence of a predominant symptom are typically diagnosed as "upper respiratory tract infection". Antibiotic treatment is almost always inappropriate because the vast majority of these syndromes has a nonbacterial cause.

Antibiotic treatment of adults with nonspecific upper respiratory tract infection does not enhance illness resolution and is not recommended. Purulent secretions from the nares or throat (commonly observed in patients with uncomplicated upper respiratory tract infection) neither predict bacterial infection nor benefit from antibiotic treatment.

The clinical diagnosis of acute bacterial rhinosinusitis should be reserved for patients with rhinosinusitis symptoms lasting 7 days or more, have maxillary pain or tenderness in the face or teeth (especially when unilateral), and have purulent nasal secretions. Patients with rhinosinusitis symptoms that last less than 7 days are unlikely to have a bacterial infection. Acute rhinosinusitis resolves without antibiotic treatment in most cases. Thus, antibiotic therapy should be reserved only for patients with moderately severe symptoms who meet the criteria for the clinical diagnosis of acute bacterial rhinosinusitis, and those with severe rhinosinusitis symptoms regardless of duration of illness.

The evaluation of adults with an acute cough illness should focus on ruling out serious illness, particularly pneumonia. Routine antibiotic treatment of uncomplicated acute bronchitis is not recommended, regardless of duration of cough.

The variables³⁷ were chosen from a review of the literature and from discussions with primary care physicians who treat ARI in their practices. They included clinical data such as presence or absence of: 1) colored nasal secretion; 2) productive cough; 3) paranasal pain; 4) fever; 5) duration of the illness >10 days. Subjective variables included the presence or absence of: 6) patient's feelings about severe illness that need antibiotics; 7) patient's expectation of receiving antibiotics; 8) patient's previous experience benefit from antibiotics for a similar illness; and 9) imminent travel.

The main outcomes were the absolute and relative weight of each clinical variable that predicted an antibiotic being prescribed for a given clinical scenario. The absolute weight expresses the average of the difference between the probability of prescribing antibiotics when the variable is present and when it is absent, or how many times more likely an antibiotic is prescribed when the variable is present. The relative

weight of each variable was calculated as the percentage of the total weight of all variables. Secondary outcomes were the overall probability of antibiotic use, the theoretical rate of antibiotic use and which antibiotics were the most frequently prescribed.

The data were analyzed with the 11.0 version of SPSS for Windows. The absolute weight of each clinical variable⁴⁶ that predicted antibiotic use was calculated for each individual practitioner using multiple linear regression. The correlation coefficient was also calculated between predictors and probability of prescribing and represents the proportion of the answers that can be explained by its linear association with the predictor variables. The medial probability and theoretical rate of prescription were also calculated.

Results

Thirty seven of the 60 physicians contacted returned the questionnaire (62%). Two questionnaires were eliminated because of incomplete data. The characteristics of the physicians are shown in Table 1.

The absolute and relative weights of the strongest global predictors for antibiotic use for ARI are shown in Table 2, together with the square of the regression coefficient (r²). The clinical variables of greatest weight for prescribing antibiotics were nasal secretion and cough.

Individual predictors for antibiotic use and the percentage of subjects who gave more weight to each variable are shown in Table 3. Nasal secretion and cough were considered the variables of greatest weight by 62% of participants. The specialty of the physician had no significant impact on which clinical variables were considered more important for prescribing an antibiotic (Table 4).

TABLE 1.– Demographic characteristics.

	N	%
N	35	
Women	20	57.1
Hospital*:		
HCJSM	10	28.6
Centro Medicus	6	17.1
ISORL	1	2.9
Hospital Pirovano	18	51.4
Age, mean (range)	34.97	(24-73)
Speciality:		
Internal Medicine	30	85.7
Otolaryngology	5	14.3
Current position:		
Residents	20	57.1
Emergency physician	4	11.4
Staff physician	9	25.7
Chief position	2	5.7

*HCJSM: Hospital de Clínicas José de San Martín; ISORL: Instituto Superior de Otorrinolaringología.

The overall probability of prescribing antibiotics was 50.1% and the theoretical rate of prescribing an antibiotic was 50.4% (335 cases). The specialty had no significant impact on the probability of prescribing an antibiotic (49.4% internists vs. 54.4% otolaryngologists; p=0.193); but it had on the rate of antibiotics use (277 cases [48.8%] vs. 58 cases [59.8%]; p=0.045).

Aminopenicillins were prescribed in 53% of cases, aminopenicillins plus betalactamases (BLI) inhibitors in

TABLE 2.– Global predictors of antibiotics use. Absolute and relative weights.

Global predictors	Absolute weight	Relative weight* %
Nasal secretion	23.12	24.12
Cough	20.12	20.99
Fever	17.70	18.45
Sinusal pain	14.37	14.99
Duration > 10 days	14.35	14.97
Severe illness	6.91	7.21

r² = 0.73

*The percentage doesn't add 100 because only weights statistically significant are shown.

TABLE 3.– Individual predictors of antibiotics use. Number and percentage.

Individual predictors	Subjects n	%*
Nasal secretion	11	31.4
Cough	11	31.4
Duration > 10 days	5	14.3
Fever	5	14.3
Paranasal pain	4	11.4
Patients' expectations	1	2.9

*Some subjects gave the same maximum weight to more than one variable, so total percentage can be > 100.

TABLE 4.– Differences in the predictors of antibiotics use according to speciality. Relative weights.

	Internists %	Otolaryngologists %
Nasal secretion	23.44	28.61
Cough	20.25	26.02
Fever	17.68	24.05
Duration >10 days	17.06	–
Sinusal pain	14.19	20.02
Severe illness	7.5	–

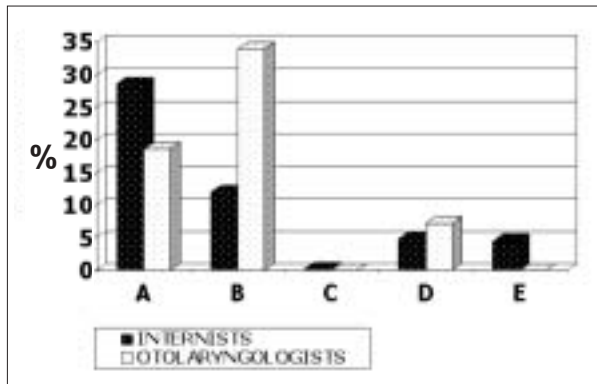


Fig. 1.– Prescribed antibiotics according to speciality.

- A: Aminopenicillins ($p = 0.04$)
 B: Aminopenicillins + BLI ($p = 0.000$)
 C: Eritromicine ($p = 0.683$)
 D: New macrolides ($p = 0.323$)
 E: TMS ($p = 0.034$)

29% of cases, and new macrolides in 10% of cases. *Streptococcus pneumoniae* and *Haemophilus influenzae* account for the majority of acute bacterial respiratory infections among healthy adults. Therefore, 39% of the antibiotics chosen by the participating physicians to prescribe in the given clinical scenarios are not the recommended initial treatment regimen.

Figure 1 shows the difference in antibiotic prescribing habits between specialties. Internists more frequently prescribe aminopenicillins ($p=0.04$) while otolaryngologists are more likely to prescribe aminopenicillins plus BLI ($p=0.000$).

Discussion

This study analyzed the weight given to various clinical variables by physicians in deciding whether to prescribe antibiotics in clinical scenarios.

We found that the presence of nasal secretions was the most important clinical variable in predicting antibiotic use (25% of total weight), followed by cough, fever, and duration of illness of over 10 days. In previous studies, independent predictors of antibiotic use for ARI included sinus tenderness^{37, 41}, rales or ronchi⁴¹, colored nasal discharge^{37, 38, 40, 41}, productive cough^{37-39, 40, 42}, post-nasal drainage⁴¹, fever^{37, 40, 42}, age greater than 18 years⁴¹, duration greater than 14 days^{37, 40, 41}, urgent consultation⁴¹, patient's imminent travel⁴⁰, patient expecting or requesting antibiotics^{31, 32, 40} and patient's prior use of over-the-counter medications⁴⁰.

Thirtyone percent of the physicians surveyed gave greater weight to the presence of nasal secretion and the presence of cough, suggesting that differentiating a diagnosis of bacterial sinusitis or acute bronchitis was critical in deciding whether or not to use an antibiotic.

We did not find differences between internists and otolaryngologists as to which clinical variables were most significant in prescribing antibiotics.

In this study, the mean rate of prescribing an antibiotic was 50%, which is higher than would be recommended. This rate is similar to those found in studies conducted in the United States, Canada, Australia, New Zealand and United Kingdom^{1-4, 9-13}, where rates of prescribing antibiotics ranged between 50-70% of adult ARI cases. 25-50% of the antibiotics used were broad spectrum. Studies conducted in Latin American countries¹⁴⁻¹⁸, albeit with serious methodological flaws, showed rates of antibiotic prescription for ARI of approximately 50% with ampicillin being the most frequently used.

The most commonly prescribed antibiotics were aminopenicillins, followed by aminopenicillins plus BLI, and then new generation macrolides. Internists more frequently prescribed aminopenicillins while otolaryngologists were more likely to prescribe aminopenicillins plus betalactamase inhibitors.

It is not certain how well the results of this study represents the prescribing habits of physicians. The physicians in the sample were practicing in Buenos Aires City and caring for patients in hospitals and private clinics. However, the participating centers were not selected in a randomized fashion, although the participants were. The results of this study suggest what variables physicians consider in treating bacterial sinusitis and acute bronchitis but a larger study is required to determine which clinical variables are most significant in prescribing antibiotics among a more general physician population.

From this study, we can conclude that physicians in this sample gave great weight to the presence of nasal secretion and cough for prescribing antibiotics for patients with ARI.

These results show that the predictors used in deciding whether or not to use an antibiotic and which antibiotic to use do not comply with international guidelines for antibiotic use in ARI. Educational strategies which emphasize the low prevalence of bacterial etiology in these illnesses could be designed as a tool to improve medical decision making and overall patient care.

We found that the probability of an antibiotic being prescribed for an acute respiratory infection was approximately 50%. This rate exceeds the prevalence of bacterial etiology among ARI. Therefore, the development and utilization of management guidelines for acute respiratory infections can help to improve the judicious use of antibiotics among prescribing physicians.

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La acumulación de saber no es saber. El poeta galo Décimo Magno Ausonio, [. . .] se burló en sus opúsculos de la confusión entre ambas tareas:

Has comprado libros y llenado estantes, oh, amante de las musas.

¿Significa eso que ya eres sabio?

Si compras hoy cuerdas para instrumentos, plecto y lira:

¿Crees que mañana será tuyo el reino de la música?

En: Manguel A. Una historia de la lectura. Bogotá: Editorial Norma, 1999, p 251