

Analysis of under- and overprescribing of antibiotics in acute otitis media in general practice

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Objectives: To assess clinical determinants of under- and overprescribing of antibiotics according to the Dutch national guideline for patients with acute otitis media (AOM) in general practice.

Patients and methods: A total of 146 general practitioners (GPs) from the Netherlands included all patients with AOM during a 4 week period in winter, and recorded patient characteristics, clinical presentation and management. Under- and overprescribing of antibiotics in AOM was assessed using the Dutch national guideline.

Results: A total of 458 AOM consultations were recorded. In seven out of 10 consultations (310/439; excluding 19 consultations in which patients were referred to secondary care), antibiotic prescribing decisions were according to the national guideline. In 11% of all consultations (50/439), there was underprescribing and in 18% (79/439) there was overprescribing. Patients with an antibiotic indication but without an antibiotic prescription (underprescribing; $n = 50$) had more short-term symptoms (OR: 0.93), relatively few inflammation signs (OR: 0.47) and were less severely ill (OR: 0.30), compared with patients with an antibiotic indication and an antibiotic prescription ($n = 167$). Patients without an antibiotic indication but with an antibiotic prescription (overprescribing; $n = 79$) were more often younger than 24 months (OR: 0.34), more severely ill (OR: 3.30) and expected more often an antibiotic as perceived by their GP (OR: 2.11), compared with patients without an antibiotic indication and without an antibiotic prescription ($n = 143$).

Conclusions: Clinical determinants which are stated as criteria for antibiotic treatment of AOM in the Dutch national guideline were recognized by GPs as important items, but were frequently given too much weight.

Keywords: antibiotic prescribing, appropriateness, general practice, the Netherlands

Introduction

Acute otitis media (AOM) is one of the most common diseases in general practice, especially in children (incidence: 200 per 1000 patient-years for children aged 0–4 years¹). Antibiotics are a common treatment of AOM in many countries,² in spite of evidence that they only have a limited effect.^{3–5} The proportion of patients with AOM who receive antibiotics varies among countries, ranging from about 95% in the USA,² Canada,⁶ UK,² New Zealand,⁷ Sweden⁸ and Spain,⁹ to about 50% in the Netherlands.¹⁰

There is much discussion about what might be an optimal antibiotic prescribing rate in patients with AOM. Overprescribing of antibiotics leads to unnecessary costs, frequent side effects and risk of antimicrobial resistance.^{11,12} On the other hand, some suggest that a very restricted antibiotic use in respiratory tract infections is associated with a relatively high incidence of complications.^{13,14} Notably, our group showed a somewhat higher incidence of acute mastoiditis in the Netherlands as opposed to countries with higher antibiotic use for AOM.¹⁵ Thus, it is important not only to study overprescribing of antibiotics in AOM but also possible underprescribing, in order to enhance evidence-based use of antibiotics

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in general practice without putting patients at risk for preventable complications.

Therefore, this study assessed clinical determinants of under- and overprescribing of antibiotics in Dutch general practice patients with AOM. To study this association, the Dutch general practice setting is well suited because of patient enlistment, high involvement of general practitioners (GPs) in research projects, and computerized records of patient contacts in daily practice.

Patients and methods

Setting, GPs and patients, and data collection

Data for this study were prospectively collected. About 600 GPs in the middle region of the Netherlands were invited to participate and 146 GPs volunteered. The participating GPs included all patients with a diagnosis of AOM (complaints persisting up to 21 days) during a 4 week period between November 2002 and May 2003. For each consultation, GPs recorded patient characteristics, clinical presentation, their perception of the severity of illness, and whether patients (or their parents) expected an antibiotic (Table 1). At the end of the consultation, the final diagnosis and management (reassurance, symptomatic treatment, antibiotics, referral to secondary care) were recorded. Because we aimed to describe everyday practice, GPs interpreted the signs and symptoms of their patients in their usual way. Only consultations with diagnosis code H71 ‘acute otitis media’, classified according to the International Classification of Primary Care (ICPC) coding,¹⁶ were included. Medication was classified according to the Anatomical Therapeutic Chemical (ATC) classification system.¹⁷ All records were checked after the 4 weeks of recording and additional information was gathered from the electronic patient records.

Antibiotic prescribing according to the Dutch national guideline: criteria

To assess under- and overprescribing of antibiotics, the recommendations of the national guideline on AOM of the Dutch College of General Practitioners¹⁸ (which apply to ear complaints persisting up to 21 days) were converted into criteria, by three GPs with special expertise on AOM. The criteria are given in Table 2. Only one of these criteria was expert-based and not guideline-based, i.e. the need for more than four episodes of AOM in a year for children aged 6–24 months. These criteria were put into an algorithm for data analysis. This algorithm was used to categorize all AOM consultations according to antibiotic indication and prescribing; categories were: antibiotics indicated and prescribed (category A), antibiotics not indicated but prescribed (overprescribing; B), antibiotics indicated but not prescribed (underprescribing; C) and antibiotics not indicated and not prescribed (D).

Analysis

After description of the management of AOM in three age groups (infants from 0 to 2 years, children from 3 to 12 years, and patients aged 13 years and over), the algorithm for under- and overprescribing of antibiotics was applied to all consultations (excluding those in which patients were referred to secondary care). After checking for interactions between age and clinical determinants, we calculated the independent association (univariate and multivariate) between patient characteristics, clinical presentation and GPs’ perception of severity of illness and whether the patient expected an antibiotic on the one hand (see Table 1 for the exact determinants for analysis), and under- and overprescribing of antibiotics on the other; underprescribing was defined as consultations in which an indication was present without an antibiotic prescription (C) versus consultations in which an indication was present with an antibiotic

Table 1. Determinants as recorded and used in analyses

Determinants	Categories	Classification
Patient characteristics		
age	2	1 = 0–24 months, 2 = 25+ months
gender	2	1 = male, 2 = female
type of insurance	2	1 = National Health Insurance, 2 = private health insurance
comorbidity (respiratory, ear, nose or throat malformations, immunodeficiencies)	2	0 = absent, 1 = present
Clinical presentation		
previous episodes for the same diagnosis in the last year	continuous	in number of episodes
duration of symptoms prior to consultation	continuous	in days
worsening since previous contact in same episode	2	0 = no worsening or no previous contact, 1 = yes
cough	2	0 = absent, 1 = present
earache or ear grasping in case of infant	2	0 = absent, 1 = present
signs of inflammation (fever, ear discharge and deviating colour or position of the tympanic membrane)	continuous	in number of signs
GP’s perception of:		
severity of illness	4	1 = light to 4 = severe
whether the patient (or his/her parent) expected an antibiotic	5	1 = definitely not to 5 = sure

Antibiotic under- and overprescribing in acute otitis media

Table 2. Criteria for antibiotics in cases of acute ear complaints (persisting up to 21 days) according to the guideline of the Dutch College of General Practitioners

Antibiotics are indicated when the following factors are present:		
Clinical presentation:	<i>For children aged 0–24 months:</i>	<i>For patients aged 25 months or over:</i>
	Earache <i>or</i> fever <i>or</i> child grasps the ear and Red, bulging <i>or</i> retracted tympanic membrane <i>or</i> ear discharge and	Earache <i>or</i> fever and Red, bulging <i>or</i> retracted tympanic membrane <i>or</i> ear discharge and
Severity of illness and risk of complications:	<i>Only for infants over 6 months:</i>	
	More than 4 episodes of AOM a year <i>or</i> severely ill <i>or</i> more than 3 days of complaints <i>or</i> worsening since previous contact <i>or</i> ear, nose <i>or</i> throat malformations	Severely ill <i>or</i> more than 3 days of complaints <i>or</i> worsening since previous contact <i>or</i> ear, nose <i>or</i> throat malformations
Or (in all age groups)		
More than 14 days ear discharge		

Amoxicillin is the antibiotic of first choice in all cases.

prescription (A), and overprescribing was defined as consultations in which no indication was present with an antibiotic prescription (B) versus consultations in which no indication was present without an antibiotic prescription (D). Associations were assessed by odds ratios (ORs) with 95% confidence intervals (95% CI) using logistic regression (backward stepwise analysis) with Generalized Estimating Equation (GEE) estimations¹⁹ to control for clustering at the level of GPs.

For descriptive analyses, SPSS version 12.0 was used and for the GEE analysis SAS version 8.02.

Results

Consultations and patients

The 146 GPs included a total of 458 AOM consultations (median: 3 consultations per GP; range: 1–15 consultations). The median age of the patients was 4 years (mean: 10 years; range: 0–87 years) and 49% were male (Table 3). More than 80% of all patients had earache and 16% had ear discharge. The only significant differences between the age groups [infants from 0 to 2 years (171 patients), children from 3 to 12 years (197 patients), and patients aged 13 years and over (90 patients)] were for fever and cough. These latter symptoms were most often present in younger patients: presence of fever was 51% in infants, 43% in children and 24% in older patients, and presence of cough was 39%, 23% and 10%, respectively ($\chi^2 = 17$ for fever, and 27 for cough with $df = 2$ and $P < 0.001$).

Management of AOM and antibiotic prescribing

In three-quarters of all consultations, GPs reassured the patient (75%; 343/458 consultations), with no differences between age groups [infants (0–2 years): 75%; children (3–12 years): 76%; older patients (13+ years): 73%]. In 4% of consultations, patients were referred to secondary care ($n = 19$), these consultations were not taken into consideration in further analyses (consultations for analyses; $n = 439$). Antibiotics were prescribed in 56% of the consultations (246/439 consultations). Amoxicillin was the most frequently prescribed antibiotic (82%), and amoxicillin/clavulanate and macrolides were prescribed in 7% and 9% of all antibiotic prescriptions ($n = 246$), respectively. These latter percentages vary little between the three age groups (Figure 1).

Table 3. Patient characteristics ($n = 458$)

Patient characteristics	Percentage
Gender	
male	49
Earache or ear grasping in case of infant ^a	
present	83
Ear discharge	
present	16
Number of episodes in the last year	
more than 4	5
Perception of severity of illness	
marked/severe	20
Duration of symptoms prior to consultation	
0–2 days	26
3–7 days	52
8–21 days	22
Fever	
present	42
Cough	
present	26

^aIn infants, ear grasping is an indication of earache, older patients can state whether or not they have earache.

Amoxicillin was prescribed in 84% of all prescriptions ($n = 97$) in infants, amoxicillin/clavulanate in 6% and macrolides in 9%. In children, these percentages were 84%, 6% and 7%, respectively (95 prescriptions), and in older patients 74%, 9% and 11%, respectively (54 prescriptions).

Appropriateness of antibiotic prescribing

In about half of the AOM consultations, antibiotics were indicated (category A + C = 49%; Table 4) and in three-quarters of these consultations, an antibiotic was prescribed (A versus C = 38% versus 11%); thus, in one-quarter of these consultations an antibiotic was not prescribed while indicated. In the other half of the AOM consultations, antibiotics were not indicated (B + D = 51%; Table 4), but in one-third of these consultations an antibiotic was prescribed (B versus D = 18% versus 33%). This means that in

seven out of each 10 AOM consultations the antibiotic prescribing decisions were according to the guideline (A + D = 71%; Table 4). One-third (29%) of the antibiotic prescribing decisions were inappropriate (B + C); in 11%, antibiotics were indicated but not prescribed (C: underprescribing) and in 18% antibiotics were not indicated but prescribed (B: overprescribing). These percentages varied little between the three age groups.

Determinants of under- and overprescribing of antibiotics

There were no interactions between age and clinical determinants relating to under- or overprescribing of antibiotics. Patients who should have been prescribed an antibiotic according to the Dutch national guideline but who did not get it, had a shorter duration of symptoms, had few inflammation signs (e.g. fever), and were less severely ill according to their GP, compared with the remaining patients to whom antibiotics were indeed prescribed (Table 5).

Patients who should not have been prescribed an antibiotic according to the Dutch national guideline but did get a prescription,

were younger than 24 months of age, were more severely ill according to the GP, and their GP assumed more often that they (or their parents) expected an antibiotic, compared with those who did not get an antibiotic (Table 5).

Discussion

According to the Dutch national guideline, in this study, in 11% of AOM consultations patients were not prescribed an antibiotic when it was indicated (underprescribing), and in 18% of consultations patients were prescribed an antibiotic when it was not indicated (overprescribing). Clinical determinants which are stated as criteria for antibiotic treatment in the Dutch national guideline were recognized by GPs as important items, but given too much weight when treating patients with AOM. In addition, patients' expectation as perceived by their GP was a strong non-clinical determinant of a GP's decision to prescribe antibiotics.

Strengths and weaknesses of the study

This study addressed 458 consultations from 146 GPs. The recruitment rate was in line with the incidence of AOM, because, based on Dutch national morbidity studies,^{1,20} we expected somewhat less than 1 consultation per week per GP. Characteristics of the participating GPs did not differ from other Dutch GPs.²¹ However, because the participating GPs were volunteers, they may more often follow guidelines than non-participating GPs. In that case, our results could underestimate inappropriateness of antibiotic prescribing. It is, however, highly unlikely that a possible underestimation of inappropriate antibiotic prescribing will bias the associations explored in this study.

While our data can be considered complete for consultations and antibiotic prescriptions, misclassification of clinical determinants is possible. Such misclassification because of missing data might result in inaccurate estimates of the appropriateness of antibiotic prescribing. However, bias would only occur if misclassification is limited to a specific subgroup of patients; we think that this is highly unlikely.

Guidelines are partly evidence-based and partly based on expert opinion, and should be regarded as the best indication at this moment as to how patients should be treated. For individual

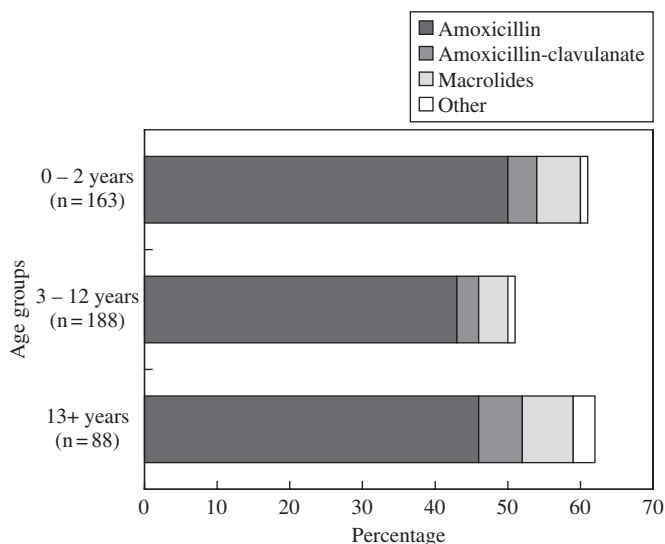


Figure 1. Antibiotic prescribing for acute otitis media per age group (n = 439; 19 patients referred to secondary care were excluded).

Table 4. Appropriateness of antibiotic prescribing for acute otitis media (n = 439; 19 patients referred to secondary care were excluded)

Acute otitis media consultations		Antibiotic indicated according to the Dutch national guideline		
		yes	no	total
Antibiotic prescribing	yes	A: 38% antibiotics indicated and prescribed (n = 167)	B: 18% antibiotics not indicated, but prescribed (n = 79)	56% (n = 246)
	no	C: 11% antibiotics indicated, but not prescribed (n = 50)	D: 33% antibiotics not indicated and not prescribed (n = 143)	44% (n = 193)
	total	49% (n = 217)	51% (n = 222)	100% (n = 439)

A, antibiotics appropriately prescribed; B, antibiotics inappropriately prescribed (overprescribing); C, antibiotics inappropriately not prescribed (underprescribing); D, antibiotics appropriately not prescribed.

Antibiotic under- and overprescribing in acute otitis media

Table 5. Determinants of under- and overprescribing of antibiotics for acute otitis media; univariate and multivariate odds ratios (ORs) with 95% confidence intervals (95% CI)

Variables in model	Univariate OR (95% CI) ^a	Multivariate OR (95% CI) ^a
Underprescribing (outcome C versus A)		
duration of symptoms prior to consultation	0.96 (0.89–1.04)	0.93 (0.86–1.00)
number of inflammation signs	0.38 (0.20–0.74)	0.47 (0.23–0.97)
severity of illness	0.29 (0.18–0.48)	0.30 (0.18–0.50)
Overprescribing (outcome B versus D)		
age	0.54 (0.31–0.93)	0.34 (0.16–0.75)
severity of illness	3.76 (2.46–5.73)	3.30 (2.08–5.22)
whether the patient (or his/her parent) expected an antibiotic	2.27 (1.60–3.20)	2.11 (1.47–3.02)

^aOdds ratio < 1: negative association [the lower the value of the variable (Table 1), the more under- or overprescribing]. Odds ratio > 1: positive association (the higher the value of the variable, the more under- or overprescribing).

patients, GPs can of course have valid reasons to deviate from the guidelines. However, for large groups of patients, we think that non-compliance with the current guidelines is the best estimation of inappropriate antibiotic prescribing in the total group of patients under study.

Comparison with the literature

The rates of under- and overprescribing of antibiotics we found are comparable with those reported more than 10 years ago in the Netherlands.²² Our results showed that characteristics such as age of the child, duration of symptoms, signs of inflammation (e.g. fever) and severity of illness, all of which are mentioned in the guideline as criteria for antibiotic treatment, were recognized by GPs as important items but not applied in a correct manner. In the presence of only one or two criteria (e.g. a red tympanic membrane with severe illness), some GPs prescribed an antibiotic, whereas a combination of at least three criteria (e.g. presence of fever, a red tympanic membrane and severe illness) is required for an antibiotic according to the Dutch guidelines. It may be difficult for GPs to appreciate combinations of multiple signs and symptoms. This study confirmed earlier findings on inappropriate assessment of the clinical impact of severity of illness and GPs' perception of patients' expectations as causes of overprescribing.^{23,24} In daily practice, it is worthwhile to explore whether the patient with for example a respiratory tract infection (or his/her parent) really does expect an antibiotic or merely desires reassurance that nothing is seriously wrong, as we found in an earlier study.²⁵

Our conclusion is that both under- and overprescribing of antibiotics for AOM are important problems in Dutch general practice. More appropriate use of the Dutch national guideline in this field should be targeted to prevent under- and overprescribing of antibiotics. In particular, a correct interpretation and recognition of combinations of signs and symptoms as indications for antibiotic therapy should be emphasized. To obtain these targets, a multiple educational intervention has been proven effective in the Netherlands.²⁶

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