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ORIGINAL ARTICLE

Primary care management of respiratory tract infections in Dutch preschool children

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Abstract

Objective. To determine age-specific antibiotic prescription and referral rates in preschool children diagnosed with acute respiratory tract infection (RTI) in primary care. *Design*. Retrospective cohort study. *Setting*. Research database of the Netherlands University Medical Center Utrecht Primary Care Network. *Subjects*. All children aged 0–5 years within the database were included, covering 1998 to 2002 (18,801 child-years). *Main outcome measures*. Antibiotic prescription and referral rates were determined as percentage of children with at least one prescription or referral within a year, as total number of prescriptions per 1000 child-years, and as percentage of all RTI episodes. *Results*. Antibiotics, mostly beta-lactam (80%) and macrolides (16%), were prescribed in 35% of RTI episodes. Annually 13% of the children received at least one antibiotic following an RTI. Antibiotics were prescribed in more than half of episodes of LRTI, sinusitis, AOM, and acute tonsillitis, and in 12–15% of episodes of asthma exacerbation, acute laryngitis, influenza acute, and acute upper respiratory infection (including common cold and pharyngitis). Almost 98% of RTIs were managed in primary care. On average 1% of the children were referred to a paediatrician or ENT specialist following RTI per year, especially after AOM (59% of referrals). Compared with older children, those under two years of age were more often treated with antibiotics (relative risk [RR] 1.4, 95% CI 1.3–1.6) and referred (RR 2.3; 95% CI 1.8–3.0). *Conclusion*. In the Netherlands most episodes of RTIs in preschool children were managed in primary care and this often involves prescription of antibiotics. Children younger than two years of age receive more often antibiotics for RTI and are also referred more, especially for AOM.

Key Words: *Anti-bacterial agents, child, family practice, referral and consultation, respiratory tract infections*

Respiratory tract infections (RTIs) are the most common diagnoses in primary care [1–3]. Preschool children in particular suffer from respiratory tract infections [3–6]. However, only a few studies have assessed aspects of primary care management of the various RTIs and referral to secondary care in these children over a period of several years.

Most childhood RTIs have a viral aetiology and are self-limiting [4,7,8]. Yet, RTIs are the indication for 75% of the total amount of prescribed antibiotics in Western countries and most referrals to secondary care in children are because of respiratory symptoms [3,9]. Besides causing health-care costs and side effects, liberal use of antibiotics causes bacterial resistance. In the Netherlands bacterial resistance to antibiotics is still among the lowest in the world, probably due to limited use of antibiotics in that country [10]. In view of the marginal efficacy of both antibiotics and ear–nose–throat (ENT) surgery for recurrent RTI [11–13], preventive strategies such as immunization need to receive more attention. In assessing the cost-effectiveness of such strategies, baseline information is required regarding current management and referral rates for RTI. The present study was carried out to gain insight into these matters. Since children below the age of two years are considered to be more prone to RTIs due to

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Baseline information on the management of respiratory infection in preschool children is needed in order to evaluate the potential impact of preventive strategies such as immunization.

- This multiple-year study demonstrated that 98% of respiratory infections were managed in primary care.
- Children under the age of two accounted for most antibiotic prescriptions and referral in primary care, especially for acute otitis media.
- Measures to prevent respiratory infection in young children may substantially reduce the primary healthcare burden and amount of antibiotic prescriptions.

immaturity of the immune system and the developing anatomy of the airways [14,15], we also determined potential differences in primary care management among these children as compared with older children.

Material and methods

Setting and study population

All data for this retrospective cohort study were obtained from the computerized medical database of the University Medical Center Utrecht Primary Care Research network. Twenty general practices, covering a cumulative population of about 60,000 patients, participate in this network. Main characteristics of this patient population are similar to the Dutch population as a whole [16]. Medical data of all enlisted patients have been recorded using a uniform, structured, contact registration format in the general practitioner information system ELIAS® (ISoft, Nieuwegein, Netherlands). The participating GPs received education regarding the correct coding of diagnostic information according to the International Classification of Primary Care (ICPC) coding system [17,18]. More than 90% of contacts have received an ICPC code and accuracy appeared high. Prescribed medication is also recorded in the database, including the Anatomical Therapeutic Chemical (ATC) code [19].

For this study all children aged 0 to 5 years enlisted in the participating practices between 1998 and 2002 were included. This study population covered 18,801 child-years. The size of the cohort did not change substantially over the years.

Outcomes

Outcomes of interest were prescription of antibiotics and rate of referral to the paediatrician or ENT specialist after GP-attended acute RTI. We defined an RTI as a clinical diagnosis of acute otitis media/myringitis (ICPC code H71), acute upper respiratory infection (R74) (including common cold and pharyngitis), sinusitis (R75), acute tonsillitis (R76), acute laryngitis/tracheitis (R77), acute bronchitis (R78), influenza (R80), pneumonia (R81), other RTI (R83), or exacerbation of asthma, defined as asthma (R96), and the use of systemic corticosteroids (H02AB or H02B). Asthma exacerbation was considered as RTI, because it has been shown frequently to be induced by viral infections, most commonly rhinovirus [20]. Lower RTI (LRTI) was defined as acute bronchitis (R78) or pneumonia (R81). A new GP-attended RTI was recorded after a consultation-free interval of at least 28 days. Since there was no direct link in the database between a disease episode and antibiotic prescription or referral, we defined for antibiotic prescription a time window beginning three days before and ending after the RTI episode (maximum of 28 days). Antibiotics (ATC code J01) were subdivided into β-lactam antibiotics including penicillins (J01C), sulfonamides and trimethoprim (J01E), macrolides, lincosamides, and streptogramins (J01F). Referrals from primary care to a paediatrician or ENT specialist were recorded by review of the medical records.

Analysis

The mid-time population of each consecutive year was determined at 1 July. Age-specific antibiotic prescription and referral were determined on episode level, i.e. the percentage of episodes leading to antibiotic prescription and referral. Antibiotic prescription and referral rates were also calculated per 1000 child years by dividing the number of prescriptions and referrals by the total number of child-years. Additionally we calculated the antibiotic prescription and referral rates on child level, i.e. the percentage of children with at least one prescription or referral per year (children could only contribute once within a year to this percentage). The study population was divided into children younger and older than two years of age, to determine differences in antibiotic prescriptions rates and referral rates between both age groups. Relative risks (RRs) with 95% confidence intervals (95% CI), and 95% CIs for proportions and rates were determined with Rothman's spreadsheets [21].

Results

Antibiotic prescription

In 35% (95% CI 34.5–36.4) of all GP-attended acute RTIs antibiotics were prescribed: in 50% or more of episodes of LRTI, sinusitis, AOM, and acute tonsillitis, and in 12–15% of episodes of asthma exacerbation, acute laryngitis, influenza, and acute upper respiratory infection, including common cold and pharyngitis (Table I). In 80% (95% CI 78.9–81.6) of all RTI episodes in which antibiotics were prescribed, β-lactam antibiotics (including penicillins) were chosen, in 16% (95% CI 15.0–17.5) macrolides, lincosamides, or streptogramins, and in 7% (95% CI 5.8–7.4) trimethoprim or sulfonamines (since sometimes more than one type of antibiotic was prescribed per RTI episode, the sum of these percentages exceeds 100%).

On average 13.3% of children (95% CI 12.8–13.9) received antibiotics for a GP-attended RTI at least once yearly. In total 197 courses of antibiotics were prescribed per 1000 child years. Almost 49% of all antibiotics were prescribed because of AOM, followed by 27% for LRTI and 15% for upper respiratory tract infection (including common cold and pharyngitis).

The amount of antibiotics prescribed for RTI was higher in children below two years of age compared with older children; on average 18.0% versus 12.4% of the children received antibiotics at least once yearly, RR 1.45, 95% CI 1.34–1.56 (Table II). On episode level, however, children below two years of age had a somewhat lower probability of receiving antibiotics for all RTIs together than older children (relative risk (RR) of 0.87, 95% CI 0.82–0.92), and LRTI (RR 0.77, 95% CI 0.71–0.84). For AOM, however, children below two years of age had a slightly higher probability of receiving antibiotics (RR 1.13, 95% CI 1.06–1.21).

Table I. Antibiotic prescription for RTI on episode level.

Type of RTI	Percentage of antibiotic prescription (episode level)	95% CI
All RTIs	35.4	34.5–36.4
LRTIs	57.0	54.6–59.4
Sinusitis	61.5	42.5–77.6
AOM	49.7	48.0–51.4
Acute tonsillitis	47.3	42.4–52.1
Asthma exacerbation	15.0	5.2–36.0
Acute upper respiratory infection	14.1	13.0–15.2
Acute laryngitis/tracheitis	11.7	8.5–16.0
Influenza	11.6	5.1–24.5
Other RTIs	54.2	45.3–62.8

Referrals

Overall, in 2.2% (95% CI 1.9–2.5) of GP-attended RTI episodes children were referred to secondary care (51% ENT specialist, 46% paediatrician). For children with tonsillitis this proportion was 4.5%, for AOM and sinusitis 3.8%, and for LRTI 3.3%. On average 1.1% of the children (95% CI 0.9–1.2) were referred at least once per year (including referral to the emergency ward) after a GP-attended RTI. Most referrals were because of AOM (59%) and LRTI (25%); 83% of the referrals to the ENT specialist were because of AOM. Children younger than two years old were referred more often than older children (RR 2.3, 95% CI 1.76–3.05) (Table III). Episode-based referrals in both age groups were less different from each other (RR 1.27, 95% CI 0.97–1.66), although for AOM (RR 1.41, 95% CI 1.09–1.84) and especially for LRTI (RR 7.99, 95% CI 3.17–20.12) it was higher for children younger than two years of age.

Discussion

This five-year study demonstrated an overall antibiotic prescription rate of 35% for acute RTI among preschool children in primary care. Almost all GP-attended RTIs were managed in primary care; only 2.2% of RTI episodes resulted in referral to a pediatrician or ENT specialist. AOM proved to be by far the most frequent reason for antibiotic prescription and referral. Children below two years of age received more antibiotics and were referred more often as compared with older children.

Antibiotic prescription has proven to be relatively low in the Netherlands compared with other countries [22–25]. Our study also showed lower prescription rates for the various RTIs than those reported in many other countries, although these rates are not completely comparable due to the definition of different age groups [25–27]. Except for sinusitis the antibiotic prescription rates found in our study are somewhat higher than those reported by a previous Dutch study [28]. This may be caused by the fact that we used episode-based antibiotic prescription rates instead of contact-based rates. We defined an RTI episode to have ended after a consultation-free interval of 28 days, because we hypothesized that most parents would revisit their GP within 28 days if their child continued to have serious respiratory complaints. We also defined a time window for antibiotic prescription lasting for 28 days. This may possibly have led to a slight overestimation of the antibiotic prescription rate. Besides contact-based instead of episode-based rates and applying slightly different definitions of clinical

Table II. Age-specific antibiotic prescription for all RTIs together.

Age (years)	Percentage of children that received at least one antibiotic prescription per year	Number of prescriptions per 1000 child-years	Percentage of episodes with antibiotic prescription
0	17.2	258	30.9
1	18.8	284	34.9
2	15.1	198	36.8
3	12.8	157	37.1
4	13.1	168	40.0
5	8.5	102	38.3

entities, the discrepancy in prescription rates may be explained by the fact that they determined the rates over one year while we covered five years [28].

Cultural factors such as habits, patients' expectations, and the structure of the healthcare system may result in differences in clinical practice guidelines between countries [29]. The national guidelines of the Dutch College of General Practitioners are displayed in Table IV. In view of these guidelines, the antibiotic prescription rates in our study may still seem high. Our finding that 15% of the total amount of antibiotics for RTI was prescribed for acute upper respiratory infection (including common cold and pharyngitis), a condition that is generally considered to be self-limiting, suggests that GPs do not always follow these guidelines. We also found that in 15% of the RTI episodes in which antibiotics were prescribed, macrolides were given. This supports the fact that the use of broad-spectrum antibiotics like macrolides is considerable [10,30,31].

Our study confirms that most RTIs are managed in primary care [3]; only 2.2% of GP-attended episodes resulted in referral to secondary care. Since RTIs are very common conditions among preschool children, the number of referrals is, however, high, especially in children younger than two years of age. Although the amount of prescribed antibiotics and number of referrals were clearly higher among children younger than two years of age compared with older children, episode-based antibiotic prescription and referral rates were less different. This indicates that the higher amount of antibiotics and number of referrals among children younger than two years of age were mainly caused by the higher frequency of consults for RTI. For LRTI, however, we found that on episode level younger children received antibiotics less often, despite the fact that their immune system is less mature and less capable of handling these infections than in older children [16]. In contrast, younger children were more often referred on episode level for AOM and especially for LRTI. It may be that in younger children compared with older children, GPs are less confident about their diagnosis of RTI in the case of lower respiratory symptoms (such as acute bronchitis), and consequently prescribe antibiotics less and refer more.

To appreciate the results of our study, some possible limitations should be discussed. The validity of our study depends on the accuracy with which the participating GPs registered the consultation and prescription of antibiotics. More than 90% of all patient contacts were coded and GPs were trained once yearly to register the conditions and management appropriately. In the Netherlands most inhabitants are registered with a GP. The GP functions as a 'gatekeeper' and a patient may only attend secondary healthcare when he or she has been referred by the GP. In the case of an emergency, the GP may be bypassed. It is therefore possible that antibiotic prescription rates for the more serious LRTIs may have been slightly underestimated in our study since medication use resulting from emergency

Table III. Age-specific referral rates for all RTIs together.

Age (years)	Percentage of children that were referred at least once per year	Number of referrals per 1000 child-years	Percentage of episodes with referral
0	1.7	18.1	2.4
1	1.7	18.6	2.5
2	1.0	10.3	2.0
3	0.8	8.6	2.1
4	0.7	6.9	1.8
5	0.4	4.3	1.7

Table IV. Guidelines for antibiotic prescription according to the Dutch College of General Practitioners.

Clinical entity	Indication for antibiotic prescription
AOM	Age $\leq$6 months
	Abnormal course:
	– progressing illness, decreased fluid intake, increasing earache
	– no improvement after three days
	Age $<$2 years with a recurrence of AOM within 12 months
	Presence of relevant comorbidity
Acute bronchitis/ cough	Age $\leq$6 months and presence of fever
	Presence of relevant comorbidity
Pneumonia	Always
Sinusitis	Abnormal course:
	– serious illness, alarm symptoms
	– more than 5 days' complaints
	Presence of relevant comorbidity
Throat infection	Serious illness/serious scarlet fever: peritonsillar infiltrate or abscess-forming lymphadenitis
	Presence of risk factors for complications
Acute upper respiratory infection	No indication

visits or hospital admissions may not have been recorded. However, most RTIs do not need such visits.

A major strength of our study is the use of a reliable extended research database including a large study population followed up for several years. Further, this is, to our knowledge, the first study assessing antibiotic prescription and referral rates in preschool children in one-year age categories.

In conclusion, although in the Netherlands most episodes of RTI among preschool children are managed in primary care and conservatively, its high frequency results in large antibiotic consumption and many referrals, especially in children younger than two years of age. In view of the increasing bacterial resistance to antibiotics and their limited efficacy for RTIs, together with the only marginal effects of surgical interventions for recurrent RTI [11–13], more attention needs to be paid to the possible role of preventive therapies such as immunization. As most RTIs are managed in primary care, such preventive strategies may substantially reduce the primary healthcare burden of these infections in young children.

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