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REVIEW ARTICLE

Diagnosis and treatment of acute otitis media: review

EDWARD C TOLL[1], DESMOND A NUNEZ[2]

[1]*University College London Ear Institute, and* [2]*Academic Department of Otolaryngology | Head and Neck Surgery, ENT Unit, Southmead Hospital, Bristol, UK*

Abstract

Background: Acute otitis media is very common, but diagnostic criteria and treatment recommendations vary considerably.

Methods: Medline, the Cochrane Database of Systematic Reviews and the Cochrane Central Register of Controlled Trials were searched using the key words 'acute otitis media' AND 'diagnosis' OR 'diagnostic criteria' OR 'definition', and by combining the terms 'acute otitis media' AND 'guidelines'. PubMed was searched using the key words 'mastoiditis' and 'prevalence'.

Results: The 11 most recently published guidelines unanimously agreed that adequate analgesia should be prescribed in all cases. The majority recommended that routine antibiotic prescription should be avoided in mild to moderate cases and when there was diagnostic uncertainty in patients two years and older. Antibiotics were recommended in children two years and younger, most commonly a 5-day course of amoxicillin (or a macrolide in patients allergic to penicillin).

Conclusion: Level 1A evidence shows that selected cases of acute otitis media benefit from antibiotic prescription.

Key words: Otitis Media; Practice Guideline; Diagnosis; Therapy; Mastoiditis

Introduction

Acute otitis media is one of the most common ear diseases affecting children in the UK, with 15 747 completed in-patient consultant episodes recorded in the 2009–2010 financial year.[1] How is it defined and diagnosed, and what is the evidence base? A 1981 survey found that, out of 43 acute otitis media studies identified, only 26 described their diagnostic criteria, and that there were 18 different sets of criteria.[2]

Literature review

Medline, the Cochrane Database of Systematic Reviews and the Cochrane Central Register of Controlled Trials were searched to 6 August 2010, using the key words 'acute otitis media' in the title AND 'diagnosis' OR 'diagnostic criteria' OR 'definition' in the title or abstract, identifying 195 titles. Combining the terms 'acute otitis media' in the title AND 'guidelines' in the title or abstract produced 50 titles. The two authors independently judged the titles identified for relevance to the review. Full titles selected by either author were retrieved and their reference lists likewise searched for relevant articles.

Additional searches of the UK National Institute of Health and Clinical Excellence (NICE) and of the Agence Française de Sécurité Sanitaire des Produits de Santé (French Health Products Safety Agency) directory of guidelines, in November 2009 and May 2010, identified two guideline documents.

Relevant papers not identified by the search strategy but known to the senior author were also reviewed.

PubMed was searched for trials, meta-analyses, reviews, studies, government publications, guidelines and journal articles published between 1 January 2005 and 31 July 2011, with the key words 'mastoiditis' and 'prevalence', applying the following restrictions: human, child 0–18 years and English language publication. This yielded 39 titles, of which 14 were selected based on their relevance to the review. Ten of these 14 titles were excluded from further study, because they were not national studies, included less than 100 mastoiditis cases, or presented duplicate data.

Diagnosis

The American Academy of Family Physicians and the American Academy of Pediatrics guidelines for the diagnosis and management of acute otitis media are

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based on a systematic review which defines diagnostic criteria for acute otitis media in children.[3,4] These criteria have three components: a history of acute onset of symptoms, signs of a middle-ear effusion and features of middle-ear inflammation. Otoscopic examination is highlighted as particularly important, including pneumatic otoscopy to identify middle-ear effusion.[3] Whilst the committee concluded from five studies that tympanometry and acoustic reflexometry were useful for diagnosing middle-ear effusion, a subsequently published trial found that tympanometry did not influence prescribing behaviour.[5–10] The single feature with the highest predictive value for diagnosing a middle-ear effusion consistent with acute otitis media was bulging of the tympanic membrane. The predictive value of a bulging tympanic membrane was increased when combined with impaired mobility and abnormal colouration.[11–13] These criteria have been adopted by the US Centers for Disease Control and Prevention.

The UK National Institute for Health and Clinical Excellence has published no guidelines on acute otitis media diagnosis; however, the UK National Health Service Clinical Knowledge Summaries publication cites diagnostic criteria drawn from a 2003 systematic review of six studies by Rothman *et al.*, which was not referenced by the American Academy of Family Physicians and American Academy of Pediatrics guidelines.[14,15] These National Health Service criteria are more specific about presenting symptoms (e.g. earache, pulling or rubbing the ear in younger children, and non-specific symptoms such as fever and irritability), but the examination findings stipulated are very similar to those in the American Academy of Family Physicians and American Academy of Pediatrics guidelines.

The 2008 Alberta Clinical Practice Guidelines highlight the importance of distinguishing between myringitis and acute otitis media, the main difference being the lack of tympanic membrane mobility seen in the latter condition.[16] Reduced mobility on pneumatic otoscopy is a key component of acute otitis media diagnosis in this document. The 2004 Cincinnati Children's Medical Center guidelines likewise recommend pneumatic otoscopy and tympanometry to improve diagnostic accuracy.[17] The British Columbia Medical Association, however, disapproves of diagnostic pneumatic otoscopy as it may cause severe pain.[18]

The acute otitis media diagnostic criteria presented in the French Health Products Safety Agency guidelines for antibiotic treatment of upper respiratory tract infections highlight the key importance of otoscopic findings obtained with good otoscopic technique.[19] The French guidelines and the American Academy of Family Physicians and American Academy of Pediatrics guidelines are almost identical. Otalgia and fever are heralded as the most classical clinical features of suppurative acute otitis media. Specified otoscopic findings are the absence of the light reflex, loss of normal contour and bulging of the tympanic membrane.

There is consensus in the literature on acute otitis media diagnostic criteria in childhood. In summary, these criteria comprise acute onset of otalgia or symptoms and signs consistent with otalgia (e.g. ear pulling or bulging of an erythematous tympanic membrane), together with loss of the light reflex or the presence of otorrhoea on otoscopy.

The implementation of uniform diagnostic criteria should help to improve diagnostic accuracy and enable more uniform treatment. Otolaryngologists are more accurate than other clinicians in diagnosing acute otitis media,[20,21] with lower false positive rates.[22] This improved accuracy is not related to the use of the oto-microscope.[23] Targeted training of healthcare practitioners in otoscopic examination improves diagnostic accuracy.[24] Such training is therefore justified, as accurate otoscopic examination is the core component required for reliable acute otitis media diagnosis.

Treatment

The management of acute otitis media is controversial, with considerable differences in approach between Western countries. In 1990, the prevalence of antibiotic treatment for acute otitis media varied from 31 per cent in the Netherlands to more than 90 per cent in the USA, Australia, New Zealand, England and Wales.[25] The UK NICE guidelines recommend a strategy of either no antibiotics or delayed antibiotics for acute otitis media treatment, depending on severity, except in children under two years with bilateral otitis media or otorrhoea, in whom antibiotics are recommended.[26] These recommendations are based on a Cochrane review,[27] a meta-analysis,[28] and three large randomised, controlled trials (RCTs).[29–31]

The Dutch College of General Practitioners guidelines similarly advise withholding immediate antibiotic prescription in most cases, except in the 'systemically' ill child or when there are risk factors for acute otitis media complications.[32] These guidelines recommend that antibiotics be considered in children younger than two years in the presence of bilateral acute otitis media, and in children of any age presenting with otorrhoea, failure to improve after 72 hours of conservative treatment, or failure of otorrhoea to resolve spontaneously after one week.

The Scottish Intercollegiate Guideline Network guidance recommends that antibiotics not be routinely prescribed for acute otitis media in any child, irrespective of age.[33] However, this guidance is based on only one study, of children younger than two years.[34] The Scottish Intercollegiate Guideline Network guidance concludes that in all general practice based studies 25–75 per cent of children were excluded, presumably because clinicians felt that these children were too sick to be included in a trial. This means that regimes specifying no or delayed antibiotic prescription are appropriate only for milder acute otitis media cases, which

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account for as little as one in four cases presenting to UK general practitioners.

A 2004 Cochrane review found that the main benefit of immediate antibiotic treatment, compared with initial observation, was a 30 per cent relative reduction in pain at days 2 to 7.[27] However, in four of the studies reviewed, no reduction in pain was found from days 3 to 7. In Rovers and colleagues' meta-analysis, children under two years with bilateral acute otitis media or otorrhoea demonstrated the most benefit from immediate antibiotic treatment.[28] As regards adverse events, children receiving delayed prescription of antibiotics were 12 per cent less likely to develop diarrhoea than those receiving immediate antibiotics. Antibiotics side effects occurred in one in 24 children in the Cochrane review, with an increased risk of rash, diarrhoea and vomiting with immediate antibiotic treatment, compared with observation (risk ratio 1.37; 95 per cent confidence interval (CI) 1.34 to 1.39).

The American Academy of Family Physicians and American Academy of Pediatrics guidelines make different recommendations, and specify what antibiotics should be prescribed. In children aged six months or more, and who are otherwise healthy with non-severe symptoms and an uncertain diagnosis, initial observation is recommended. Antibiotics are recommended in all patients under six months with suspected acute otitis media.[3] These recommendations are based on three meta-analyses and an earlier version of the above Cochrane review.[4,27,35,36] The latter found that, for one child to receive any benefit, one would need to treat between seven and 20 children with antibiotics.

A meta-analysis published by the Agency for Healthcare Research and Quality found a 12 per cent reduction in the clinical failure rate (95 per cent CI, 3–22 per cent) within 2 to 7 days if amoxicillin or ampicillin was prescribed, compared with placebo or observation, with a 'number needed to treat' of eight.[4]

The Cincinnati Children's Hospital Medical Center guidelines differ from the American Academy of Family Physicians and American Academy of Pediatrics recommendations in that they advise antibiotics for all children under two years of age, rather than for those six months and under.[17] Parental involvement in antibiotic prescription decisions reduces antibiotic usage.[37,38] The French Health Products Safety Agency (French) guidelines similarly recommend antibiotics for all children under two years of age and in all cases with severe symptoms, defined as high fever or severe otalgia.[19] For children over two years with non-severe symptoms, a trial of no antibiotics is recommended, with re-evaluation in 48–72 hours. If symptoms are persistent at this stage, then antibiotics are recommended.

The Ontario Guidelines Advisory Committee recommends antibiotics in cases of symptomatic acute otitis media, but recommend deferring antibiotics for children of all ages with 'minimally symptomatic' or asymptomatic acute otitis media.[39] The British Columbia and Alberta guidelines recommend immediate antibiotics in all children under two years, but delayed antibiotics in children over two years, and then only if there is no improvement after 48–72 hours of conservative treatment.[16,18] A recent RCT that stringently assessed clinical signs in children under two years of age demonstrated that amoxicillin 90 mg/kg plus clavulanate 6.4 mg/kg improved the acute otitis media clinical resolution rate from 77 per cent to 96 per cent at 4 days.[40] The number needed to treat was five to six, similar to the seven to eight found by Damoiseaux *et al.*[34] However, the high complete resolution rate at day 4 contrasts markedly with the resolution rates of 41–68 per cent recorded in amoxicillin-treated groups.[34,41] This high early resolution rate supports the use of antibiotics, specifically amoxicillin-clavulanate, in children under two years.

The 2004 Israeli Medical Association guidelines on antibiotic usage in acute otitis media mirror the American Academy of Family Physicians and American Academy of Pediatrics guidelines.[42] Implementation of the former guidelines led to a significant reduction in antibiotic usage in children aged six months to five years.[42]

The 2010 Finnish Medical Society Duodecim guidelines differ considerably from others in that they recommend antibiotics as a rule for all patients regardless of age, although they stress that the diagnosis of acute otitis media must be reliable.[43] This recommendation is based on the rationale that antibiotics may speed up the resolution of symptoms in some children. Antibiotics are recommended in particular for cases of bilateral acute otitis media and children younger than two years. An option to withhold antibiotics in cases of mild inflammation is permitted, although close monitoring and follow up at 2 to 3 days is required.

Optimal analgesia is particularly important when treating acute otitis media.[3,16,18,26,32,43] Otalgia is viewed as a peripheral issue by some clinicians; however, in order to effectively treat acute otitis media, pain should be assessed and managed regardless of antibiotic use. The Finnish guidelines state that effective pain control is the key target of early intervention.[43] In trials assessing antibiotic therapy for acute otitis media, suboptimal analgesia may have had a significant effect on results, as pain is frequently used as an outcome measure.

The risk of developing mastoiditis is not increased by initial observation, compared with immediate antibiotic treatment, and the latter is not an absolute safeguard against complications.[4] Likewise, the incidence of bacterial meningitis is not influenced by whether the child is treated with immediate antibiotics or initial observation and symptomatic treatment. In the updated Cochrane review, which included studies of a total of 2928 children from high-income countries, only one case of mastoiditis was identified.[27]

Therefore, no comment could be made on the risk of developing this complication in patients receiving either immediate antibiotics or initial observation, except to say that it is a rare complication in the countries from which the studies originated.[27] This case of mastoiditis was one of two such cases reported in van Buchem and colleagues' 1985 study.[41] One case was excluded from the trial because mastoiditis was diagnosed at presentation, and the other case occurred in the 'no antibiotic' treatment group. The clinical trials demonstrating the efficacy of a 'no antibiotic' prescription policy in acute otitis media are too underpowered to assess the risk of developing mastoiditis.[44]

In the UK, hospital data revealed almost a doubling in admissions for mastoiditis or simple mastoidectomy in zero- to four-year-olds with the reduction in antibiotic prescription which occurred between 1993 and 2002.[45] This change almost exactly matches the difference in mastoiditis incidence between countries prescribing antibiotics in less than 80 per cent of acute otitis media cases versus those doing so in 100 per cent of such cases (in the late 1990s).[46] In Sweden from 1987 to 2004, there was a 37 and 52 per cent reduction in out-patient antibiotic prescriptions in children aged zero to four and five to 14 years, respectively, which was not accompanied by an increase in mastoiditis prevalence.[47] Thompson and colleagues conducted a 16-year, retrospective study which found that the annual incidence of childhood mastoiditis did not increase over that time; however, they calculated that universal adoption of a 'no antibiotics' prescription policy in the UK would lead to an extra 255 cases of childhood mastoiditis per year.[48] The risks of promoting antibacterial resistance by treating 4834 acute otitis media cases with antibiotics for each one mastoiditis case prevented should be clear to all clinicians.[48,49] Bodies which formulate antibiotic prescription guidelines need to present the implications of guidance strategies for the incidence of mastoiditis and other serious acute otitis media complications, in order to gain the support of clinicians and ultimately the public, who may in some instances have to deal with greater numbers of seriously ill children as a consequence.

Comparing different antibiotic regimes for acute otitis media is challenging. A 2002 review of acute otitis media treatment trial methodology by Dagan and McCracken found that trials comparing differing antibiotic regimes are often limited by significant flaws which could affect outcomes.[50]

One of the most frequent of these flaws is the lack of a clear, uniform definition of acute otitis media, leading to the potential inclusion of patients with otitis media with effusion (OME) rather than acute otitis media. In patients with OME, placebo treatment is likely to be as effective as antibiotics. The French Health Products Safety Agency (French) guidelines recommend amoxicillin-clavulanate or third generation cephalosporins as first-line therapy, with erythromycin for the penicillin-allergic.[19] The UK NICE and Scottish Intercollegiate Guideline Network guidelines refer clinicians to the most recent edition of the *British National Formulary* for specific antibiotic guidance.[26,33] The March 2010 edition of the *British National Formulary* recommended amoxicillin (or erythromycin if allergic to penicillin) as first-line therapy.[51] The American Academy of Family Physicians and American Academy of Pediatrics guidelines likewise recommend amoxicillin as the first-line agent for non-severe infections; however, in severe infections additional coverage of β-lactamase positive organisms with amoxicillin-clavulanate is also recommended. Cephalosporins or macrolides are recommended for patients allergic to penicillin.[3] The Dutch guidelines also recommend amoxicillin as the first agent of choice, or azithromycin (a specific macrolide) or co-trimoxazole in the penicillin-allergic.[32] The Finnish guidelines recommend amoxicillin or penicillin V as first-line therapy, with amoxicillin-clavulanate or cefuroxime as second-line therapy, and sulfa-trimethoprim, azithromycin and clarithromycin in the penicillin-allergic.[43] Amoxicillin is the first-line agent of choice in the Alberta guidelines, with azithromycin or clarithromycin for β-lactam hypersensitivity and amoxicillin-clavulanate or cefuroxime as second-line treatment. Erythromycin is highlighted as an antibiotic to avoid in acute otitis media due to high rates of resistance by haemophilus species and moraxella.[16] The Ontario guidelines particularly recommend the avoidance of macrolides in acute otitis media, although trimethoprim-sulfamethoxazole, azithromycin or cefprozil are recommended for penicillin-allergic patients.[39] These guidelines recommend amoxicillin as first-line therapy, with high-dose amoxicillin-clavulanate or cefuroxime if there is no improvement in 72 hours, and intra-muscular ceftriaxone as third-line therapy. Similarly, the British Columbia guidelines advise amoxicillin as first-line treatment, with amoxicillin-clavulanate in cases of treatment failure. However, in contrast to the other Canadian guidelines, erythromycin is recommended for penicillin-allergic patients, with clarithromycin as second-line treatment.[18]

The recommended duration of antibiotic therapy differs considerably amongst the guidelines reviewed. The optimum duration of antibiotic therapy for uncomplicated acute otitis media is recommended as 4 days by the NICE guidelines. No evidence is cited for this recommendation, but a 2000 Cochrane review found that treatment outcomes at 8 to 19 days were more favourable following a 5-day course of antibiotics, compared with courses of 8 to 10 days (summary odds ratio = 1.52, 95 per cent CI = 1.17–1.98; $n = 1524$).[52] The Scottish Intercollegiate Guideline Network recommends 5 days of antibiotics, when prescribed. The French recommendations differ by advising an 8 to 10 day course, referencing a RCT that showed significantly less efficacy for 5-day courses in children under two years of age.[53] A shorter course is however recommended for children over two years, based on a meta-analysis that found a 5-day course to be effective

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in this group.[54] The American Academy of Family Physicians and American Academy of Pediatrics guidelines are not fully consistent with either of these recommendations, advocating a 10-day course for younger children and those with severe symptoms, and a 5- to 7-day course for children aged six years or over with mild to moderate disease. The Alberta guidelines advocate a 5-day course for first-line therapy and a 10-day course for second-line therapy.[16] The Ontario guidelines recommend 5 days of antibiotics for children over two years and 10 days for children under two years.[39] The British Columbia guidelines recommend 5 days of amoxicillin, 10 days of erythromycin for penicillin-allergic patients, and 10 days of second-line antibiotics.[18] The Dutch guidelines recommend 7 days' initial treatment.[32]

The most consistent recommendation for first-line therapy is to prescribe analgesia in all cases but to avoid routine antibiotic prescription for mild to moderate cases and where there is diagnostic uncertainty in patients two years and older. Six of the 11 guidelines recommend prescribing antibiotics in children aged two years and younger, and an additional two make the same recommendation provided there is unilateral otorrhoea or bilateral disease. Amoxicillin is the most recommended first-line antibiotic agent. In penicillin-allergic patients, the use of a macrolide (erythromycin or azithromycin) has the greatest support. Nine of the 11 guidelines give a clear upper time limit of 72 hours for symptom improvement or resolution. Patients not improving on analgesia alone should be prescribed amoxicillin or a macrolide if penicillin-allergic, without the need for further clinical review. Failure to respond or worsening features after 72 hours of analgesia and first-line antibiotic therapy should prompt clinical review to reaffirm the diagnosis, exclude complications and switch to second-line treatment with amoxicillin-clavulanate.[3,16,26,33,39,43] Cefuroxime is the only second-line agent for the penicillin-allergic proposed by more than one guideline. Nine of the 11 guidelines recommend a 5-day course of initial antibiotic treatment in patients aged two years or older; six of the guidelines also recommend this course for patients aged six months to two years. There is no predominant opinion on the duration of antibiotic treatment for children aged six months or younger. Failure to respond after 10 days of antibiotics should be managed as outlined for second-line antibiotic failures (see the following section).

Tympanocentesis

The French Health Products Safety Agency (French) guidelines advocate tympanocentesis by an otolaryngology specialist for children who are in severe pain and who have a bulging tympanic membrane.[19] As the natural history of acute otitis media often involves progression to spontaneous tympanic membrane perforation, tympanocentesis could be viewed as hastening a natural outcome that often relieves pain. This recommendation in the French Health Products Safety Agency guidelines is not referenced. In the American Academy of Family Physicians and American Academy of Pediatrics guidelines and the NICE guidelines, there is no mention of tympanocentesis or myringotomy for treatment. Kaleida *et al.* conducted a randomised, controlled trial of severe acute otitis media treatment involving 536 children, comparing myringotomy (with or without antibiotics) to amoxicillin or placebo, and found the former to have no advantage.[55] However, several guidelines recommend tympanocentesis as a diagnostic procedure in cases of acute otitis media unresponsive to second- or third-line antibiotic therapy.[3,16,19,26,39] The high degree of skill required to safely perform tympanocentesis can usually only be attained and maintained by specialist otolaryngological training and practice.[56] Whilst Pichichero advocates that general practitioners undertake tympanocentesis in their surgeries, this view is widely opposed because of the risks and logistical demands.[56,57] In routine UK specialist otolaryngological practice, tympanocentesis is rarely undertaken to guide antibiotic treatment. It is unclear whether this is a reflection of the high success rate of first-line intervention, or due to general practitioners' reluctance to pursue specialist referral for patients with acute otitis media which is hard to manage.

Referral

The Scottish Intercollegiate Guideline Network recommends otolaryngological referral of children with acute otitis media complicated by facial paralysis and mastoiditis, and of those with more than four episodes of acute otitis media in six months.[33] This is similar to the Dutch Artsennet guidelines, which advise referral of acute otitis media patients with suspected meningitis or mastoiditis to an ENT doctor or paediatrician.[32] The British Columbia guidelines recommend elective referral to an ENT specialist if there are three episodes in six months or four episodes in 12 months, or if there is persistent perforation present for over six weeks.[18] In the UK, early specialist referral for children with recurrent otitis media is currently being publicised to general practitioners,[58] based on the Cochrane review of the use of ventilation tubes in recurrent acute otitis media.[59]

Tympanostomy tubes

Tympanostomy tubes (also known as ventilation tubes or grommets) reduce the incidence of recurrent acute otitis media in children.[59] It is difficult to determine the proportion of children who undergo tympanostomy tube placement for recurrent acute otitis media as opposed to otitis media with effusion (OME). The latter can develop following acute otitis media, and is the prime indication for tympanostomy tube insertion. It is possible that national differences in the first-line management of acute otitis media will lead to differences in the OME disease burden and in requirements

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to manage the same. This is supported by the findings that the Netherlands, which boasts the lowest antibiotic prescription rate for acute otitis media, has the highest tympanostomy tube insertion rate (20 per 1000 children) of all developed Western countries. On the other hand, the US, which historically has had high antibiotic prescribing rates, has a comparatively low tympanostomy tube insertion rate (nine per 1000 children). The UK, which also has high antibiotic prescription rates, has the lowest tympanostomy tube insertion rate of the developed world countries reported by Schilder *et al.*[60] The downward trend in antibiotic prescribing rates for acute otitis media in both the UK and the US over the last 15 years if unrelated to any real reduction in acute otitis media incidence, may have led to a concomitant increase in OME, tympanostomy tube insertion, and other complications and sequelae of untreated or partially treated acute otitis media. However, between 2000 and 2006 UK myringotomy rates decreased by 22 per cent.[61] The increase in admissions for mastoiditis and mastoidectomy in children four years or younger has been discussed above.[45] The reduction in myringotomies and antibiotic prescriptions for acute otitis media are together resulting in an increased prevalence of mastoiditis amongst young children in the UK.

Conclusions

Accurate diagnosis is critical in clinical practice and research. Future acute otitis media trials should use the American Academy of Family Physicians and American Academy of Pediatrics diagnostic criteria.

Current level IA evidenced treatment guidelines recommend initial observation with symptomatic treatment in non-severe infections in healthy patients aged over two years. Assessment and treatment of pain is essential. When antibiotics are used, a five-day course of amoxicillin is the most recommended first-line therapy.

In the UK and USA, antibiotic prescriptions for upper respiratory tract infections that include acute otitis media have been decreasing; this is related to a long-term and persistent reduction in the number of patients presenting with these conditions, which predated the publication of the American Academy of Family Physicians and American Academy of Pediatrics guidelines and the 2008 UK NICE guidelines.[62–64] The additive effect of treatment guidelines on the reduction in antibiotic prescription rates is questionable in view of most healthcare practitioners' poor adherence to such guidelines.[65,66] This poor adherence may be partly explained by the following: (1) the fact that recommendations on antibiotic avoidance only apply to patients presenting with mild to moderate acute otitis media; (2) the evidence of clear benefit of antibiotics in severe cases and children under two years of age; and (3) the higher rate of mastoiditis in untreated cases.

The community prevalence of, and optimal analgesia for, acute otitis media require further investigation.

References

1 HESonline: Primary Diagnosis: 4 character. In: http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=214 [04 October 2010]
2 Hayden GF. Acute suppurative otitis media in children. Diversity of clinical diagnostic criteria. *Clin Pediatr (Phila)* 1981;**20**:99–104
3 American Academy of Pediatrics Subcommittee on Management of Acute Otitis Media. Diagnosis and management of acute otitis media. *Pediatrics* 2004;**113**:1451–65
4 Marcy M, Takata G, Shekelle P, Chan LS, Mason W, Wachsman L *et al*. *Management of Acute Otitis Media. Evidence Report/Technology Assessment No. 15*. Rockville, Maryland: Agency for Healthcare Research and Quality, 2001
5 Brookhouser PE. Use of tympanometry in office practice for diagnosis of otitis media. *Pediatr Infect Dis J* 1998;**17**:544–51, 580
6 Kimball S. Acoustic reflectometry: spectral gradient analysis for improved detection of middle ear effusion in children. *Pediatr Infect Dis J* 1998;**17**:552–5, 580
7 Barnett ED, Klein JO, Hawkins KA, Cabral HJ, Kenna M, Healy G. Comparison of spectral gradient acoustic reflectometry and other diagnostic techniques for detection of middle ear effusion in children with middle ear disease. *Pediatr Infect Dis J* 1998;**17**:556–9, 580
8 Block SL, Mandel E, McLinn S, Pichichero ME, Bernstein S, Kimball S *et al*. Spectral gradient acoustic reflectometry for the detection of middle ear effusion by pediatricians and parents. *Pediatr Infect Dis J* 1998;**17**:560–4, 580
9 Block SL, Pichichero ME, McLinn S, Aronovitz G, Kimball S. Spectral gradient acoustic reflectometry: detection of middle ear effusion in suppurative acute otitis media. *Pediatr Infect Dis J* 1999;**18**:741–4
10 Spiro DM, King WD, Arnold DH, Johnston C, Baldwin S. A randomized clinical trial to assess the effects of tympanometry on the diagnosis and treatment of acute otitis media. *Pediatrics* 2004;**114**:177–81
11 Karma PH, Penttila MA, Sipila MM, Kataja MJ. Otoscopic diagnosis of middle ear effusion in acute and non-acute otitis media. I. The value of different otoscopic findings. *Int J Pediatr Otorhinolaryngol* 1989;**17**:37–49
12 Karma PH, Sipila MM, Kataja MJ, Penttila MA. Pneumatic otoscopy and otitis media. II. Value of different tympanic membrane findings and their combinations. In: Lim DJ, Bluestone CD, Klein JO, Nelson JD, Ogra PL, eds. *Recent Advances in Otitis Media: Proceedings of the Fifth International Symposium*. Burlington, Ontario, Canada: Decker Periodicals, 1993;41–5
13 Pelton SI. Otoscopy for the diagnosis of otitis media. *Pediatr Infect Dis J* 1998;**17**:540–3, 580
14 CKS Clinical Knowledge Summaries. In: http://www.cks.nhs.uk/otitis_media_acute [14 April 2010]
15 Rothman R, Owens T, Simel DL. Does this child have acute otitis media? *JAMA* 2003;**290**:1633–40
16 *Guideline for the Diagnosis and Management of Acute Otitis Media*. In http://www.topalbertadoctors.org/download/364/AOM_brochure.pdf [08 February 2011]
17 Cincinnatti Children's Hospital Medical Center, Health Policy & Clinical Effectiveness Program. *Evidence-based Clinical Practice Guideline for Medical Management of Acute Otitis Media in Children 2 Months to 13 Years of Age*. In http://www.cincinnatichildrens.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=87856&libID=87544 [08 February 2011]
18 Guidelines and Protocols Advisory committee Acute Otitis Media (AOM) Revised 2004. In http://www.bcguidelines.ca/pdf/otitaom.pdf [08 February 2011]
19 French Health Products Safety Agency. *Antibiotic Therapy in Clinical Practice in Upper Respiratory Tract Infections in Adults and Children* [in French]. In http://www.infectiologie.com/site/medias/_documents/consensus/2005-infVRB-argu-afssaps.pdf [01 April 2010]
20 Asher E, Leibovitz E, Press J, Greenberg D, Bilenko N, Reuveni H. Accuracy of acute otitis media diagnosis in community and hospital settings. *Acta Paediatr* 2005;**94**:423–8

https://doi.org/10.1017/S0022215112001326 Published online by Cambridge University Press

21 Pichichero ME, Poole MD. Assessing diagnostic accuracy and tympanocentesis skills in the management of otitis media. *Arch Pediatr Adolesc Med* 2001;**155**:1137–42
22 Legros JM, Hitoto H, Garnier F, Dagorne C, Dubin J, Fanello S. Reliability of the diagnosis of acute otitis media by general practitioners [in French]. *Arch Pediatr* 2007;**14**:427–33
23 Hemlin C, Hassler E, Hultcrantz M, Papatziamos G, Krakau I. Aspects of diagnosis of acute otitis media. *Fam Pract* 1998; **15**:133–7
24 Wormald PJ, Browning GG, Robinson K. Is otoscopy reliable? A structured teaching method to improve otoscopic accuracy in trainees. *Clin Otolaryngol Allied Sci* 1995;**20**:63–7
25 Froom J, Culpepper L, Grob P, Bartelds A, Bowers P, Bridges-Webb C *et al*. Diagnosis and antibiotic treatment of acute otitis media: report from International Primary Care Network. *BMJ* 1990;**300**:582–6
26 National Institute of Health and Clinical Excellence. *NICE Clinical Guideline No. 69: Respiratory Tract Infections – Antibiotic Prescribing*. London: National Institute of Health and Clinical Excellence, 2008
27 Glasziou PP, Del Mar CB, Sanders SL, Hayem M. Antibiotics for acute otitis media in children. *Cochrane Database Syst Rev* 2004;(1):CD000219
28 Rovers MM, Glasziou P, Appelman CL, Burke P, McCormick DP, Damoiseaux RA *et al*. Antibiotics for acute otitis media: a meta-analysis with individual patient data. *Lancet* 2006;**368**: 1429–35
29 Spiro DM, Tay KY, Arnold DH, Dziura JD, Baker MD, Shapiro ED. Wait-and-see prescription for the treatment of acute otitis media: a randomized controlled trial. *JAMA* 2006;**296**: 1235–41
30 Little P, Gould C, Williamson I, Moore M, Warner G, Dunleavey J. Pragmatic randomised controlled trial of two prescribing strategies for childhood acute otitis media. *BMJ* 2001; **322**:336–42
31 McCormick DP, Chonmaitree T, Pittman C, Saeed K, Friedman NR, Uchida T *et al*. Nonsevere acute otitis media: a clinical trial comparing outcomes of watchful waiting versus immediate antibiotic treatment. *Pediatrics* 2005;**115**: 1455–65
32 Appelman CLM, van Balen FAM, van de Lisdonk EH, van Weert HCPM, Eizenga WH. *NHG Clinical Practice Guidelines: M09 Acute Otitis Media*. Amsterdam: Dutch College of General Practitioners, 2006
33 Scottish Intercollegiate Guidelines Network 66 Diagnosis and management of childhood otitis media in primary care. A national clinical guideline. In http://www.sign.ac.uk/guidelines/fulltext/66/index.html [17 December 2010]
34 Damoiseaux RA, van Balen FA, Hoes AW, Verheij TJ, de Melker RA. Primary care based randomised, double blind trial of amoxicillin versus placebo for acute otitis media in children aged under 2 years. *BMJ* 2000;**320**:350–4
35 Rosenfeld RM, Vertrees JE, Carr J, Cipolle RJ, Uden DL, Giebink GS *et al*. Clinical efficacy of antimicrobial drugs for acute otitis media: meta-analysis of 5400 children from thirty-three randomized trials. *J Pediatr* 1994;**124**:355–67
36 Del Mar C, Glasziou P, Hayem M. Are antibiotics indicated as initial treatment for children with acute otitis media? A meta-analysis. *BMJ* 1997;**314**:1526–9
37 Pshetizky Y, Naimer S, Shvartzman P. Acute otitis media – a brief explanation to parents and antibiotic use. *Fam Pract* 2003;**20**:417–19
38 Siegel RM, Kiely M, Bien JP, Joseph EC, Davis JB, Mendel SG *et al*. Treatment of otitis media with observation and a safety-net antibiotic prescription. *Pediatrics* 2003;**112**:527–31
39 University of Michigan Health System. Guidelines for Clinical Care. Otitis Media. In http://cme.med.umich.edu/pdf/guideline/om.pdf [accessed 18 February 2011]
40 Hoberman A, Paradise JL, Rockette HE, Shaikh N, Wald ER, Kearney DH *et al*. Treatment of acute otitis media in children under 2 years of age. *N Engl J Med* 2011;**364**:105–15
41 van Buchem FL, Peeters MF, van't Hof MA. Acute otitis media: a new treatment strategy. *Br Med J (Clin Res Ed)* 1985;**290**: 1033–7
42 Grossman Z, Silverman BG, Porter B, Miron D. Implementing the delayed antibiotic therapy approach significantly reduced antibiotics consumption in Israeli children with first documented acute otitis media. *Pediatr Infect Dis J* 2010;**29**:595–9
43 Otitis media (acute). Current Care guideline. Working group appointed by the Finnish Medical Society Duodecim, the Finnish Paediatric Society, the Finnish Otolaryngological Society and the Finnish Association for Central Practice. Helsinki: Finnish Medical Society Duodecim, 2010. In http://www.kaypahoito.fi [In Finnish, accessed 8 February 2011]
44 Keith T, Saxena S, Murray J, Sharland M. Risk-benefit analysis of restricting antimicrobial prescribing in children: what do we really know? *Curr Opin Infect Dis* 2010;**23**:242–8
45 Sharland M, Kendall H, Yeates D, Randall A, Hughes G, Glasziou P *et al*. Antibiotic prescribing in general practice and hospital admissions for peritonsillar abscess, mastoiditis, and rheumatic fever in children: time trend analysis. *BMJ* 2005; **331**:328–9
46 Van Zuijlen DA, Schilder AG, Van Balen FA, Hoes AW. National differences in incidence of acute mastoiditis: relationship to prescribing patterns of antibiotics for acute otitis media? *Pediatr Infect Dis J* 2001;**20**:140–4
47 Molstad S, Erntell M, Hanberger H, Melander E, Norman C, Skoog G *et al*. Sustained reduction of antibiotic use and low bacterial resistance: 10-year follow-up of the Swedish Strama programme. *Lancet Infect Dis* 2008;**8**:125–32
48 Thompson PL, Gilbert RE, Long PF, Saxena S, Sharland M, Wong IC. Effect of antibiotics for otitis media on mastoiditis in children: a retrospective cohort study using the United Kingdom general practice research database. *Pediatrics* 2009; **123**:424–30
49 Petersen I, Johnson AM, Islam A, Duckworth G, Livermore DM, Hayward AC. Protective effect of antibiotics against serious complications of common respiratory tract infections: retrospective cohort study with the UK General Practice Research Database. *BMJ* 2007;**335**:982
50 Dagan R, McCracken GH Jr. Flaws in design and conduct of clinical trials in acute otitis media. *Pediatr Infect Dis J* 2002; **21**:894–902
51 Joint Formulary Committee. *British National Formulary 59*. London: BMJ Publishing/RPS Publishing, 2010
52 Kozyrskyj AL, Hildes-Ripstein GE, Longstaffe SE, Wincott JL, Sitar DS, Klassen TP *et al*. Short course antibiotics for acute otitis media. *Cochrane Database Syst Rev* 2000;(2): CD001095
53 Cohen R, Levy C, Boucherat M, Langue J, de la Rocque F. A multicenter, randomized, double-blind trial of 5 versus 10 days of antibiotic therapy for acute otitis media in young children. *J Pediatr* 1998;**133**:634–9
54 Kozyrskyj AL, Hildes-Ripstein GE, Longstaffe SE, Wincott JL, Sitar DS, Klassen TP *et al*. Treatment of acute otitis media with a shortened course of antibiotics: a meta-analysis. *JAMA* 1998; **279**:1736–42
55 Kaleida PH, Casselbrant ML, Rockette HE, Paradise JL, Bluestone CD, Blatter MM *et al*. Amoxicillin or myringotomy or both for acute otitis media: results of a randomized clinical trial. *Pediatrics* 1991;**87**:466–74
56 Culpepper L. Tympanocentesis: to tap or not to tap. *Am Fam Physician* 2000;**61**:1987–92
57 Pichichero ME. Acute otitis media: Part I. Improving diagnostic accuracy. *Am Fam Physician* 2000;**61**:2051–6
58 Anekwe L. *Grommets Effective for Recurrent Otitis Media*. In http://www.pulsetoday.co.uk/newsarticle-content [accessed 12 November 2010]
59 McDonald S, Langton Hewer CD, Nunez DA. Grommets (ventilation tubes) for recurrent acute otitis media in children. *Cochrane Database Syst Rev* 2008;(4)CD004741
60 Schilder AG, Lok W, Rovers MM. International perspectives on management of acute otitis media: a qualitative review. *Int J Pediatr Otorhinolaryngol* 2004;**68**:29–36
61 Pothier DD, Toll EC, Grant DG, Giddings CE. Trends in operative training opportunities for junior and senior trainees in otolaryngology. *Clin Otolaryngol* 2009;**34**:179–84
62 Grijalva CG, Nuorti JP, Griffin MR. Antibiotic prescription rates for acute respiratory tract infections in US ambulatory settings. *JAMA* 2009;**302**:758–66
63 McCaig LF, Besser RE, Hughes JM. Trends in antimicrobial prescribing rates for children and adolescents. *JAMA* 2002; **287**:3096–102
64 Gulliford M, Latinovic R, Charlton J, Little P, van Staa T, Ashworth M. Selective decrease in consultations and antibiotic prescribing for acute respiratory tract infections in

UK primary care up to 2006. *J Public Health (Oxf)* 2009;**31**: 512–20
65 Vernacchio L, Vezina RM, Mitchell AA. Management of acute otitis media by primary care physicians: trends since the release of the 2004 American Academy of Pediatrics/American Academy of Family Physicians clinical practice guideline. *Pediatrics* 2007;**120**:281–7
66 Ganga-Zandzou PS, Fermantel A, Robic C, Pouessel G, Pierre MH, Bourgois B *et al*. Assessment of the management of acute otitis media in children by family practitioners in the North of France [in French]. *Presse Med* 2009;**38**:1730–7

Address for correspondence:
Desmond A Nunez, MD FRCS(ORL)
Associate Professor & Head
University of British Columbia,
Division of Otolaryngology – Head and Neck Surgery,
Vancouver Hospital,
Diamond Health Care Centre,
4th Floor, 2775 Laurel Street, Vancouver, BC, Canada
V5Z 1M9

E-mail: desmond.nunez@ubc.ca

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