RESEARCH

Physician Education Intervention Influenced Prescribing for Otitis Media

by Michael E. Pichichero

OBJECTIVE: To assess the impact of a continuing medical education (CME) program on frequency of diagnosis of acute otitis media (AOM) versus otitis media with effusion (OME) and adherence to national guideline recommendations for antibiotic management.

STUDY DESIGN: Intervention study comparing CME participants to nonparticipants for frequency of AOM versus OME diagnoses and associated costs of care for a Rochester-based health maintenance organization (HMO).

METHODS: Frequency of use of ICD-9 codes in the OM group and associated costs of care were compared. Designed to influence physician prescribing, a 3.5 hour CME course was taught that utilized video, interactive instruction, and an audience response system, obliging providers to commit to decisions about diagnosis and treatment.

RESULTS: After the CME, intervention physicians (n=9) more frequently diagnosed otitis media with effusion (OME) (28% of all OM diagnoses) compared to nonintervention physicians (n=90) (11.1% OME diagnoses) (p =0.003). Analysis of 1938 OM episodes showed CME intervention physicians wrote prescriptions for 59% (95% confidence Interval (52%-66%) of episodes compared to 88% (95% CI = 82-90%) of episodes in the nonintervention group; p<0.0001. CME-attending physicians wrote an average of 109 (95% CI = 78-132) fewer prescriptions, resulting in an average total savings of $914 to the health care plan (95% CI = $604-$1,052) per doctor for OM over the 16-month study time-frame. CME attendees less frequently wrote prescriptions for macrolides and sulfonamides (p<0.001 for both) and more frequently for aminopenicillins and cephalosporin antibiotics (p=0.006 and <0.001, respectively) compared to the nonintervention group, in keeping with national guideline recommendations.

CONCLUSIONS: A favorable prescription cost impact on management of OM can be achieved through a well-designed, interactive, technology-driven CME intervention provided to physicians.

KEYWORDS: Otitis media, Antimicrobials, Continuing Professional Education

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To improve quality and reduce costs of care for otitis media, three strategies have been advocated during a continuing medical education (CME) course focused on OM management: (1) improve diagnostic accuracy, differentiating acute otitis media (AOM) from otitis media with effusion (OME) and otalgia, which sometimes occurs in conjunction with upper respiratory viral illnesses; (2) target antibiotic therapy for appropriate pathogens, with particular attention to recommended use of first and second line antibiotics in the OM indication; and (3) reduce antibiotic exposure by shortening the duration of therapy in selected patients.

Otitis media is costly to manage.[1-11] Antibiotics are indicated for AOM but may be appropriately deferred for children with OME, in agreement with recommendations by the U.S. Agency for Healthcare Policy and Research (now AHRQ).[12] Thus, the distinction is essential for management decision making and appropriate antimicrobial prescribing. Recommendations have been issued from the Centers for Disease Control on management of AOM with particular focus on drug-resistant *Streptococcus pneumoniae*.[13] These recommendations have been recently extended to include additional antimicrobials in the recommended treatment paradigm.[14] Recommendations for cost-reducing strategies must be consistent with such national guidelines, utilize evidence-based data, and take into account local information and opinion leader input.

The optimal approach to elicit change in physician prescribing habits is through education—active participation programs where providers are confronted with their shortcomings in knowledge while receiving immediate reinforcing feedback on correct information.[15,16] Continuing medical education (CME) programs that are interactive usually are more effective at producing change.[15,16] In this study we assess the impact of a CME course on physician diagnosis of AOM and OME and antibiotic prescribing patterns and compare those results to a nonintervention group that did not participate in CME instruction.

Methods

Setting

Metropolitan Rochester, New York, has a population of approximately 1 million; about 80% of the health-insured population participate in two health maintenance organizations (HMOs). There are approximately 100 pediatricians, virtually all of whom participate in both HMO panels.

Description of CME Course

The CME course was conducted at a local hospital (Strong Memorial Hospital) in Rochester. The 3.5 hour CME-accredited program on the topic "Improving Outcomes in Otitis Media" was organized by Outcomes Management Educational Workshops (OMEW), Boynton Beach, Florida. Twenty-four participants took the course; nine agreed to subsequent evaluation of their ICD-9 coding and associated prescribing patterns.

The course had three components: (1) improving diagnostic accuracy (1 hour), (2) improving familiarity with OM diagnostic tools, i.e., tympanometry, acoustic reflectometry, audiometry, and tympanocentesis training (1.5 hours), and (3) judicious antibiotic selection strategies (1 hour).[17] To improve diagnostic skills, participants were shown 30-second video clips of tympanic membranes (TMs) with large-screen projection. After two example examinations were shown of AOM and normal ears, participants viewed nine sequential video clips of TMs for diagnostic assessment. Video footage included a 10-second interval in still frame, 10 seconds with pneumatic otoscopy, and then another 10 seconds in still frame. All cerumen had been removed from the external auditory canal prior to filming. Participants were instructed to record TM findings in a structured format and thereafter reach a conclusion as to one of four possible diagnoses (AOM, OME, retracted but otherwise normal TM, and normal). The correct diagnoses had been established by consensus among an expert panel based on reviewing the video plus tympanometry and tympanocentesis findings. The difference between AOM and OME was defined mainly by the position of the TM: In AOM the TM is full or bulging, whereas in the OME the TM is retracted or in a neutral position; an effusion is present behind the TM in both conditions. Participants were given as much time as necessary to reach a conclusion and record their answers on a digitized personal keypad that was electronically linked to a laptop computer, thus creating a database. Active instruction and interaction between the teacher and participants occurred as the correct answers were reviewed for each diagnosis test.

During the hands-on portion of the workshop, participants rotated in small groups and were taught the value, sensitivity, specificity, and interpretation of tympanometry, acoustic reflectometry, and audiometry readings. Because tympanocentesis is now a recommended procedure for primary care physicians to be used in selective cases of presumed resistant, persistent, or recurrent AOM,[13] participants were given the opportunity to perform tympanocentesis on lifelike infant mannequins.[18,19] In the third hour, the principles of judicious antibiotic prescribing were discussed in lecture format using a Powerpoint presentation.

Appropriate medical and prescription drug management for AOM emphasized amoxicillin at a dose of 80 mg/kg/day with amoxicillin/clavulanate, cefuroxime, cefprozil, and cefpodoxime as second-line choices.[13,14] For OME the recommended management was watchful waiting without antibiotic prescribing.[12] The rationale for these national guidelines on antibiotic selection was provided; endorsement by the American Academy of Pediatrics, Otolaryngology, and Family Physicians was acknowledged. Strengths in antibiotic coverage for preferred antibiotics and weaknesses for nonpreferred antibiotics were explained. The evidence-based data favoring shortened duration of antibiotic therapy in selected patients[20,21] also were presented.

Study Groups

Nine pediatricians attending the CME course agreed to have medical records and computer data reviewed on their use of ICD-9 diagnosis coding after completion of the course and an unlinked analysis of their antibiotic prescribing patterns associated with the OM diagnosis categories. Fifteen pediatricians attending the course declined access to their patient medical records and computer data on diagnosis coding and billing. Ninety HMO panel pediatricians not attending the CME intervention were used as a comparator group.

All nine intervention pediatricians were in private practice in suburban Rochester. All were board-certified and graduates of U.S. medical schools. They were representative in age (34–64 years old), gender (four men and five women), years in practice (0-3 years=1, 4–10 years=4 and over 10 years=4), and work schedule (half-time to full-time with variations between) compared to the nonintervention study group.

Data Source

Antibiotic prescribing data for this study were obtained from the data warehouse created from the claims-processing system of a large health insurer in Rochester, with membership of approximately 600,000; approximately 90% of all plan members have drug coverage. For all drugs and services provided to plan members, providers (pharmacies, physicians, and hospitals) submit claims for reimbursement directly to the insurer. Data available for each prescription included the drug dispensed, the dispensing date, the number of days of therapy dispensed, and total pharmacy cost to the health plan after patient copays. Selected data from these claims were abstracted and entered into computer data files. Data for each physician's office visit included the date the service was rendered and a diagnosis code (in International Classification of Diseases, 9th rev., clinical modification [(ICD-9-CM)] format).

Sample Selection

To identify patients cared for by physicians in the intervention group we analyzed all professional service claims for all plan members who had at least one physician office visit in the 16-month period (from August 1, 1997, to January 1, 1999) following the CME intervention and for which there was a diagnosis of otitis media recorded (including acute suppurative otitis media [ICD-9-CM 382.0], unspecified suppurative otitis media [382.4], unspecified otitis media [382.9], nonsuppurative otitis media [381.0, 381.3-81.4], chronic serous otitis media [381.1] and chronic mucoid otitis media [381.2], eustachian tube dysfunction [381.8],

or otalgia [388.7]). As a validation of the pharmacy claims data, for each visit with such a diagnosis, antibiotic prescriptions were scanned to identify those instances in which a prescription for one or more selected antimicrobials (among those approved by the U.S. Food and Drug Administration for treatment of acute otitis media) was filled on the same day as the visit. Each prescription that could be linked in this fashion to an office visit was considered to represent antimicrobial therapy for otitis media, provided that the number of therapy days supplied was less than 28; longer durations of therapy were deemed to represent chemoprophylaxis.

To identify visits and prescriptions that represented new episodes of acute otitis media (as opposed to ongoing treatment), all pharmacy and professional service claims during the 14 days before the date of the visit for receipt of prescriptions for antimicrobials used to treat otitis media were identified. Patients with no such claims in the two weeks before the visit were considered to have experienced a new episode of otitis media.

To ensure that each patient's pharmacy claims history was complete, enrollment records were reviewed to identify and exclude patients who were not continuously enrolled in the health insurance plan or whose insurance did not include drug coverage.

Statistics

Comparisons between the CME intervention and nonintervention groups utilized Student t, Chi square, and Mann-Whitney rank tests; a $p<0.05$ was considered statistically significant.

Results

Otitis Media Diagnosis Frequency

During the CME course pretest five of nine (55%) of the intervention pediatricians correctly answered a question identifying the most reliable TM finding for AOM (a bulging eardrum); in the post-test, eight of nine (89%) knew the correct answer. In an analysis based on one diagnosis per patient, after CME intervention the study physicians utilized the diagnosis of AOM 70.1%, of OME 28.2%, and otalgia 1.1% of all OM diagnoses (see Table 1). In comparison, among pediatricians not attending the CME intervention the average diagnosis frequency of AOM was 88.8%, of OME 11.0%, and of otalgia 0.2% ($p=0.003$). Antibiotic prescribing associated with the OME diagnosis was negligible in the intervention group, thus accounting for a 17% reduction in antibiotic prescriptions as a consequence of making the diagnosis of OME.

Prescriptions/Episode

Of 3,589 randomly selected episodes of OM 1,938 were included in the analysis from the intervention group and 3,723 of 41,600 episodes of OM in the non-CME intervention group. Overall, the CME intervention group wrote 0.59 prescriptions/episode (95% CI = 0.52-0.66) of OM compared to 0.88 prescriptions/episode (95% CI = 0.82-0.90) in the nonintervention group ($p<0.003$) (see Table 2). The mean overall reduction in prescriptions was 0.29/episode (range 0.11-0.44 prescriptions/episode). Overall,

TABLE 1 OM Diagnosis Frequency with Earache

	CME Intervention Group (N)	No CME Intervention Group* (N)
AOM	70.1% (2,537)	88.8% (36,941)
OME	28.2% (1,013)	11.0% (4,576)
Otalgia	1.1% (39)	0.2% (83)

**p=0.003 comparing CME intervention group that attended OMEW Workshops (n=3,589 diagnoses by nine physicians) versus no CME intervention group (n=41,600 diagnoses by 90 physicians).*
AOM = acute otitis media; OME = otitis media with effusion; otalgia = complaint of earache with retracted tympanic membrane but no effusion. Data are from 16 months, August 1, 1997–January 1, 1999.

TABLE 2 Prescriptions per OM Episode

	CME Intervention Group	No CME Intervention Group*
Total	59%[a]	88%[a]
Amoxicillin± clavulanate	74.5%	71.6%[b]
Cephalosporins	18.6%	10.2%[c]
Macrolides/Azalides	1.3%	4.3%[d]
Sulfonamides	6.7%	13.9%[e]

[a] p<0.003; [b] p=0.006; [c,d,e] p<0.001 comparing CME intervention group that attended the OMEW Worksops (n=9 physicians) to nonCME intervention group (n=90 physicians)

the CME intervention group physicians wrote significantly more prescriptions for the aminopenicillins and cephalosporins and significantly fewer prescriptions for macrolides and sulfonamides than the nonintervention group ($p=0.006$ for aminopenicillins and $p<0.001$ other drug class comparisons) (see Table 2). Specifically, intervention group physicians more frequently prescribed amoxicillin and amoxicillin/clavulanate and national guideline-recommended cephalosporins (cefprozil, cefuroxime axetil, cefpodoxime proxetil) and less frequently other agents.

Total Prescriptions and Costs

The CME intervention group wrote an average of 109 (95% CI = 95-132) fewer prescriptions/doctor for otitis media in the 16 months of study (see Table 3, next page). The reduction in total prescriptions written was associated with a total savings of $914 per physician to the health plan (95% CI = $604-$1052) in the 16-month study period (see Table 3).

Cost/Prescription

The average cost per aminopenicillin group prescription to the health plan in the intervention group was $9.00 per prescription, for the cephalosporins $30.00 per prescription, for the macrolides

$11.00 per prescription, and for the sulfonamides $5.00 per prescription. The average in the nonintervention group for aminopenicillins ($10.00), cephalosporins ($36.00), macrolides ($14.00), and sulfonamides ($6.00) was similar. Although the CME intervention group wrote prescriptions with a similar average cost per prescription compared to the non-intervention group, this occurred as a consequence of their prescribing somewhat more expensive antibiotics (amoxicillin/clavulanate and cephalosporins) more often, but the quantities dispensed per prescription were lower, reflecting more frequent prescribing of shortened duration of therapy.

Discussion

In this study the effectiveness of a CME course on antibiotic prescribing for the OM indication was assessed. The course taught differences in diagnostic features of AOM versus OME, the rationale for national guideline-recommended, appropriate antibiotic selection; and the evidence-based data on efficacy of shortened durations of antibiotic therapy. Pediatricians attending the CME course made the diagnosis of OME more frequently than other pediatricians from the same community who did not attend the course (absolute difference 16.9%, with a relative difference of 60%). The recognition of OME had a direct proportionate impact on a reduction in the diagnosis of AOM, thereby eliminating inappropriate antibiotic prescribing in 17% of OM episodes. Although the CME intervention emphasized the association of mild otalgia in the context of viral upper respiratory infections, the frequency of this diagnosis (and associated non-antibiotic prescribing) was not increased.

In a recent review, Faden et al,[22] citing studies from four OM research groups (Boston, Pittsburgh, Cleveland, and Buffalo), calculated that 30%-35% of new OM episodes occur in children with OME and 65%-70% occur in children with AOM. The 71% AOM diagnosis rate by the CME attendee pediatricians is consistent with that estimate, whereas the 88% AOM diagnosis rate by non-CME attendee pediatricians likely represents over diagnosis.

Using claims data from a large New England health insurer, evaluating children less than 10 years of age who had one or more episodes of AOM in 1995-96, Thompson et al[9] found amoxicillin prescribed for 56.6%, cephalosporins for 18.3%, trimethoprim sulfamethoxazole for 12.3%, macrolides for 6.4%, and amoxicillin/clavulanate for 6.0% of episodes. In our non-CME attending physician group, antibiotic prescribing patterns were similar to those in the Thompson study. However, antibiotic prescribing by CME attendees differed, with more use of aminopenicillins, the same for cephalosporins, and less use of macrolides and sulfonamides.

National recommendations for antibiotic selection continue to emphasize amoxicillin as first-line therapy in most patients.[13,14] However, patients who have been treated with amoxicillin within a preceding month prior to the redevelopment of AOM may appropriately receive extended spectrum antibiotics such as amoxicillin/clavulanate or selected cephalosporins (cefprozil, cefuroxime axetil, cefpodoxime proxetil, and more recently cefdinir) or injectable cephalosporin (ceftriaxone).[13,14] The use of macrolide and sulfonamide antibiotics is discouraged.

TABLE 3 Total Prescriptions and Costs to Health Care Plan for Otitis Media (OM)

Group	CME Intervention	No CME	Difference
Average number of patients with OM diagnosis per physician	399	462	63
Average total prescriptions per physician for OM diagnosis	235	407	172*
Average total nonprescription per physician for OM diagnosis	164	55	109*
Average cumulative prescription costs for OM diagnosis per physician	$1,618	$2,532	$914

*$p<0.01$ *Comparing groups for total prescriptions, nonprescriptions, and total costs, taking into account the difference in patients with OM diagnosis between groups. Prescription cost was to the HMO plan and does not correspond with retail or wholesale pharmacy costs.*

The foregoing modifications in prescribing patterns were clearly recognizable in the CME intervention group; 74.5% of OM episodes for which prescriptions were written were within the aminopenicillin group. Cephalosporin use was higher comparing the CME intervention and nonintervention groups due to increased use of guideline-recommended second and third generation agents. Also there was a clear and dramatic reduction in the use of macrolides/azalides (more than three-fold); a similar two-fold reduction in sulfonamide use was noted. In keeping with the conclusion of a recent comprehensive review[20] and evidence-based meta-analysis,[21] CME intervention group physicians prescribed antibiotics for the AOM indication for a shorter period than non-intervention group physicians. This resulted in savings on average of $5.00/prescription to the health care plan.

The results of this study should be considered in the context of the substantial direct and indirect costs of AOM management. Alsarraf et al,[10] utilized an otitis media diary to measure the costs associated with AOM in a prospective cohort study involving 25 children aged 1-3 years. The total cost attributable to AOM in the three-month period following diagnosis was $1,330.00 (95% C.I. 1008-1006.52), with the majority of the costs stemming from indirect rather than direct costs of illness. The per-patient antibiotic cost in that study was $8.48/patient;. $3.53 was spent on cold medications and $1.30 on pain or fever medications in association with each AOM episode. Other direct costs included 2.5-4.6 visits/episodes of AOM at a total cost per patient of $124.00/episode. These estimates far exceed those in prior literature, where the esti-

mates range from $233/episode to $406/episode, depending on the number of follow-up visits assumed with each infection.[1,2,12] The indirect cost attribution estimates by Alsarraf et al, also are higher than the 55% of costs calculated by Gates[2] and Stool et al.[12] They are also higher than the analysis by Capra et al,[11] who calculated the cost of simple versus complex episodes of AOM and found the average simple episode of AOM total medical costs to be $132/episode in contrast to complex episodes, which had an average cost of $331/episode. Capra et al.[11] found indirect costs associated with work loss for simple episodes to be $114 per episode and for complex episodes $411 per episode.

Limitations

This study has limitations. Fifteen pediatricians who attended the CME course declined study participation, presumably due to concerns about data access and anonymity. This introduces the possibility of selection bias in the intervention group. Data were not available to allow a direct comparison of physicians before and after attendance of the CME accredited course; this would have offered an enhanced analytic approach. However, a change likely occurred because eight of nine CME attendees (89%) answered "highly likely" to a post-course question about how likely they would be to "change their diagnosis approach regarding AOM and OME" and the same eight of nine responded to a postcard contact a year later that they had maintained a changed approach.

We were unable to directly link the data available for each prescription and for each office visit as Thompson et al. accomplished,[9] to examine the frequency with which selected surgical procedures related to otitis media (i.e., adenoidectomy, myringotomy, and insertion of tympanostomy tubes) occurred among patients cared for by the intervention versus the nonintervention group, or to assess the impact of initiation of performance of tympanocentesis by the CME intervention group physicians on diagnosis, treatment, and other surgical procedures. Such a study is now underway because each of these analyses should prove useful in assessing the overall impact on quality and costs of care.

Conclusions

A CME course reduced the diagnostic frequency of acute otitis media (AOM) by 17% and led to fewer, and possibly more appropriate and cost effective, antibiotic prescriptions. ■

DISCLOSURES

Michael D. Pichichero, M.D., is the principal author of this paper. Study concept and design, drafting, and all revisions of the manuscript were done by Pichichero. He also provided statistical expertise and conducted all critical analysis and interpretation of data. No outside funding supported this work. The author discloses that he is a faculty member of the University of Rochester and the CME accreditation for the course was provided by the University of Rochester. In addition, Pichichero is co-chairman of and has stock ownership in Outcomes Management Education Workshop, Inc., (OMEW). OMEW organized the CME course described in the manuscript.

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