Table 1: Technical Expert Panel

Technical Expert	Area of Expertise	Affiliation/Location
Larry Culpepper, MD, MPH	Family Medicine	Boston Medical Center, MA
Douglas G. Long, MD	Family Medicine	Manchester Community Health Center, NH
Richard M. Rosenfeld, MD, MPH	Otolaryngology	SUNY Health Science Center Brooklyn, NY
Norman Wendell Todd, Jr., MD	Otolaryngology	Emory University, GA
Allan Lieberthal, MD	Pediatrics	Southern California Kaiser Permanente Medical Group, CA
Anthony Magit, MD	Pediatric Otolaryngology	Children's Hospital San Diego, CA
Jack Paradise, MD	Pediatrics	Children's Hospital, Pittsburgh, PA
Ross Miller, MD	Quality Management	CIGNA Health Care, CA
Joanne Roberts, PhD	Speech and Hearing	University of North Carolina, NC
Lisa L. Hunter, PhD	Audiology	University of Minnesota, MN
Linda Carlson, MS, RN, CPNP	Nurse Practitioner	Statesboro, GA
Fran Goldfarb, MA	Consumer	Family Voices, Los Angeles, CA

Table 2: Questions Suggested for Consideration in Evidence Report

1. What is the relative risk of developing OME in the child who has food or inhalant allergies compared to the child without food or inhalant allergies

2. What is the natural history for various types of OME?

3. What is the long-term level of speech and language development in infants and preschool children with untreated OME? What are the high risk groups?

4. What is the accuracy of various diagnostic methods?

5. When should conservative treatment (non-surgical) be considered a failure?

6. What is the evidence on effectiveness of various diagnostic instruments in deciding on intervention for OME?

7. What is the evidence regarding level of hearing decrease and whether unilateral or bilateral hearing decrease is an indication for intervention?

8. What is the effectiveness of the use of hearing levels to decide on intervention for OME?

9. Are antibiotics more effective than placebo in treating OME?

10. Are steroids more effective than placebo in treating OME?

11. Do antibiotics add an incremental benefit to steroids in treating OME?

12. Are interventions for allergies (food or inhalant) more effective than placebo in treating OME?

13. Are antihistamines and/or decongestants more effective than placebo in treating OME?

14. Are tympanostomy tubes more effective than other interventions in treating OME?

15. Is adenoidectomy more effective than other interventions in treating OME of greater than 3 months duration?

16. Is tonsillectomy more effective than other interventions in treating OME of greater than 3 months duration?

17. Is myringotomy more effective than other interventions in treating OME of greater than 3 months duration?

18. Are alternative or complementary therapies more effective than other interventions in treating OME of greater than 3 months duration?

19. Are prophylactic antibiotics more effective than other interventions in treating OME?

20. What is the effectiveness of monitoring by pneumatic otoscopy, tympanometry, acoustic reflectometry with spectral gradient, and otoacoustic emissions to decide on intervention for OME?

Table 3: Ranking of Potential Key Questions

Of the 20 questions, each technical expert ranked the top 10 questions **from 10 (highest priority) to 1 (lowest priority),** (experts' identification numbers were randomly assigned).

	Topic of question	**Rank Total**	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10	E 11	E 12
1.	Food or inhalant allergies	**8**				5					3			
2.	Natural history	**78**	10	9	10	9	7	9	4	2		6	7	5
3.	Speech and language development	**97**	8	10	4	8	9	5	8	5	10	10	10	10
4.	Accuracy of diagnostic methods	**57**			5	10	6	10	6	9		8	1	2
5.	Conservative treatment	**39**	9	5	6	4	1		3			1	9	1
6.	Diagnostic instruments vs intervention	**38**	7	8				6		9		8		
7.	Level of hearing decrease	**67.5**		7		7	8	4	9	6.5	9		8	9
8.	Hearing levels and intervention	**16.5**		6	1			3		6.5				
9.	Antibiotics versus placebo	**51**	6	4	9	6	5		1		7	5	2	6
10.	Steroids versus placebo	**23**					4		7	1	6		5	
11.	Antibiotics and steroids	**22**	5	2	3		3				5		4	
12.	Treatment for allergies vs placebo	**2**	1			1								
13.	Antihistamines/decongestants vs placebo	**10**							10					
14.	Tympanostomy tubes vs other interventions	**51**	3	1	8		10	2	2	4	4	3	6	8
15.	Adenoidectomy vs other interventions	**32**			7		2	1	5	3	2	2	3	7
16.	Tonsillectomy vs other interventions	**2**	2											
17.	Myringotomy vs other interventions	**5**			2	3								
18.	Alternative/complementary therapies vs other interventions	**10**				2		7			1			
19.	Prophylactic antibiotics vs other interventions	**15**	4	3								4		4
20.	Effectiveness of diagnostic methods for monitoring	**36**						8		9	8	8		3

Note: Kendall Coefficient of Concordance = 0.36, p=0.0001.

Table 4: Comments from Technical Expert Panel on Potential Key Questions

Potential Key Questions		Comments/Notes
1.	What is the relative risk of developing OME in the child who has food or inhalant allergies compared to the child without food or inhalant allergies?	• Difficult to obtain evidence • Doesn't seem to have adequate research base • Assumed to be a minor player, but there could be a surprise here
2.	What is the natural history for various types of OME?	
3.	What is the long-term level of speech and language development in infants and preschool children with untreated OME? What are the high risk groups?	• Evidence incomplete • Several new prospective studies are available • This is probably the most important single question for justifying surgical intervention • Available results inconsistent and/or contradictory. No definitive answers yet available
4.	What are the accuracy of various diagnostic methods?	• Combine with 6 and 20 • Probably not much data there • Add binocular micro-tympanoscopy, MRI, and quantitative tympanometry to the list of methods of diagnosing OME. Binocular micro-tympanoscopy, which I do to every patient that I assess in the clinic, is using the surgical "operating" microscope to view each tympanic membrane. I think MRI should be the "gold standard" (see Swarts JD et al.: In vivo observation with magnetic resonance imaging of middle ear effusion in response to experimental underpressures. Ann Otol Rhinol Laryngol 104:522-528, 1995). To diagnose OME by looking at the tympanic membrane is traditional, but provides only a look at the "window on the middle ear". To use fluid found at myringotomy as the "gold standard" assumes that either (1) no inhalational general anesthetic has been given to the patient, or (2) there is no effect of inhalational general anesthetic on the finding of fluid in that part of the mesotympanum when the myringotomy is done. Since practically, inhalational general anesthetic is usually administered to patients getting myringotomy in the US in 1999, I'm not comfortable with this first assumption. From clinical experience, I've very uncomfortable with the second assumption. MRI also affords an opportunity to measure the volume of the middle ear system (I'm including mastoid, mesotympanum, epitympanum and all the spaces normally containing "gas" in this definition of the middle ear system); smallness of volume of the middle ear system is a well-documented correlate of severity of otitis media condition, and also a correlate of the severity of the anatomic eustachian and skull base differences of otitis media.) [The MRI data would also help, I think, in answering "Potential Key Question # 2.] Quantitative tympanometry is a promising technique. ANSI mandated that all new tympanometers (as of 1996, as I recall) provide quantitative information. Such quantitative information, [DeChicchis & Todd, unpublished data] to date show advantages over the qualitative A-B-C Jerger classification.

Table 4 (Continued)

5.	When should conservative treatment (non-surgical) be considered a failure?	• Unclear question • Very broad category • Unclearly written. What is the conservative treatment • No definitive information on which to base an answer
6.	What is the evidence on effectiveness of various diagnostic instruments in deciding on intervention for OME?	• Same as 4 • Combine with #4 and #20
7.	What is the evidence regarding level of hearing decrease and whether unilateral or bilateral hearing decrease is an indication for intervention?	• Minimal evidence • Combine with 8 • Pairs with question 3 • No definitive information on which to base an answer
8.	What is the effectiveness of the use of hearing levels to decide on intervention for OME?	• Same as 7 • Combine with 7
9.	Are antibiotics more effective than placebo in treating OME?	• Is this still an issue? • Is this still an issue? Has it been addressed with meta-analysis already? • Let's see if there is any new data out there
10.	Are steroids more effective than placebo in treating OME?	• There wasn't enough data during the original panel. Is there now?
11.	Do antibiotics add an incremental benefit to steroids in treating OME?	• This area showed some potential promise last time • Should be "Do steroids add an incremental benefit to antibiotics"
12.	Are interventions for allergies (food or inhalant) more effective than placebo in treating OME?	• Minimal evidence • Inadequate research base
13.	Are antihistamines and/or decongestants more effective than placebo in treating OME?	• If used need to indicate if there is a presence or absence of allergies • Still an issue? Addressed in last OME guidelines
14.	Are tympanostomy tubes more effective than other interventions in treating OME?	• Good to test the current recommendation to see if they still have validity • Answers might vary depending on outcome measures
15.	Is adenoidectomy more effective than other interventions in treating OME of greater-than 3 months duration?	• Need to indicate in what age group and if used combine with myringotomy • The key is age of patient. Are there studies for younger children? • Answers might vary depending on outcome measures • Though I think adenoidectomy has some benefit to some patients in helping the resolution of their otitis media, none of the purported mechanisms make any sense to me. One purported mechanism is to decrease the "cesspool" of the nasopharynx; but,

Table 4 (Continued)

		cystic fibrosis patients, who typically have the worse cesspools of any nasopharynges, have (on average) less otitis problems than the general population. Another purported mechanism is removing the mass of lymphoid tissue in the nasopharynx; but, I don't know of any data that size of adenoid tissue correlates with either the occurrence or severity of otitis media. Indeed, in my experience with a population who have one of the highest rates of otitis of any population, adenoid tissue is usually scant. I'd love to know the explanation by which adenoidectomy improves the course of otitis media in some children. (I suspect the explanation is scarring in the adenoid bed, that stabilizes the posterior lamina of the eustachian cartilage. If this is indeed the explanation, then it is one of the rare occasions that surgery benefits a patient by inducing scarring.)
16.	Is tonsillectomy more effective than other interventions in treating OME of greater-than 3 months duration?	• Still an issue?
17.	Is myringotomy more effective than other interventions in treating OME of greater-than 3 months duration?	• Still an issue
18.	Are alternative or complementary therapies more effective than other interventions in treating OME of greater-than 3 months duration?	• Minimal evidence • Inadequate research base? • Probably won't find much, but the public will be clamoring for it
19.	Are prophylactic antibiotics more effective than other interventions in treating OME?	• Still an issue
20.	What is the effectiveness of monitoring by pneumatic otoscopy, tympanometry, acoustic reflectometry with spectral gradient, and otoacoustic emissions to decide on intervention for OME?	• Similar to 6 combined • Combine with #6 and #4 • Add binocular micro-tympanoscopy, MRI, and quantitative tympanometry to the list of methods of diagnosing OME. See my comments about "Potential Key Question" 4.
	Epidemiology	• The material on epidemiology thus far circulated omits mention of a key factor in predisposing infants and children to otitis media, namely, low socioeconomic status. For data and a discussion, see our report in Pediatrics 1997;99:318-333.
	Definition of AOM	• I disagree with the definition of AOM as stated in your recent Definition section. As stated, the definition would call for a diagnosis of AOM in a child with middle-ear effusion and rapid onset of either irritability or fever. On the one hand, some infants with AOM have none of the 4 listed signs or symptoms, and the diagnosis is made on the basis of specific tympanic membrane findings--bulging and/or marked erythema--in addition to findings of middle-ear effusion. On the other hand, some infants with only OME rather

Table 4 (Continued)

		than AOM present with rapid onset of fever and/or irritability that may be due the underlying viral respiratory tract infection. If such patients are assumed to have AOM, much unnecessary antibiotic will be prescribed. The point to be made is that diagnosis should not be linked to either the presence or the absence of signs or symptoms such as fever and irritability that are nonspecific. Ear pain, on the other hand, is reasonably specific. This issue was discussed in Commentary in Pediatrics 1995;96:712-715.

Table 5: Overall Causal Pathway for OME

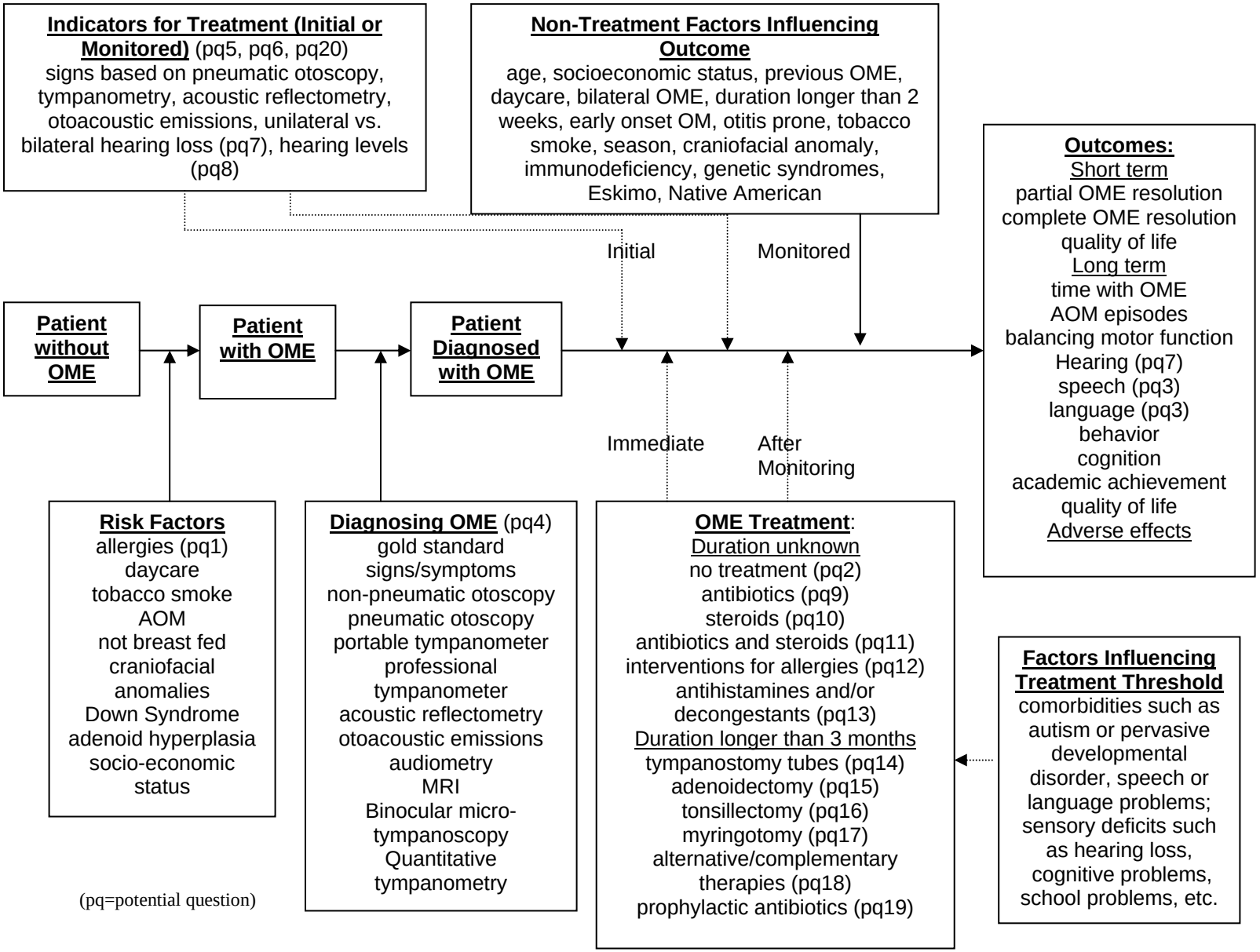

Table 6: Causal Pathway for Key Question 1 on Natural History

What is the natural history (spontaneous resolution rate over time without treatment) for:

- OME persisting after a discrete episode of acute otitis media,
- newly diagnosed OME of unknown duration (unilateral or bilateral),
- OME persisting for weeks or months (unilateral or bilateral),
- unilateral OME lasting 3 months or longer,
- bilateral OME lasting 3 months or longer?

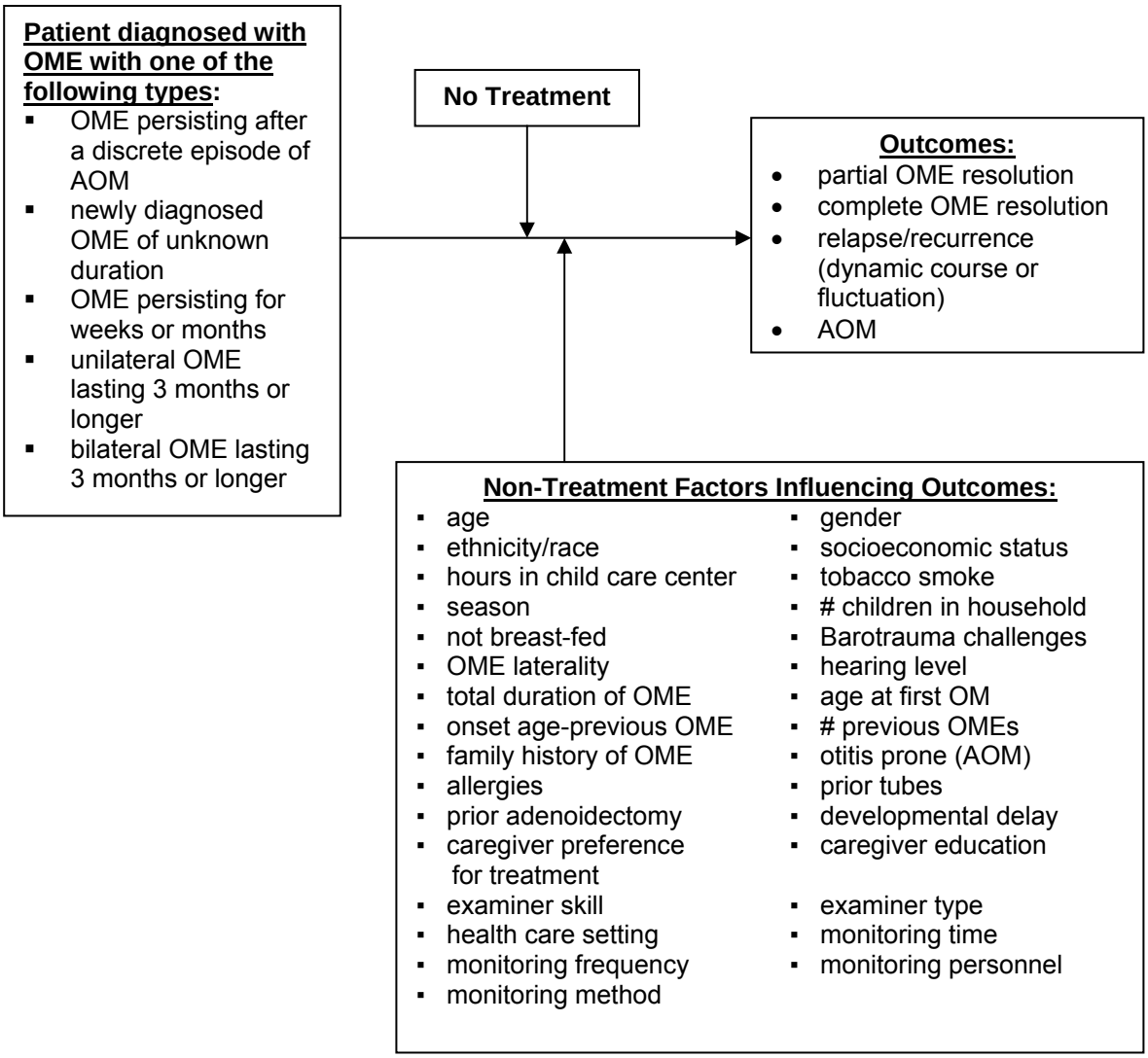

Table 7: Causal Pathway for Key Question 2 on Speech and Language

a) Do infants and preschool children with longer duration early life OME as compared to those with shorter duration OME have greater delays in speech and language development (receptive or expressive) later in life? One specific formulation of this question is: Is OME-associated conductive hearing loss in the first 3 years of life a risk factor for speech and language developmental delays?

b) What are the risk factors that interact with the effect of OME on speech and language development in infants and preschool children?

Patient with all types of OME or OM characterized by the presence of middle ear effusion

Outcomes:
- speech and/or language development, expressive or receptive
- cognition, measures of intelligence (verbal)

Treatment Factors Influencing Outcomes:

Any combination of the following:
- no treatment
- tympanostomy tubes
- adenoidectomy
- myringotomy
- antibiotics
- systemic steroids
- decongestant
- antihistamine
- N-acetyl-cysteine
- unknown
- others (list)

Non-Treatment Factors Influencing Outcomes:
- age at first OM
- ethnicity/race
- hours at child care center
- early intervention program
- tobacco smoke
- OME laterality
- gender
- socioeconomic status
- quality of child care
- # children in household
- not breast-fed
- hearing level
- total duration of OME ≥3 months)
- # previous OMEs
- repeated or persistent vs infrequent early life OME
- allergies
- OM complications, e.g. perforated TM, cholesteatoma
- chronic illness of any type
- caregiver education
- quality of parent-child interaction
- examiner skill
- health care setting
- frequency of rechecks
- equipment type
- duration of MEE
- developmental delay
- examiner type
- age at rechecks
- primary provider

Table 8: Causal Pathway for Key Question 3 on Hearing

a) Do infants and preschool children with longer early-life OME as compared to those with shorter duration OME have permanent (or sensorineural) hearing loss later in life? One specific formulation of this question is "Is OME-associated conductive hearing loss in the first 3 years of life a risk factor for permanent (or sensorineural) hearing loss later in life?"

b) What are the risk factors that interact with the effect of OME on hearing later in life (unilateral or bilateral) in infants and preschool children?

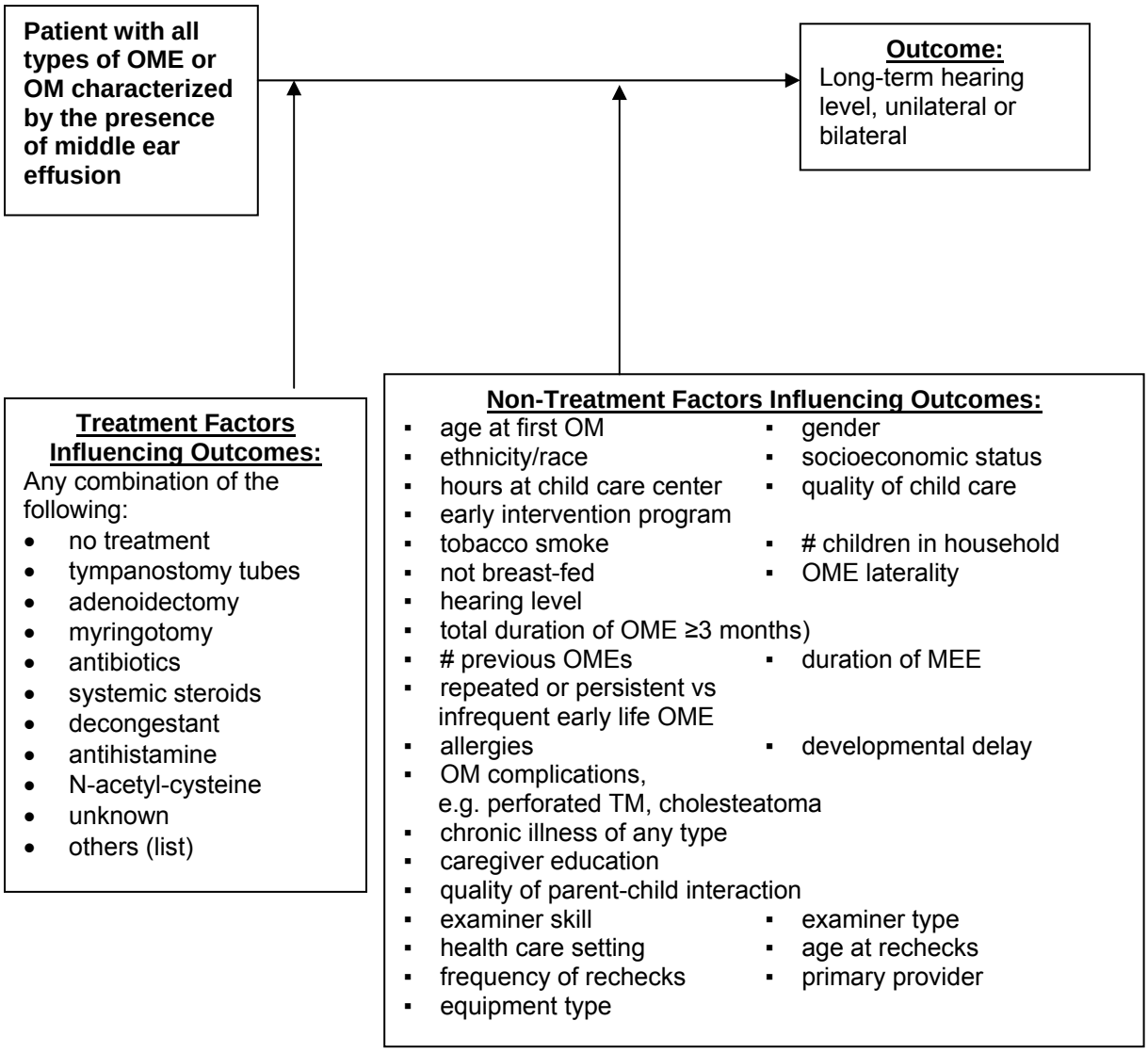

Table 9: Causal Pathway for Key Question 4 on Diagnostic Methods

What are the sensitivity, specificity, and predictive values for alternative methods of diagnosing OME compared with one of the gold standards?

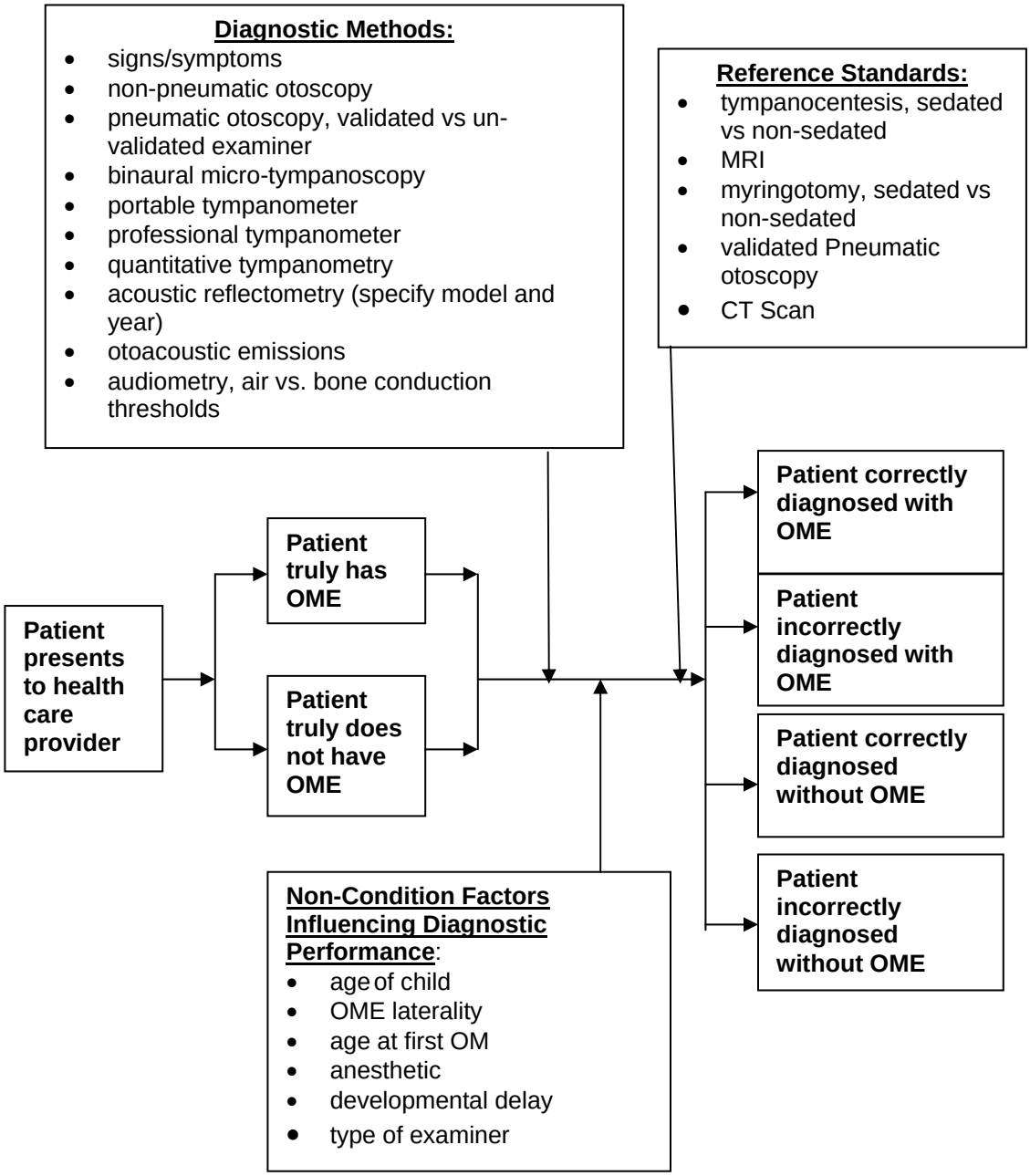

Table 10: Ranking of Influencing Factors by Technical Experts

Key Question 1: Natural History

Factors	Total "Yes" Based on Responses of 11 Technical Experts[a]
total duration of OME (≥3 mos)	10
otitis prone (AOM)	9
number of previous OMEs	9
number of hours attending child care center	9
tobacco smoke exposure	9
season of the year	9
age at first OM	9
not breast-fed	9
allergies	8
age of child	8
family history of OME	7
number of children in household	7
prior tubes	7
ethnicity/race	6
barotrauma challenges	6
prior adenoidectomy	5
socioeconomic status	5
laterality, unilateral versus bilateral	4
gender	3
skill to diagnose (validated)	3
age of onset of previous OME	3
tympanometry	3
monitoring frequency	2
monitoring time	2
MRI	2
type of examiner	2
setting of care	1
parent/caregiver education	1
hearing level, conductive versus sensorineural	1
primary provider	1
acoustic reflectometry	1
otoscopy	1
pneumatic otoscopy	1
parent/caregiver preference for treatment	1
developmental delay	0

[a] 11 technical experts responded; 1 abstained.

Table 10 (Continued)

Key Questions 2: Speech and Language

Factors	**Total "Yes" Based on Responses of 12 Technical Experts**
developmental delay	11
quality of child care	10
hearing level, conductive versus sensorineural	10
parent/caregiver education	10
quality of parent-child interaction	10
socioeconomic status	8
laterality, unilateral versus bilateral	8
early intervention program	7
total duration of OME (≥3 mos)	7
gender	6
number of children in household	6
duration of middle ear effusion	6
chronic illness of any type	6
number of hours attending child care center	5
number of previous OMEs	4
presence of active ear disease	4
ethnicity/race	3
tobacco smoke exposure	3
OM complications	3
child temperament	3
allergies	2
ambient noise	2
age at first OM	1
not breast-fed	1
skill to diagnose (validated)	1
type of examiner	0
setting of care	0
recheck times	0
frequency of recheck	0
primary provider	0
tympanometry	0
acoustic reflectometry	0
pneumatic otoscopy	0
MRI	0
equipment	0
audiometry	0

Note: Items in bold were added in the second poll after the first poll.

Table 10 (Continued)

Key Questions 3: Hearing

Factors	Total "Yes" Based on Responses of 12 Technical Experts
OM complications	10
laterality, unilateral versus bilateral	7
hearing level, conductive versus sensorineural	7
developmental delay	6
presence of active ear disease	6
total duration of OME (≥3 mos)	4
number of previous OMEs	3
duration of middle ear effusion	3
chronic illness of any type	3
ambient noise	3
allergies	2
age at first OM	1
ethnicity/race	1
socioeconomic status	1
quality of child care	1
early intervention program	1
tobacco smoke exposure	1
number of children in household	1
child temperament	1
equipment	1
audiometry	1
gender	0
number of hours attending child care center	0
not breast-fed	0
parent/caregiver education	0
quality of parent-child interaction	0
skill to diagnose (validated)	0
type of examiner	0
setting of care	0
recheck times	0
frequency of recheck	0
primary provider	0
Tympanometry	0
acoustic reflectometry	0
pneumatic otoscopy	0
MRI	0

Note: Items in bold were added in the second poll after the first poll.

Table 10 (Continued)

Key Question 4: Diagnostic Tests

Factors	Total "Yes" Based on Responses of 11 Technical Experts[a]
age of child	11
otolaryngologist	6
nurse practitioner	5
pediatrician	5
family physician	5
laterality, unilateral versus bilateral	5
anesthetic	5
age at first OM	5
developmental delay	4
physician assistant	4
others	3

[a] 11 technical experts responded; 1 abstained.

Table 11: Reason for Rejection of Titles/Abstracts at Initial Screening (N=3,200)

Reason Code	Reason for Rejection	Number (Percent) of Citations
R0	Written in non-English language	170 (5.3%)
R1	Case report/editorial/letter/ clinical/overview/practice guidelines/consensus statements	459 (14.3%)
R2	Non-human subjects	19 (0.6%)
R3	Study condition not OM	804 (25.1%)
R4	Age of study population >12 years[a]	57 (1.8%)
R5	Study population exclusively on any one of the following: Craniofacial defects, primary mucosal disorders, Immunodeficiencies, or Down or other genetic syndromes	15 (0.5%)
R7	Any key questions not addressed	697 (21.8%)
R8	Duplicate citation	9 (0.3%)

[a] The age limit was later extended to 22 years of age for Questions 2 and 3.

Table 12: Reason for Rejection of Full-Length Articles at Secondary Review

Reason Code	Reason for Rejection	Cochrane and Medline N=614	AAP Data Files N=29	Symposia on OME N=107	Technical Experts N=17	Articles and books N=31	Total N=798[a]
R0	Non-English language	1	0	0	0	0	1 (0.1%)
R1	Case report/editorial/ letter/clinical/ overview/ practice guidelines/ consensus statements	142	24	22	4	17	209 (26.2%)
R2	Non-human subjects	4	0	0	0	2	6 (0.8%)
R3	Study condition not OM	33	0	0	2	2	37 (4.6%)
R4	Age of study population >22 years	0	0	2	0	1	3 (0.4%)
R5	Study population exclusively one of the following: craniofacial defects, primary mucosal disorders, immunodeficiencies, or Down or other genetic syndromes	3	0	1	2	0	6 (0.8%)
R7	Key questions not addressed	354	5	74	9	2	444 (55.6%)
R8	Duplicate citation	39	0	3	0	7	49 (6.1%)
R9	Data not abstractable from article	38	0	5	0	0	43 (5.4%)

[a] 3 incorrect citations not included.

Table 13: Results of Secondary Screening of Full-Length Articles

	Cochrane and Medline	AAP Data Files	Symposia Proceedings on OME	Technical Experts	Articles and books	All Sources
Total Citations	3200	1441	159[a]	39	40	4879
Number of articles reviewed at secondary screening	975[b]	32	159	36	40	1242
Number accepted after secondary screening	372	3	52	19	5	451
Question 1	127	0	14	0	0	141
Question 2	74	1	20	17	0	112
Question 3	157	2	22	2	3	186
Question 4	69	0	4	0	2	75
Total of above [c]	427	3	60	19	5	514

[a] Exact number of citations not determined.
[b] Four cases previously rejected because of age limit >12 were added to the original 971 accepted citations.
[c] The 'total of above' number can exceed the number accepted because an article can address more than one question.

Table 14: Results of Tertiary Screening of Full-Length Articles for Analysis

	Accepted at Secondary Screening	Abstracted in Evidence Tables
	449	114 (25%)
Question 1	141	38 (27%)
Question 2	112	21 (19%)
Question 3	186	8 (4%)
Question 4	75	52 (69%)
Total of above [a]	514	119 (23%)

[a] An article can address more than one question.

Table 15: Peer Review Panel

Peer Reviewer	Area of Expertise	Affiliation/Location
Howard Bauchner, M.D.	General Pediatrics	Child and Adolescent Health Scholar in Residence Agency for Healthcare Research and Quality
Hanan S. Bell, Ph.D.	Methodology reviewer	Seattle, WA
Alfred O. Berg, MD, MPH	Family Medicine	University of Washington, Seattle, WA
Patricia A. Fall, MS, CRNP	Nurse Practitioner	Wexford, PA
George A. Gates, MD	Otolaryngology	University of Washington, Seattle, WA
Janice Goertz, RN, CPNP	Nurse Practitioner	Portage, MI
Judith Gravel, PhD	Hearing and Speech	Albert Einstein College of Medicine, Bronx, NY
Mark P. Haggard, Ph.D.	Hearing/ Psychoacoustics	Institute for Hearing Research, Nottingham, UK
Vic Hasselblad, Ph.D.	Meta-analysis reviewer	Duke University, Durham, NC
Tracy Lieu, MD	Pediatrician/Health Plan	Harvard Pilgrim Health Care, Boston, MA
Martin C. Mahoney, MD, Ph.D.	Family Medicine	DeGraff Family Medicine, North Tonawanda, NY
A. Richard Maw MS FRCS	Otolaryngology	Bristol Royal Infirmary, Bristol UK
Robert Ruben, MD	Otolaryngology	Montefiore Medical Center, Bronx, NY
Anne GM Schilder, MD, Ph.D.	Otolaryngology	University Medical Center Utrecht, The Netherlands
Steve Shelov, MD	Pediatrics	Scarsdale, N.Y
Sylvan Stool, MD	Otolaryngology	The Children's Hospital, Denver, CO
Robin Yurk, MD, MPH	Consumer/Health Plan	Community Clinic, Inc. Rockville, MD
Dr. J.O.M. Zaat (Joost Zaat)	Methodology reviewer	Purmerend, The Netherlands

Table 16: Instructions for Reviewing Draft Evidence Report

Enclosed is a draft evidence report on the diagnosis and treatment of otitis media with effusion. You may make your comments either directly on the draft evidence report, or on a separate sheet of paper. If you choose to record your comments on a separate piece of paper, please use the page and paragraph number to identify to which part of the report your comments pertain.

We ask that you consider the following questions while you read this report. We realized that some of the questions may not pertain to your area of expertise. Please feel free to comment only on those that you feel most suited to answer.

1. **Overall evaluation**

Is it clear what we did? You may agree or disagree with our methods, findings, or conclusions, but you should be able to understand what we did in order to produce this report.

2. **Methodology**

Are the methods we used appropriate:
a) for identifying the key questions of interest from the panel of technical experts?
b) for searching and reviewing the identified literature?
c) for synthesizing the literature?

3. **Evidence**

a) Did we miss any crucial pieces of information in our literature search?
b) Does the evidence support the conclusions?

4. **Utility**

Would you find this information to be useful if you had to develop clinical practice guidelines or medical review criteria for diagnosis and treatment of otitis media with effusion in children?

Table 17: Cohorts and Articles Relevant to Question 1 (n=40)

Cohort Identifier	Relevant Articles (ID, authors, year)	Comments
Birch	862 Birch and Elbrønd (1984)	0.75- to 7-year old children followed from 1/1982 to 4/1982.
Casselbrant I	1000 Casselbrant, Brostoff, Ashoff, and Bluestone (1985) 2929 Casselbrant, Brostoff, Ashoff, and Bluestone (1990)	2- to 5-year old children followed from 9/1981 to 8/1983.
Casselbrant II	2929 Casselbrant, Brostoff, Ashoff, and Bluestone (1990)	5- to 12-year old children followed from 9/1984 to 5/1985.
Ernston	1202 Erston and Sundberg (1984)	Children 1- to 11-years old embedded in a controlled trial.
Fiellau-Nikolajsen I	1237 Fiellau-Nikolajsen and Lous (1979) 1235 Fiellau-Nikolajsen (1979) 1242 Fiellau-Nikolajsen (1981) 3051 Lous and Fiellau-Nikolajsen (1988)[a]	Children in Hjoerring, Denmark first examined in 1976.
Fiellau-Nikolajsen II	1235 Fiellau-Nikolajsen (1979) 1245 Fiellau-Nikolajsen (1983)	Children in Hjoerring, Denmark first examined in 1978.
Fiellau-Nikolajsen III	1777 Lous and Fiellau-Nikolajsen (1981)	Children in Hirtshals and Sindal, Denmark first examined in 1978.
Holmquist	1494 Holmquist, Fadala, and Qattan (1987)	7- to 9.5-year old children followed 2/1983 to 4/1983.
Lamothe	1714 Lamothe, Boudreault, Blancette, Tetreault, and Poliquin (1981)	First graders followed over a 6 week period in 1979.
Leiberman	1735 Leiberman and Bartal (1986)	2- to 12-year old children who had a follow-up exam after a 2.5 year delay in ventilating tube placement.
Marchisio	9 Marchisio, Principi, Salpietro, Boschi, Chetri, Caramia, Longhi, Reali, Meloni, DeSantis, Sacher, and Cupido (1998)	Primary school children followed for 12 weeks after the initial exam, and then a subset were randomized to a placebo group for another 8 weeks of follow-up.
Mills	1927 Mills and Vaughan-Jone (1992)	Prospective single cohort embedded in a comparative cohort of children 1- to 14-years old who had a follow-up exam about 2 months after the initial visit.
Portoian-Shuhaiber	2184 Portoian-Shuhaiber and Cullinan (1984)	5- to 6-year old children followed for 10 weeks in 1979.
Renvall I	2240 Renvall, Lidén, Jungert, and Nilsson (1978)	10- to 11- year old children examined after a 3-year interval.
Renvall II	2242 Renvall, Anniansson, and Lidén (1982)	4-year old children followed over a 12 week period in 1980.
Reves	2243 Reves, Budgett, Miller, Wadsworth, and Haines (1985)	3- to 6-year old children followed 11/1983 to 2/1984.
Roberts	2262 Roberts, Johnson, Carlin, Turczyk, Karnutta, and Yaffee (1995)	Newborns followed for 2 months after birth.
Robinson	2270 Robinson, Allen, and Root (1988)	Infants followed for 6 weeks.

[a] The article did not include abstractable data relevant to the specific Question 1 outcome measures.

Table 17: Cohorts and Articles Relevant to Question 1 (n=40) (Continued)

Cohort Identifier	Relevant Articles	Comments
Sly I	2457 Sly, Zambie, Fernandes, and Frazer (1980)	4- to 5-year old children recruited in 2/1977.
Sly II	2457 Sly, Zambie, Fernandes, and Frazer (1980)	4- to 5-year old children recruited in 9/1977.
Tos I	1486 Holm-Jensen, Sørenson, and Tos (1981) 2636 Tos (1981) [a] 543 Tos, Holm-Jensen, Sørenson, and Mogensen (1982) 2639 Tos (1983) [a] 2642 Tos (1984) [a] 4834 Tos (1984) [a] 4835 Tos (1988) [a]	Children born in 1975 and followed from 5/1979 to 2/1985.
Tos II	2629 Tos (1979) 2190 Poulsen and Tos (1980) 2631 Tos (1980) [a] 2634 Tos (1980) 2593 Thomsen and Tos (1981) 2639 Tos (1983) [a] 2642 Tos (1984) [a] 4834 Tos (1984) [a] 4835 Tos (1988) [a]	Children born in 1976 and followed from 11/1977 to 2/1985.
Tos III	2189 Poulsen and Tos (1978) 2627 Tos (1979) 2631 Tos (1980) [a] 2634 Tos (1980) 2639 Tos (1983) [a] 2642 Tos (1984) [a] 4834 Tos (1984) [a] 4835 Tos (1988) [a]	Children born in 1977 and followed from 1-2/1977 to 2/1985.
Tos IV	1946 Moller and Tos (1990)	Children checked daily for 30 days.
van Balen	91 van Balen, De Melker, Touw-Otten (1996)	6-month to 6-year old children followed for 3 months in the early 1990's.
Williamson	2791 Williamson (1994)	5- to 8-year old children followed from 1988-1989 to 1991.
Wilmot	2795 Wilmot (1988)	6-month to 10-year old children were followed for 12 months after developing OME after AOM.
Zielhuis	2863 Zielhuis, Rach, and van den Broek (1990)	2- to 4-years old children followed from 1982-1983.

[a] The article did not include abstractable data relevant to the specific Question 1 outcome measures.

Table 18: Disposition of Articles From Rosenfeld's Natural History Assessment

ID Number	Author	Year	Included	Excluded	Reason for Exclusion From Assessment
1000	Casselbrant	1985	X		
1238, 1240	Fiellau-Nikolajsen	1980		X	1238 is a study of tympanometry as a diagnostic tool. 1240 is the same cohort as in 1245 and does not present sufficient data tracking individual cases or episodes of OME.
2242	Renvall	1982	X		
2593	Thomsen	1981	X		2593 uses same cohort as 2190, 2629,2631, 2639, 2642, 4834, and 4835.
2627	Tos	1979	X		
2634	Tos	1980	X		
543	Tos	1982	X		543 uses same cohort as 1486, 2636, 2639,2642, 4834, and 4835.
2791	Williamson	1994	X		
2863	Zielhuis	1990	X		
2857	Zeisel	1995		X	2857 included 13% with purulent OME. Antibiotic administration and other interventions for either purulent or non-purulent OME. Insufficient data track individual cases or episodes of OME.
2243	Reves	1985	X		
91	van Balen	1996	X		Randomized controlled trial with an initial 3-month watchful waiting period of children with OME.
1777	Lous	1981	X		

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1238, 1240	Fiellau-Nikolajsen	1980		X	1238 is a study of tympanometry as a diagnostic tool. 1240 is the same cohort as in 1245 and does not present sufficient data tracking individual cases or episodes of OME.
2242	Renvall	1982	X		
2593	Thomsen	1981	X		2593 uses same cohort as 2190, 2629,2631, 2639, 2642, 4834, and 4835.
2627	Tos	1979	X		
2634	Tos	1980	X		
543	Tos	1982	X		543 uses same cohort as 1486, 2636, 2639,2642, 4834, and 4835.
2791	Williamson	1994	X		
2863	Zielhuis	1990	X		
2857	Zeisel	1995		X	2857 included 13% with purulent OME. Antibiotic administration and other interventions for either purulent or non-purulent OME. Insufficient data track individual cases or episodes of OME.
2243	Reves	1985	X		
91	van Balen	1996	X		Randomized controlled trial with an initial 3-month watchful waiting period of children with OME.
1777	Lous	1981	X		

Table 19 Question 1: Articles Excluded During Data Abstraction

ID#	Author	Year	Reason Not Included
705	Aniansson	1985	Screening study over 2 years. Some retest of same subjects, but no control over treatment.
3051	Lous	1988	Data not abstractable as presented. Available counts are in essential agreement with articles 1235, 1237, and 1242 apart from minor differences in number of tympanogram types, e.g. type A in Jan 1975 (629 in articles 1235, 1237, and 3051 and 631 in article 1242) and types B, C1, and C2 in Jun-July 1976 (32, 31,, and 42 respectively in articles 1235, 1242, and 3051 and 37, 28, and 40 respectively in article 1237).
2578	Teele	1980	Data not abstractable; data on persistent OME after AOM are not presented and cannot be derived.
2631	Tos	1980	Article does not present any new information other than the actual initial counts of tympanogram types for the 1976 and 1977 Tos cohorts utilized in the evidence tables for article 2629 and 2627.
2636	Tos	1981	Data not abstractable as presented relative to the data on 3- and 6-month follow-up presented in article 1486. Individual cases of type B, C1, or C2 tympanograms cannot be tracked from 2/1979 to 11/1979 or 2/1980.
2639	Tos	1983	The only relevant new information is that the authors mention that in the 1976 cohort, 50% of tympanogram type B changed to types A or C over the first 3 months of the study. However, the number with type B who presented for the 3-month follow-up exam is not given so per cent change cannot be calculated.
2642	Tos	1984	Article does not present any abstractable data relevant to Q1.
4834	Tos	1984	Article does not present any new data relevant to Q1.
4835	Tos	1988	Article does not present any new data relevant to Q1.
2795	Wilmot	1988	Article presented data on OME following AOM which was eliminated as a condition of interest because it had been studied in a recent evidence analysis.

Table 19 Question 1: Articles Excluded During Data Abstraction

ID#	Author	Year	Reason Not Included
705	Aniansson	1985	Screening study over 2 years. Some retest of same subjects, but no control over treatment.
3051	Lous	1988	Data not abstractable as presented. Available counts are in essential agreement with articles 1235, 1237, and 1242 apart from minor differences in number of tympanogram types, e.g. type A in Jan 1975 (629 in articles 1235, 1237, and 3051 and 631 in article 1242) and types B, C1, and C2 in Jun-July 1976 (32, 31,, and 42 respectively in articles 1235, 1242, and 3051 and 37, 28, and 40 respectively in article 1237).
2578	Teele	1980	Data not abstractable; data on persistent OME after AOM are not presented and cannot be derived.
2631	Tos	1980	Article does not present any new information other than the actual initial counts of tympanogram types for the 1976 and 1977 Tos cohorts utilized in the evidence tables for article 2629 and 2627.
2636	Tos	1981	Data not abstractable as presented relative to the data on 3- and 6-month follow-up presented in article 1486. Individual cases of type B, C1, or C2 tympanograms cannot be tracked from 2/1979 to 11/1979 or 2/1980.
2639	Tos	1983	The only relevant new information is that the authors mention that in the 1976 cohort, 50% of tympanogram type B changed to types A or C over the first 3 months of the study. However, the number with type B who presented for the 3-month follow-up exam is not given so per cent change cannot be calculated.
2642	Tos	1984	Article does not present any abstractable data relevant to Q1.
4834	Tos	1984	Article does not present any new data relevant to Q1.
4835	Tos	1988	Article does not present any new data relevant to Q1.
2795	Wilmot	1988	Article presented data on OME following AOM which was eliminated as a condition of interest because it had been studied in a recent evidence analysis.

Table 20 Study Quality for Studies Included in Evidence Table on Natural History

ID	Author	Year	Study Quality Score[a]
862	Birch	1984	3 (1,1,1,0,0,0)
1000	Casselbrant	1985	3 (1,1,1,0,0,0)
2929	Casselbrant	1990	3 (1,1,1,0,0,0)
1202	Ernstson	1984	2 (1,0,0,1,0,0)
1235	Fiellau-Nikolajsen	1979	4 (1,1,1,0,0,1)
1237	Fiellau-Nikolajsen	1979	4 (1,1,1,0,0,1)
1242	Fiellau-Nikolajsen	1981	4 (1,1,1,0,0,1)
1245	Fiellau-Nikolajsen	1983	3 (1,1,1,0,0,0)
1486	Holm-Jensen	1981	3 (1,1,1,0,0,0)
1494	Holmquist	1987	3 (1,1,1,0,0,0)
1714	Lamothe	1981	4 (1,1,1,1,0,0)
1735	Leiberman	1986	2 (1,1,0,0,0,0)
1777	Lous	1981	3 (1,1,1,0,0,0)
9	Marchisio	1998	3 (1,1,1,0,0,0)
1927	Mills	1992	1 (1,0,0,0,0,0)
1946	Moller	1990	3 (1,1,1,0,0,0)
2184	Portoian-Shuhaiber	1984	3 (1,1,1,0,0,0)
2189	Poulsen	1978	3 (1,1,1,0,0,0)
2190	Poulsen	1980	3 (1,1,1,0,0,0)
2240	Renvall	1978	3 (1,1,1,0,0,0)
2242	Renvall	1952	4 (1,1,1,1,0,0)
2243	Reves	1985	3 (1,1,1,0,0,0)
2262	Roberts	1995	4 (1,1,1,0,1,0)
2270	Robinson	1988	1 (1,1,0,0,0,0)
2457	Sly	1980	3 (1,1,1,0,0,0)
2593	Thomsen	1981	3 (1,1,1,0,0,0)
2627	Tos	1979	3 (1,1,1,0,0,0)
2629	Tos	1979	3 (1,1,1,0,0,0)
2634	Tos	1980	3 (1,1,1,0,0,0)
543	Tos	1982	3 (1,1,1,0,0,0)
91	van Balen	1996	3 (1,1,1,0,0,0)
2791	Williamson	1994	2 (1,1,0,0,0,0)
2863	Zielhuis	1990	3 (1,1,1,0,0,0)

[a] The six components of study quality are: a prospective cohort study; outcome clearly defined; time point at which outcome measured clearly defined; subjects followed without any intervention; blinded assessment of outcome; and point and variability estimates provided for main outcome measures. 1 indicates presence and 0 indicates absence

Table 21 Tympanometry Definitions in Natural History Cohorts Utilizing Tympanometry as the Sole Diagnostic Method

Tympanogram Type	A		As		B		
Cohort[a]	Pressure (mmH_2O)	immitance	Pressure (mmH_2O)	immitance	Pressure (mmH_2O)	immitance	Comments
Birch	> -100					< 0.25ml[c,1]	[1]stapedial reflex absent and max compliance unreadable; Madsen Electronics tympanoscope, model ZS 330, 226 Hz probe tone
Fiellau-Nikolajsen I	> -100	> 0.1 [d]			200 to -400[1]	≤ 0.1[d]	[1]or indeterminable
Fiellau-Nikolajsen II							middle-ear effusion=flat curve or <= -100 with absent middle ear reflexes
Fiellau-Nikolajsen III	> -100					multiple criteria[1]	[1]type B=otoadmittance < 0.20millimhos, absolute gradient < 0.04millimhos and absence of ipsilateral acoustic reflex; Grason-Stadler Middle Ear Analyzer 1722
Holmquist	50 to -99				flat curve		Madsen ZA 330, 226 Hz probe tone
Portoian-Shuhaiber							abnormal defined as an abnormal tympanometric curve and/or absent acoustic reflex; Grason-Stadler Middle-ear Analyser (Model 1722)
Tos I	0 to -99				flat curve		Madsen ZO 70 tympanometer, 220 Hz probe tone
Tos II	0 to -99				flat curve		Madsen ZO 70 tympanometer, 220 Hz probe tone
Tos III	>-100				flat curve[1]		[1]<= 0.1[e]; Madsen ZO 70 impedance meter
Tos IV AZ7	99 to –99				flat curve without impedance minimum[1]		[1]or with a measurable impedance minimum and relative gradient < 0.1; Impedance audiometer AZ 7 (Interacoustics)
ZS 331	99 to –99				flat training[1]		[1]or compliance below 0.25ml[c] and absent ipsilateral stapedial reflex; Impedance tympanoscope ZS 331 (Madsen Electronics)
Reves	-100 to 50	>0.3[b]			< -100	low[b]	tympanometer 85 AR 11 (American Electro Medics)
Robinson	-149 to +50	>0.2ml[c]					types As, B, C, and Cs are failures; Maico MA 610 portable impedance screener, 226 Hz probe tone
Sly I and II					flat curve[1]		[1]or compliance < 0.3ml[c] or peak compliance occurred at or below -100 mmH_20; Teledyne Avionics acoustic impedance meter model TA-1D
van Balen	-99 to 200	≥ 0.2mmho[c]			≤ -400	< 0.2mmho[c]	
Williamson	200 to -99				flat curve		Grayson-Stadler [sic] Earscan impedance audiometer
Zielhuis	≥ -99	≥ 0.2ml[c]			≤ -400	< 0.2ml[c]	Grason-Stadler-model 27

[a]see Table 17 for associated cohort articles [b]impedance [c]admittance [d]relative gradient [e]impedance slope

Table 21 Tympanogram Definitions in Natural History Cohorts Utilizing Tympanometry as the Sole Diagnostic Method (continued)

Tympanogram Type	C		C1		C2		
Cohort[a]	Pressure (mmH_2O)	immitance	Pressure (mmH_2O)	immitance	Pressure (mmH_2O)	immitance	Comments
Birch	≤ -100						
Fiellau-Nikolajsen I			-100 to -199	>0.1[d]	-200 to -400	>0.1[d]	
Fiellau-Nikolajsen II							middle-ear effusion=flat curve or <= -100 with absent middle ear reflexes
Fiellau-Nikolajsen III	≤ -100						
Holmquist	100 to -300						
Portoian-Shuhaiber							abnormal defined as an abnormal tympanometric curve and/or absent acoustic reflex
Tos I			-100 to -199		-200 to -350		
Tos II			-100 to -199		-200 to -350		
Tos III	-100 to -300	>0.1[e]	-100 to -199		-200 to -350		
Tos IV AZ 7			-100 to –199		>-200		
ZS 331			-100 to –199		>-200		
Reves	< -100	>0.3[b]					
Robinson							types As, B, C, and Cs are failures
Sly I and II							
van Balen			-199 to -100	≥ 0.2mmho[c]	-399 to -200	≥ 0.2mmho[c]	
Williamson			-100 to -199		-200 to -400		
Zielhuis			-100 to -199	≥ 0.2ml[c]	–200 to –399	≥ 0.2ml[c]	

[a]see Table 17 for associated cohort articles [b]impedance [c]admittance [d]relative gradient [e]impedance slope

Table 22: OME Resolution by Ears on Newly Diagnosed OME of Unknown Duration
<6-month old cohorts

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Ears Resolved Interval[a]				Article(s)
				<2wk	<2m	<3m	<6m	
Roberts[e]	oto	unknown	unknown	22/24 (92%)	24/24 (100%)			2262 Roberts 1995
Tos III	Tymp	unknown	unknown			1/4[d] (25%)	1/4[d] (25%)	2627 Tos 1979

[a] interval calculated from cohort inception and not cumulative, unless otherwise noted
[b] oto=otoscopy, tymp=tympanometry (type B to A transition)
[c] Did any of the patients receive antibiotic or surgery?
[d] interval started at 6-month follow-up
[e] cumulative resolution rate

6-month to 3-year old cohorts

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Ears Resolved Interval[a]					Article(s)
				<6wk	<3m	<6m	<9m	<24m	
Robinson	tymp	unknown	unknown	10 of 25[d] (40.0%)					2270 Robinson 1988
Tos II	tymp	unknown	yes		6/51[1] (12%)	15/59[2] (25%)	19/51[3] (37%)	9/48[4] (19%)	[1] 2634 Tos 1980; [2] 2190 Poulson 1980; [3] 2629 Tos 1979; [4] 2593 Thomsen 1981
Tos II[e]	tymp	unknown	yes		6/51[1] (12%)	16/51[1] (31%)	24/51[1] (47%)		[1] 2634 Tos 1980

[a] interval calculated from cohort inception and not cumulative, unless otherwise noted
[b] oto=otoscopy, tymp=tympanometry (type B to A transition)
[c] Did any of the patients receive antibiotic or surgery?
[d] interval is minimum of 6wk so may be greater
[e] cumulative resolution rate

Table 22 (Continued)

>3-year old cohorts

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Ears Resolved Interval[a]										Article(s)
				<2wk	<3wk	<1m	<6wk	<3m	<4m	<6m	<8m	<1y	<3y	
Fiellau-Nikolajsen I[d]	tymp	unknown	yes			14/94[1] (15%)		22/91[1] (24%)		32/69[1] (46%)			33/65[2] (51%)	[1]1237 Fiellau-Nikolajsen 1979; [2]1242 Fiellau-Nikolajsen 1981
Fiellau-Nikolajsen II[d]	tymp	unknown	unknown			7/64 (11%)		16/62 (26%)						1235 Fiellau-Nikolajsen 1979
Holmquist	tymp	unknown	unknown					251/511 (49%)						1494 Holmquist 1987
Lamothe	pneum oto	no	no		24/64 (38%)		25/53 (47%)							1714 Lamothe 1981
Lamothe[d]	pneum oto	no	no		24/64 (38%)		38/53 (72%)							1714 Lamothe 1981
Renvall I	tymp	unknown	unknown										282/335 (84%)	2240 Renvall 1978
Renvall II[d]	tymp	no	no				10/40 (25%)	16/40 (40%)						2242 Renvall 1982
Sly	tymp	no	no	1/9 (11%)		4/9 (44%)	6/9 (67%)							2457 Sly 1980
Sly II	tymp	no	no	0/5 (0%)		0/5 (0%)	0/5 (0%)							2457 Sly 1980
Tos I	tymp	unknown	unknown					3/92[1] (3%); 3/87[2] (4%)		14/93[1] (15%); 14/87[2] (16%)				[1]1486 Holm-Jensen 1981; [2]543 Tos 1982
Tos I[d]	tymp	unknown	unknown					3/87[1] (3%)		17/87[1] (20%)				[1]543 Tos 1982
Williamson	tymp	unknown	yes						35/67 (52%)		52/67 (78%)	61/67 (91%)		2791 Williamson 1994

[a] interval calculated from cohort inception and not cumulative, unless otherwise noted
[b] oto=otoscopy, pneum oto=pneumatic otoscopy, tymp=tympanometry (type B to A transition)
[c] Did any of the patients receive antibiotic or surgery?
[d] cumulative resolution rates

Table 22 (Continued)

Age not stratifiable

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Ears Resolved Interval[a]							Article(s)
				<1m	<2m	<3m	<4m	<5m	<6m	<3y	
Casselbrant I[d]	algorithm	yes	yes	92/137 (67%)	109/137 (80%)	130/137 (95%)	134/137 (98%)	136/137 (99%)	137/137 (100%)		1000 Casselbrant 1985
Renvall I	tymp	unknown	unknown							282/335 (84%)	2240 Renvall 1978

[a] interval calculated from cohort inception and not cumulative, unless otherwise noted
[b] algorithm=algorithm based on pneumatic otoscopy, tympanometry, and acoustic reflex, tymp=tympanometry (type B to A transition)
[c] Did any of the patients receive antibiotic or surgery?
[d] cumulative resolution rate

Table 23: OME Resolution by Child on Newly Diagnosed OME of Unknown Duration

>3-year old cohorts

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Resolved interval[a]									Article(s)
				<2wk	<1m	<6wk	<10wk	<3m	<4m	<6m	<8m	<1y	
Fiellau-Nikolajsen II	tymp	unknown	unknown		28/81 (35%)			46/80 (58%)		53/78 (68%)			1245 Fiellau-Nikolajsen 1983
Marchisio	pneum oto, tymp	unknown	no					325/451 (72%)					9 Marchisio 1998
Portoian-Shuhaiber	tymp	unknown	unknown				65/130 (50%)						2184 Portoian-Shuhaiber 1984
Sly I	tymp	no	no	1/7 (14%)	3/7 (43%)	5/7 (71%)							2457 Sly 1980
Sly II	tymp	no	no	0/3 (0%)	0/3 (0%)	0/3 (0%)							2457 Sly 1980
Williamson	tymp	unknown	yes						22/50 (44%)		38/50 (76%)	45/50 90%)	

Age not stratifiable

Cohort ID	Diagnostic Method[b]	antibiotic[c]	surgery[c]	Resolved interval[a]		Article(s)
				<2m	<3m	
Mills	pnem oto, tymp	unknown	unknown	57/192 (30%)		1927 Mills 1992
Reves	tymp	unknown	unknown		40/68 (59%)	2243 Reves 1985
van Balen	tymp	unknown	unknown		223/443 (50%)	91 van Balen 1996

[a]interval calculated from cohort inception unless otherwise noted
[b]oto=otoscopy, tymp=tympanometry (type B to A transition)
[c]Did any of the patients receive antibiotic or surgery?

Table 24: Meta-Analysis for <6 Weeks Resolution Rate for Newly Diagnosed OME of Unknown Duration In Children Older Than 3 Years of Age

ArticleID	Author	Criterion	Age at diagnosis	Antibiotic used?	Surgery performed?	Followup interval	Number ears resolved	Total number ears	Resoluation rate in %	Random Effects Pooled Estimate (95% CI)	Test of Heterogeity statistic (P-value) Q
2457	Sly-1980	B or C to A	5yr	no	unknown	<6wk	18	32	56.3		
2457	Sly-1980	B or C to A	5yr	no	unknown	<6wk	11	22	50.0		
1714	Lamothe-1981	Otoscopy	6yr	no	unknown	<6wk	25	53	47.2		
	Total						54	107	44.9	42.3 (24.1, 60.6)	7.85 (p=0.02)

ArticleID	Author	Criterion	Age at diagnosis	Antibiotic used?	Surgery performed?	Followup interval	Number ears resolved	Total number ears	Resoluation rate in %	Random Effects Pooled Estimate (95% CI)	Test of Heterogeity statistic (P-value) Q
2457	Sly-1980	B to A	5yr	no	unknown	<6wk	6	9	66.7		
2457	Sly-1980	B to A	5yr	no	unknown	<6wk	0	5	0.0		
1714	Lamothe-1981	Otoscopy	6yr	no	unknown	<6wk	25	53	47.2		
	Total						31	67	46.3	37.2 (1.8, 72.5)	16.4 (p<0.001)

Note: Lamothe's study used otoscopy and is included in all meta-analyses

Table 25: Meta-Analysis for <3 Months Cumulative Resolution Rate for Newly Diagnosed OME of Unknown Duration In Children Older Than 3 Years of Age

ArticleID	Author	Criterion	Age at diagnosis	Antibiotic used?	Surgery performed?	Followup interval	Number ears resolved	Total number ears	Resoluation rate in %	Random Effects Pooled Estimate (95% CI)	Test of Heterogeity Q statistic (P-value)
1237	Fiellau-Nikolajsen-1979	B or C to A	3-4yr	unknown	unknown	<3mo	154	348	44.3		
1235	Fiellau-Nikolajsen-1979	B or C to A	3-4yr	unknown	unknown	<3mo	83	200	41.5		
543	Tos-1982	B or C to A	4yr	unknown	unknown	<3mo	103	393	26.2		
2242	Renvall-1982	otoscopy	4yr	no	unknown	<12wk	86	144	59.7		
	Total						426	1085	39.3	42.7 (29.3,56.1)	63.01 (p<0.001)

ArticleID	Author	Criterion	Age at diagnosis	Antibiotic used?	Surgery performed?	Followup interval	Number ears resolved	Total number ears	Resoluation rate in %	Random Effects Pooled Estimate (95% CI)	Test of Heterogeity Q statistic (P-value)
1237	Fiellau-Nikolajsen-1979	B to A	3-4yr	unknown	unknown	<3mo	22	91	24.2		
1235	Fiellau-Nikolajsen-1979	B to A	3-4yr	unknown	unknown	<3mo	16	62	25.8		
543	Tos-1982	B to A	4yr	unknown	unknown	<3mo	3	87	3.4		
2242	Renvall-1982	otoscopy	4yr	no	unknown	<12wk	16	40	40.0		
	Total						57	280	20.4	22.5 (5.9,39.0)	44.28 (p<0.001)

Table 26: List of Cohort Studies Included for Question 2

ID#	Author	Year	Cohort
1623	Kaplan	1973	Eskimo villages in the Yukon and Kuskokwim River Delta areas of Southwestern Alaska
1255	Fischler	1985	Four Indian reservations in Arizona
4657	Roberts	1986	Frank Porter Graham Child Development Center, Chapel Hill, NC
3118	Roberts	1988	Frank Porter Graham Child Development Center, Chapel Hill, NC
4806	Roberts	1988	Frank Porter Graham Child Development Center, Chapel Hill, NC
4656	Roberts	1989	Frank Porter Graham Child Development Center, Chapel Hill, NC
3117	Roberts	1991	Frank Porter Graham Child Development Center, Chapel Hill, NC
4319	Roberts	1995	Frank Porter Graham Child Development Center, Chapel Hill, NC
1373	Gravel	1992	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
4728	Gravel	1996	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
1941	Mody	1999	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
2295	Ruben	1997	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
1219	Feagans	1987	Medical and Day Care Intervention Project in Pennsylvania
2135	Paul	1993	Portland Language Development Project (PLDP), Oregon
4651	Klein	1988	The Greater Boston Otitis Media Study Group, MA
2583	Teele	1990	The Greater Boston Otitis Media Study Group, MA
1435	Harsten	1993	University Hospital of Lund, Sweden
877	Black	1993	University of Maryland Medical System, Baltimore, MD
4675	Owen	1996	University of Texas Medical Branch, TX
1277	Freeark	1992	University-based pediatric clinic in Michigan

Table 27: List of Cohort Studies Not Included for Question 2 (For Reason of Not Reporting Findings Beyond 3 Years of Age)

ID#	Author	Year	Cohort
3119	Roberts	1995	Frank Porter Graham Child Development Center, Chapel Hill, NC
4841	Wallace	1988	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
2739	Wallace	1988	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
2740	Wallace	1988	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
4842	Wallace	1992	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
667	Abraham	1996	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
4796	Petinou	1996	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
2742	Wallace	1996	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
3096	Petinou	1999	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
4671	Luloff	1993	Longitudinal study investigating the efficacy of drug prophylaxis on otitis media in greater Boston area, MA
4673	Tsushima	1993	Longitudinal study investigating the efficacy of drug prophylaxis on otitis media in greater Boston area, MA
4674	Wendler-Shaw	1993	Longitudinal study investigating the efficacy of drug prophylaxis on otitis media in greater Boston area, MA
875	Black	1988	Maryland Otitis Media Study Group, Baltimore
4708	Downs	1988	Not specified
2719	Vernon-Feagans	1996	Ongoing study of health and day-care in a semi-rural area of northeastern United States
1288	Friel-Patti	1982	Parkland Memorial Hospital, Dallas, TX
4713	Feldman	1996	Pittsburgh-area Child Development/Otitis Media Study Group, PA
4642	Paradise	2000	Pittsburgh-area Child Development/Otitis Media Study Group, PA
2819	Wright	1988	Pneumococcal vaccine study in Nashville, TN
1677	Knishkowy	1991	PROD (Promotion of Growth and Development) Program, Western Jerusalem
2579	Teele	1984	The Greater Boston Otitis Media Study Group, MA
4664	Feagans	1994	Three day-care facilities in central Pennsylvania, PA

Table 28 Definition of Early Life Positive or Negative OM History in Assessing Long-term Speech and Language Development

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
877	Black 1993	OM History defined by number of episodes of OM within the first year of life documented by otologic examination. • Positive OM History: At least 2 episodes of OM within the first year. A child could receive credit for only one bout of OM within each 29-day period. • Negative OM History: Had not experienced otitis media during first year of life	Not provided	• Based on otologic examination • Examiner not provided
1219	Feagans 1987	OM History described by frequency and duration of OM from 0 to 3 years. They were treated as continuous variables for correlation with outcome. No grouping of children by positive or negative history was done. • Frequency was calculated by counting the number of different episodes • Duration was calculated by counting the total number of days the child had effusion during the first 36 months of life.	Not provided.	• Based on pneumatic otoscopy. Beginning 1978 tympanometry was used to corroborate the diagnosis • OM diagnosed by two pediatricians and two nurse practitioners

Table 28 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
1255	Fischler 1985	OM History defined by number of OM episodes by age 2 years and over age 2. • The study defined three groups of children by OM history by number of episodes before and after age 2. • For our assessment, we used groups 1 and 2 as positive OM history, i.e. (>=2 attacks by age 2) and group 3 as negative OM history (<2 attacks by age 2).	Any mention of one of the following: • Acute suppurative OM: history of ear pain or fussiness with or without fever or ear drainage (less than 5 days), and physical evidence of redness with or without immobility, bulging, or a small perforation of the TM. • Serous OM: history of ear fullness, popping, or hearing loss, or an asymptomatic history; and physical evidence of TM retraction and/or immobility, with or without gray or yellow color or bubbles behind the TM • Chronic OM: history of ear drainage and perforation present for more than two weeks; and physical evidence of perforation.	• By medical record review of documented physician's clinical diagnosis.
1277	Freeark 1992	OM history severity defined by a) number of separate episodes of OM and b) total number of days of effusion over the first 3 years of life. • High OM: above median of OM severity • Low OM: below median of OM severity	Not specified	• By whom, not specified; How diagnosed, not specified. (OM history obtained from medical records).
1373	Gravel 1992	OM groups were defined by otoscopic histories during the first year of life. • OM positive: when bilateral OM was detected at 30% or more of the baby's first year visits. • OM negative: when middle ear status was rated as normal in both ears during 80% or more of the first year visits.	Not specified	• Pediatric nurse practitioners completed pneumo-otoscopic examinations during each scheduled well-baby visit

Table 28 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
4728	Gravel 1996	Same as 1373	Same as 1373	Same as 1373
1435	Harsten 1993	OM groups were defined by the number of AOM episodes during the first 3 years of life. • OM positive: developed six or more episodes of AOM during a 12-month period. • OM negative: no AOM episodes and less than six other acute respiratory tract infections.	• AOM was defined as an acute episode of earache in a child with red bulging eardrum(s) or purulent discharge, occasionally febrile and with signs of upper respiratory tract infection.	• By otomicropscopy performed by an otolaryngologist
1623	Kaplan 1973	OM groups were based on age of onset of first episode of otorrhea. • The study defined 3 groups: group 1-onset of first otorrhea episode during first year of life; group 2-onset of first otorrhea episode at 2-10 years, and group 3-no history of OM • For our assessment, we used group 1 as positive OM history and group 3 as negative OM history.	• Used only episodes of OM with otorrhea.	• A research nurse visited the cohort children and obtained information concerning middle ear abnormality and upper respiratory tract illness and reviewed medical records for status between visits.
4651	Klein 1988	OM history was measured by time spent with effusion during the first 2 years of life and used a 'window' of 23 days to each observation of effusion, whether accompanied by signs of illness or not. It could be shortened or extended by multiple examinations. • Group 1: time spent with effusion <32 days during first 2 years of life. • Group 2: time spent with effusion between 33-108 days during first 2 years of life. • Group 3: time spent with effusion >108 days.	• Criteria for effusion: otorrhea, gas-liquid levels visible on otoscopy or marked reduction of mobility. Tympanometric criterion: type B curve.	• By pediatricians using pneumatic otoscopy until age 3 and both pneumatic otoscopy and tympanometry in years 4 through 7.

Table 28 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
1941	Mody 1999	OM history defined by pneumatic otoscopy findings during first year of life • OM positive: children who had 30% or more of the 13 first-year visits with OM bilaterally • OM negative: children who had 80% or more of the 13 first-year visits with normal middle ear findings bilaterally.	• Used a 9-item otoscopic checklist to determine "clear", "suspicious," or "positive" for OM	• By trained and validated pediatric nurse practitioner using a pneumatic otoscope under the supervision of a pediatric otolaryngologist. • The PNP recorded a description of TM characteristics for each ear, using a 9-item otoscopic checklist and made the determination of "clear," "suspicious," or "positive" for OM.
4675	Owen 1996	OME history was measured by days or duration with OME durng the first 3 years of life. Middle ear status was monitored by home visits every 2 to 4 weeks, irrespective of symptoms for the first 3 years of life. • At each visit, each ear received a diagnosis of normal or OME. If two consecutive visits showed OME, the intervening days were counted as days with OME. If one visit showed OME and the next normal status, or vice versa, half of the intervening days were counted as days with OME. OME duration was defined as the proportion time a subject spent with OME (total OME days divided by total days) in the period examined. • Subjects who experienced 6 continuous weeks of OME in the first year of life were identified as at high risk.	• OME diagnosis was based on type B tympanogram or >= 5 acoustic reflectivity or visible purulent otorrhea without an otoscope.	• By trained technicians using automated screening tympanometers with a 26 Hz probe tone. Acoustic reflectivity was also measured using acoustic otoscope at 30% of visits.

Table 28 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
2135	Paul 1993	OM history was measured by middle ear involvement defined as either the placement of myringotomy tubes or the presence of six or more ear infections treated by a physician before the second birthday by parent report. • Positive OM: had middle ear involvement • Negative OM: lack of such middle ear involvement	• Based on parental reporting	• Based on parental reporting
4657	Roberts 1986	OM history was based on total OME duration in days during first 3 years of life. Duration of each episode of unilateral and bilateral was calculated by subtracting the data of onset of OME from the resolution date. Days of total OME was analyzed both as a continuous and categorical variable. • Group 1: days with total OME representing the lower third of the subjects • Group 2: days with total OME representing the middle third of the subjects • Group 3: days with total OME representing the upper third of the subjects.	• When middle ear fluid was seen or when the mobility of the tympanic membrane was markedly reduced or absent, OME was diagnosed. • Type B tympanograms with a flat or gradually rising shape were considered indicative of OME. • Type C tympanograms showing a maximum compliance of less than –100 mm H_2O were considered indicative of negative middle ear pressure and of an increase likelihood of effusion	• By pediatricians and pediatric nurse practitioners based on pneumatic otoscopy. 60% of the time tympanometry was used to corroborate the OME diagnosis.
4656	Roberts 1989	Same as 4657	Same as 4657	Same as 4657
3118, 4806	Roberts 1988	Same as 4657	Same as 4657	Same as 4657
3117	Roberts 1991	Same as 4657	Same as 4657	Same as 4657
4318	Roberts 1995	Same as 4657	Same as 4657	Same as 4657

Table 28 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
2295	Ruben 1997	OM history was based on the findings of pneumatic otoscopy at every scheduled and sick visit during the first year of life • The OM – group were those who were bilaterally free of OM at 80% or more of their first year visits and had no more than one episode of OM during the first year. • The OM+ group had bilateral OM at 30% or more of their first year visits, and had from 2 to 6 episodes during the first year.	Not specified	• Pneumatic otoscopy by a trained and validated pediatric nurse practitioner.
2583	Teele 1990	OM history was measured by the number of days with middle ear effusion (MEE) by age 3 years. Unless documented to be shorter, each episode of MEE lasted 29 days.	• Diagnosis of MEE required either visualization of a gas-liquid mixture through an intact tympanic memberane, otorrhea, or marked reduction in mobility of the TM to both positive and negative pressure. • Children whose TM(s) showed reduced mobility in response to positive pressure and normal mobility to negative pressure were considered to have only subatmospheric middle ear pressure. • The criteria for effusion using tympanometric devices included a tracing that showed no peak or a tracing that sagged below the baseline (for model 1720B)	• In private practice, three board-certified pediatricians performed 81% of all exams; in urban health center three board-certified pediatricians performed 66% of all exams. • Each center used otoadmittance meters, initially a Grason-Stadler model 1720B. Later, for children 4-7 years, used a Grason-Stadler model 1722. • To resolve ambiguous diagnoses, otoadmittance was used sporadically at 0-3 years of age, but frequently at 4-7 years.

Table 29 Study Quality for Studies Included in Evidence Table on Speech and Language Development

ID	Author(s)	Year	Study Quality Score [a]
877	Black	1993	3 (0,0,0,0,1,1,0,1)
1219	Feagans	1987	5 (1,1,1,0,0,1,0,1)
1255	Fischler	1985	5 (1,1,0,0,1,1,1,0)
1277	Freeark	1992	4 (1,0,0,0,0,1,1,1)
1373	Gravel	1992	5 (1,1,0,0,1,1,1,0)
4728	Gravel	1996	3 (0,1,0,0,0,1,1,0)
1435	Harsten	1993	6 (1,1,1,0,1,1,1,0)
1623	Kaplan	1973	6 (1,1,0,0,1,1,1,1)
4651	Klein	1988	4 (1,0,1,0,0,1,0,1)
1941	Mody	1999	4 (1,1,0,0,0,1,0,1)
4675	Owen	1996	4 (1,1,0,0,0,1,0,1)
2135	Paul	1993	3 (0,0,1,0,0,1,0,1)
4657	Roberts	1986	6 (1,0,1,0,1,1,1,1)
4656	Roberts	1989	6 (1,0,1,0,1,1,1,1)
4806	Roberts	1988	4 (1,0,1,0,0,1,0,1)
3118	Roberts	1988	4 (1,0,1,0,0,1,0,1)
3117	Roberts	1991	2 (0,0,0,0,0,1,0,1)
4319	Roberts	1995	3 (0,0,0,0,0,1,1,1)
2295	Ruben	1997	5 (1,1,0,0,1,1,1,0)
2583	Teele	1990	6 (1,0,1,0,1,1,1,1)

[a] The eight components of study quality score are: (1) study cohort clearly defined; (2) subjects assembled at a uniform time point; (3) pathway of subject entry clearly described; (4) complete follow-up achieved; (5) withdrawals/drop-outs described; (6) objective outcomes used; (7) outcome assessment blinded; and (8) extraneous factors adjusted. '1' indicates presence and '0' indicates absence.

Table 30: Key Characteristics of the Cohort Studies for Question 2

ID#	Author	Year	Cohort	Age of OM History	Age at Outcome Measure	Major Outcome statistic	Outcome Measure	Test	Notes
4675	Owen	1996	Texas	0-3 years	5 years	Correlation	Cognition	Stanford Binet	
4319	Roberts	1995	North Carolina	2 months-3 years	12 years	Correlation	Cognition	WISC-R	
1623	Kaplan	1973	Alaska	0-1 year	10 years	Mean (range)	Cognition	WISC	Stratified by concurrent hearing status
877	Black	1993	Maryland	8-22 months	4-6 years	Mean (SD)	Cognition	McCarthy	
1373	Gravel	1992	New York	0-1 year	4 years	Mean (SD)	Cognition	Stanford-Binet	
4657	Roberts	1986	North Carolina	2 months-3 years	3.5-6 years	Mean (SD)	Cognition	McCarthy	
4656	Roberts	1989	North Carolina	2 months-3 years	8 years	Mean (SD)	Cognition	WISC-R	
4651	Klein	1988	Massachusetts	0-2 years	7 years	Multivariate	Cognition	WISC-R	
2583	Teele	1990	Massachusetts	0-2 years	7 years	Multivariate	Cognition	WISC-R	Adjusted for SES and gender
3118/4806	Roberts	1988	North Carolina	2 months-3 years	2.5-8 years	Correlation	Expressive language	Elicited language play	
3117	Roberts	1991	North Carolina	2 months-3 years	4.5-6 years	Correlation	Expressive language	CELF	Stratified by socioeconomic status
4675	Owen	1996	Texas	0-3 years	5 years	Correlation	Expressive language	Goldman-Fristoe test	
1255	Fischler	1985	Arizona	0-2 years	6-8 years	Mean (SD)	Expressive language	TOLD	
1373	Gravel	1992	New York	0-1 year	4 years	Mean (SD)	Expressive language	SICD-R in months	
2135	Paul	1993	Oregon	0-2 years	4 years	Mean (SD)	Expressive language	MLU	Stratified by normal/late talkers
1219	Feagans	1987	Pennsylvania	0-3 years	5-7 years	Multivariate	Expressive language	MLU, Paraphrase	Reported for total group only
2583	Teele	1990	Massachusetts	0-2 years	7 years	Multivariate	Expressive language	WUG test	Mean adjusted for SES and gender
2295	Ruben	1997	New York	0-1 year	2-9 years, yearly	Percent difference	Expressive language	Unknown	
1277	Freeark	1992	Michigan	0-3 years	3-4 years	Proportion	Expressive language	Verbal Scale Index	Stratified by Parent Verbal Stimulation (PVS)

Abbreviations:

CAVAT=	Carrow Elicited Language Inventory
CELF=	Clinical Evaluation of Language Functions
MLU=	Mean Length of Utterance
PPVT-R=	Peabody Picture Vocabulary Test-Revised
SD=	Standard Deviation
SICD-R=	Sequenced Inventory of Communication Development-Revised
TOLD=	Test of Language Development
WISC-R=	Wechsler Intelligence Scale for Children-Revised
WRAML=	Wide Range Assessment of Memory and Learning
WUG=	"WUG" test (Berko-Gleason)

Table 30 (Continued)

ID#	Author	Year	Cohort	Age of OM History	Age at Outcome Measure	Major Outcome statistic	Outcome Measure	Test	Notes
4728	Gravel	1996	New York	0-1 year	9 years	Raw data not reported	Expressive language	WRAML	Only statistical testing was reported
3117	Roberts	1991	North Carolina	2 months-3 years	4.5-6 years	Correlation	Receptive language	CELF	Stratified by socioeconomic status (SES)
3117	Roberts	1991	North Carolina	2 months-3 years	4.5-6 years	Correlation	Receptive language	PPVT-R	Stratified by SES
4675	Owen	1996	Texas	0-3 years	5 years	Correlation	Receptive language	CAVAT	
1255	Fischler	1985	Arizona	0-2 years	6-8 years	Mean (SD)	Receptive language	TOLD	
877	Black	1993	Maryland	8-22 months	4-6 years	Mean (SD)	Receptive language	PPVT-R	
1373	Gravel	1992	New York	0-1 year	4 years	Mean (SD)	Receptive language	SICD-R in months	
2583	Teele	1990	Massachusetts	0-2 years	7 years	Multivariate	Receptive language	WUG test	Adjusted for SES and gender
2295	Ruben	1997	New York	0-1 year	2-9 years, yearly	Percent difference	Receptive language	Unknown	
4728	Gravel	1996	New York	0-1 year	9 years	No raw data	Receptive language	CELF-R	Statistical significance only
3118/4806	Roberts	1988	North Carolina	2 months-3 years	2.5-8 years	Correlation	Expressive speech	Goldman-Fristoe	
2135	Paul	1993	Oregon	0-2 years	4 years	Mean (SD)	Expressive speech	Goldman-Fristoe	Stratified by normal/late talkers
2583	Teele	1990	Massachusetts	0-2 years	7 years	Multivariate	Expressive speech	Goldman-Fristoe	Adjusted for SES and gender
2295	Ruben	1997	New York	0-1 year	2-9 years, yearly	Percent difference	Expressive speech	Unknown	
3118/4806	Roberts	1988	North Carolina	2 months-3 years	2.5-8 years	Correlation	Receptive speech	Articulation tests	
1941	Mody	1999	New York	0-1 year	9 years	Mean (SD)	Receptive speech	Synthetic speech syllables	
1435	Harsten	1993	Sweden	0-3 years	4 years	Proportion	Receptive speech	Linguistic analysis	
4728	Gravel	1996	New York	0-1 year	9 years	No raw data	Receptive speech	Pediatric Speech Intelligibility	Only statistical testing result was reported

Abbreviations:

CAVAT=	Carrow Elicited Language Inventory
CELF=	Clinical Evaluation of Language Functions
MLU=	Mean Length of Utterance
PPVT-R=	Peabody Picture Vocabulary Test-Revised
SD=	Standard Deviation
SICD-R=	Sequenced Inventory of Communication Development-Revised
TOLD=	Test of Language Development
WISC-R=	Wechsler Intelligence Scale for Children-Revised
WRAML=	Wide Range Assessment of Memory and Learning
WUG=	"WUG" test (Berko-Gleason)

Table 31: Meta-Analysis for Expressive Language Development

ID Number	Author-Year	Cohort	Age of OM history	Age of outcome measure	Name of Test	Positive OM History			Negative OM History			Standardized Mean Difference (95% CI)
						N	Mean	SD	N	Mean	SD	
1255	Fischler-1985 [a]	Arizona	0-2yr	6-8 yrs	TOLD	33	60.0	20.4	71	64.8	28.8	- 0.18 (-0.59, 0.23)
1373	Gravel-1992	New York	0-1yr	4yrs	SICD-R	8	36.0	5.2	12	39.0	6.2	- 0.49 (-1.40, 0.42)
2135	Paul-1993[a]	Oregon	0-2yr	4yrs	MLU	8	57.8	3.8	13	54.6	10.7	0.35 (-0.54, 1.24)
Random Effects estimate												-0.14 (-0.49, 0.20)

Test of standardized mean difference equals 0: z=0.82; p=0.413.
Test of heterogeneity: Chi-squared=1.77 (degrees of freedom=2); p-value=0.412.

[a] Retrospective-prospective studies.

Abbreviations:
OM=Otitis media
TOLD=Test of Language Development
SICD-R=Sequenced Inventory of Communication Development-Revised
MLU=Mean Length of Utterance
N=Number of subjects
SD=Standard deviation
CI=Confidence interval

Table 32: Meta-Analysis for Receptive Language Development

ID Number	Author-Year	Cohort	Age of OM history	Age of outcome measure	Name of Test	Positive OM History			Negative OM History			Standardized Mean Difference (95% CI)
						N	Mean	SD	N	Mean	SD	
877	Black-1993	Maryland	8-22 mos	4-6 yrs	PPVT-R	21	83	17	10	72	18	0.62 (-0.15, 1.39)
1255	Fischler [a] - 1985	Arizona	0-2yr	6-8 yrs	TOLD	33	67	28	71	73	32	-0.19 (-0.61, 0.22)
1373	Gravel-1992	New York	0-1yr	4yr	SICD-R	8	36	5	13	38	5	-0.38 (-1.27, 0.51)
2579	Teele-1990	Boston	0-2yr	3yr	PPVT-R	52	101	17	80	96	15	0.31 (-0.04, 0.67)
Random effects estimate												0.10 (-0.29, 0.49)
Test of standardized mean difference equals 0: z=0.52; p=0.606. Test of heterogeneity: Chi-squared=6.22 (degrees of freedom=3); p=0.102.												

[a] Retrospective-prospective study.

Abbreviations:

PPVT-R=Peabody Picture Vocabulary Test-Revised
TOLD=Test of Language Development
SICD-R=Sequenced Inventory of Communication Development-Revised
N=Number of subjects
SD=Standard deviation
CI=Confidence interval

Table 33: Meta-Analysis for Cognitive Verbal Intelligence

ID Number	Author-Year	Cohort	Age of OM history	Age of outcome measure	Name of Test	Positive OM History			Negative OM History			Standardized Mean Difference (95% CI)
						N	Mean	SD	N	Mean	SD	
877	Black-1993	MD	8-22 mos	4-6 yrs	McCarthy	21	46.7	11.5	10	41.0	10.7	0.49 (-0.27, 1.26)
1373	Gravel-1992	NY	0-1yr	4yrs	Stanford-Binet	9	88.3	15.9	13	84.3	9.4	0.31 (-0.55, 1.17)
4657	Roberts-1986	NC	2mos-3yrs	3.5-6yrs	McCarthy	19	52.0	8.0	19	52.0	9.0	0.00 (-0.64, 0.64)
											Random effects estimate	0.23 (-0.20, 0.65)
Test of standardized mean difference equals 0: z=1.05; p=0.292. Test of heterogeneity: Chi-squared=0.99 (degrees of freedom=2); p=0.609.												

Abbrevations:
OM=Otitis media
N=Number of subjects
SD=Standard deviation
CI=Confidence interval

Table 34: Cohort Studies at Tertiary Screening and Reasons for Exclusion

ID#	Author	Year	Rejection Reason
2221	Rahko	1995	Otitis media not measured at less than 3 years of age
2762	Webster	1989	Case control study
4728	Gravel	1996	No significant difference observed but no hearing data reported
4846	Wright	1984	Hearing data at 3-4 years not abstractable.

Table 35: List of Cohort Studies Included for Question 3

ID#	Author	Year	Cohort
147	Sorri	1995	Birth cohort from Northern Finland
1255	Fischler	1985	Four Indian reservations in Arizona
1373	Gravel	1992	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
1435	Harsten	1993	University Hospital of Lund, Sweden
1623	Kaplan	1973	Eskimo villages in the Yukon and Kuskokwim River Delta areas of Southwestern Alaska
2233	Reed	1967	Eskimo villages in the Yukon and Kuskokwim River Delta areas of Southwestern Alaska
2309	Ryding	1997	University Hospital of Lund, Sweden
2854	Zargi	1992	University of Ljubljana, Ljubljana, Slovenia

Table 36: List of Cohort Studies Excluded from Question 3 (For Reason of Not Reporting Findings Beyond 3 Years of Life)

ID#	Author	Year	Cohort
2264	Roberts	1998	Frank Porter Graham Child Development Center, Chapel Hill, NC
4808	Roberts	1988	Frank Porter Graham Child Development Center, Chapel Hill, NC
667	Abraham	1996	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
2740	Wallace	1988	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
4680	Gravel	2000	LIFE (Longitudinal Infant Follow-up and Evaluation) Program of the Rose F. Kennedy Center, Albert Einstein College of Medicine, Bronx, NY
1288	Friel-Patti	1982	Parkland Memorial Hospital, Dallas, TX
2819	Wright	1988	Pneumococcal vaccine study in Nashville, TN
1677	Knishkowy	1991	PROD (Promotion of Growth and Development) Program, Western Jerusalem
1544	Hutchings	1992	Six general practices in Oxford, England
4838	Vernon-Feagans	1996	Three day-care facilities in central Pennsylvania, PA

Table 37 Definition of Early Life Positive or Negative OM History in Assessing Long-term Hearing Development

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
147	Sorri 1995	OM history was obtained from all possible sources (health care centers, hospitals, and private surgeries). Only children with clear-cut differences in their history were considered. • RAOM group: had >=4 recurrent episodes until the age of 2 years. • SOM group: had been treated for a long standing (>=3 months) secretory middle ear effusion during the first two years of life. • No OM group: had not experienced an acute otitis media episode until the age of 7 years.	Not specified	Not specified
1255	Fischler 1985	• OM History defined by number of OM episodes by age 2 years and over age 2. • The study defined three groups of children by OM history by number of episodes before and after age 2. • For our assessment, we used groups 1 and 2 as positive OM history, i.e. (>=2 attacks by age 2) and group 3 as negative OM history (<2 attacks by age 2).	Any mention of one of the following: • Acute suppurative OM: history of ear pain or fussiness with or without fever or ear drainage (less than 5 days), and physical evidence of redness with or without immobility, bulging, or a small perforation of the TM. • Serous OM: history of ear fullness, popping, or hearing loss, or an asymptomatic history; and physical evidence of TM retraction and/or immobility, with or without gray or yellow color or bubbles behind the TM • Chronic OM: history of ear drainage and perforation present for more than two weeks; and physical evidence of perforation.	• By medical record review of documented physician's clinical diagnosis.

Table 37 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
1373	Gravel 1992	OM groups were defined by otoscopic histories during the first year of life. • OM positive: when bilateral OM was detected at 30% or more of the baby's first year visits. • OM negative: when middle ear status was rated as normal in both ears during 80% or more of the first year visits.	Not specified	• Pediatric nurse practitioners completed pneumo-otoscopic examinations during each scheduled well-baby visit
1435	Harsten 1993	OM groups were defined by the number of AOM episodes during the first 3 years of life. • OM positive: developed six or more episodes of AOM during a 12-month period. • OM negative: no AOM episodes and less than six other acute respiratory tract infections.	• AOM was defined as an acute episode of earache in a child with red bulging eardrum(s) or purulent discharge, occasionally febrile and with signs of upper respiratory tract infection.	• By otomicropscopy performed by an otolaryngologist
1623	Kaplan 1973	OM groups were based on age of onset of first episode of otorrhea. • The study defined 3 groups: group 1-onset of first otorrhea episode during first year of life; group 2-onset of first otorrhea episode at 2-10 years, and group 3-no history of OM • For our assessment, we used group 1 as positive OM history and group 3 as negative OM history.	• Used only episodes of OM with otorrhea.	• A research nurse visited the cohort children and obtained information concerning middle ear abnormality and upper respiratory tract illness and reviewed medical records for status between visits.
2233	Reed 1967	Same study population as 1623. This article reported findings at 3-5 years. Article 1623 reported findings at 10 years of age.	Same as 1623	Same as 1623

Table 37 (Continued)

ID#	Author Year	Definition of Positive/Negative OM History	Definition of OM	OM Diagnosis Method
2309	Ryding 1997	OM history groups were defined by the number of recurrent AOM during the first 3 years of life. • rAOM group: children with >=6 episodes of purulent AOM during a 12-month period. • Healthy group: children with no AOM and <6 other RTI episodes during the study period.	• AOM was defined as an acute episode of earache in a child with red bulging eardrum(s) or purulent discharge, occasionally febrile and with signs of upper respiratory tract infection	• AOM was diagnosed by otomicropscopy, performed by an otolaryngologist.
2854	Zargi 1992	OM history based on parental interviews and by review of hospital charts and other medical documentation. • Experimental group: children treated for recurrent acute unilateral or bilateral suppurative OM at 0-2 years of age. • Control group: children who experienced <=1 episode of OM in the first 2 years of life	Not specified	Not specified

Table 38 Study Quality for Studies Included in Evidence Table on Hearing

ID	Author	Year	Study Quality Score[a]
147	Sorri	1995	4 (0,1,0,0,1,1,0,1)
1255	Fischler	1985	5 (1,1,0,0,1,1,1,0)
1373	Gravel	1992	5 (1,1,0,0,1,1,0,1)
1435	Harsten	1993	6 (1,1,1,0,1,1,1,0)
1623	Kaplan	1973	5 (1,1,0,0,1,1,1,0)
2233	Reed	1967	4 (1,1,0,0,0,1,0,1)
2309	Ryding	1997	5 (0,1,1,0,0,1,1,1)
2854	Zargi	1992	2 (1,0,0,0,0,1,0,0)

[a] The eight components of study quality score are: (1) study cohort clearly defined; (2) subjects assembled at a uniform time point; (3) pathway of subject entry clearly described; (4) complete follow-up achieved; (5) withdrawals/drop-outs described; (6) objective outcomes used; (7) outcome assessment blinded; and (8) extraneous factors adjusted. '1' indicates presence and '0' indicates absence.

Table 39: Characteristics and Outcome Measures of Cohort Studies for Question 3

ID Number	Author	Year	Age at OM history	Age at outcome measure	Outcome measured in % hearing loss	Outcome measured in mean pure tone	Other outcome measure
147	Sorri	1995	0-2yrs	7yrs	>20 dB pure tone averages, type not specified	Mean air-conduction (AC) threshold, right/left ear	
1255	Fischler	1985	0-2yrs	6-8yrs	>25 dB at 500Hz; >20 dB at 1000 Hz; >20 dB at 2000 Hz; >25 dB at 4000 Hz; >25 dB at 6000 Hz. Pure tone type not specified.		
1373	Gravel	1992	0-1yrs	4 yrs		Mean pure tone averages obtained at octave frequencies from 500 through 4000 Hz at a minimum, right/left ear	Pediatric Speech Intelligibility sentence (PSI S) to competing messages (CM) ratio
1435	Harsten	1993	0-3yrs	4yrs	>=25 dB tone-audiometry at any frequency, type not specified.		
1435	Harsten	1993	0-3yrs	7yrs	>=25 dB tone-audiometry at any frequency, type not specified.		
1623	Kaplan	1973	0-1yrs	10yrs	>=25 dB air and bone conduction		
2233	Reed	1967	0-2yrs	3-5yrs	>25 dB pure tone air averages		
2309	Ryding	1997	0-3yrs	10yrs		Median level of air conduction hearing, right/left ear	
2854	Zargi	1992	0-2yrs	6-8yrs	>10 dB for air-conduction hearing loss	Sensorineural hearing loss	

Abbreviations:
dB=decibel
PSI=Pediatric Speech Intelligibility
S=Primary sentence
CM=Competing messages

Table 40: Meta-analysis for Effects of Early Life Otitis Media on Long-term Conductive Hearing Loss[a]

Author	Year	Age of OM history	Age at Hearing Testing	OM+ Sample Size	OM- Sample Size	OM+ Percent Hearing Loss	OM- Percent Hearing Loss	Rate Difference in %	95% CI of Rate Difference in %	Risk Ratio	95% CI of Risk Ratio
Sorri	1995	0-2yrs	7yrs	64	35	51.6	20.0	31.6	(13.5, 49.6)	2.6	(1.3, 5.2)
Fischler	1985	0-2yrs	6-8yrs	96	70	9.4	1.4	7.9	(1.5, 14.4)	6.6	(0.8, 50.6)
Harsten	1993	0-3yrs	7yrs	24	56	8.3	5.4	3.0	(- 9.6, 15.5)	1.6	(0.3, 8.7)
Kaplan	1973	0-1yrs	10yrs	162	76	19.8	7.9	11.9	(3.2, 20.5)	2.5	(1.1, 5.7)
Random effects estimates				346	237	21.7	6.4	11.3	(3.3, 19.3)	2.6	(1.6, 4.2)
Test of heterogeneity Chi-square test value						40.3	10.5	7.3		1.1	
Test of heterogeneity Chi-square test p-value						<0.001	0.015	0.064		0.768	

The following analysis excluded article by Sorri.

Author	Year	Age of OM history	Age at Hearing Testing	OM+ Sample Size	OM- Sample Size	OM+ Percent Hearing Loss	OM- Percent Hearing Loss	Rate Difference in %	95% CI of Rate Difference in %	Risk Ratio	95% CI of Risk Ratio
Fischler	1985	0-2yrs	6-8yrs	96	70	9.4	1.4	7.9	(1.5,14.4)	6.6	(0.8,50.6)
Harsten	1993	0-3yrs	7yrs	24	56	8.3	5.4	3.0	(-9.6,15.5)	1.6	(0.3,8.7)
Kaplan	1973	0-1yrs	10yrs	162	76	19.8	7.9	11.9	(3.2,20.5)	2.5	(1.1,5.7)
Random effects estimates				282	202	13.0	4.2	8.4	(3.6,13.2)	2.6	(1.3,5.2)
Test of heterogeneity Chi-square test value						6.8	4.4	1.4		1.1	
Test of heterogeneity Chi-square test p-value						0.034	0.114	0.508		0.566	

[a] Hearing Loss was at >20-25 dB threshold at any frequency with or without treatment measured at 6-10 years of age.
Sorri, Fischler and Harsten did not specify type of pure-tone test used in defining hearing loss. Kaplan used air and bone conduction.
Abbreviations: OM+: positive otitis media history; OM-: negative otitis media history; CI: confidence interval.

Table 41: List of Cohort Studies Included for Question 4

ID Number	Author	Year
759	Avery	1986
766	Babonis	1991
784	Barnett	1998
810	Beery	1975
817	Ben-David	1981
886	Block	1998
888	Bluestone	1973
889	Bluestone	1979
989	Cantekin	1977
990	Cantekin	1980
1238	Fiellau-Nikolajsen	1980
1241	Fiellau-Nikolajsen	1980
1245	Fiellau-Nikolajsen	1983
1250	Finitzo	1992
1280	Freyss	1980
1282	Fria	1980
4879	Fried	1985
4878	Gersdorff	1986
1384	Grimaldi	1976
1397	Haapaniemi	1997
1446	Haughton	1977
3022	Johnson	1980
1600	Jonathan	1989
1632	Karma	1989
1646	Kemaloglu	1999
1650	Kennedy	1982

ID Number	Author	Year
1685	Koivunen	1997
1785	Lovette	1976
1804	Macknin	1987
1817	Mains	1989
1837	Marchant	1986
1936	Mitchell	1990
2012	Nozza	1992
2013	Nozza	1994
2048	Orchik	1978
2049	Orchik	1978
2050	Orchik	1980
2055	Ovesen	1993
2058	Oyiborhoro	1987
2118	Paradise	1976
4790	Paradise	1996
4793	Park	1988
2236	Rees	1992
4804	Renvall	1996
2344	Sassen	1994
2412	Shaw	1978
2545	Szucs	1995
2601	Tom	1994
2607	Toner	1990
2675	van Balen	1994
2713	Vaughan-Jones	1992
2758	Watters	1997

Table 42: Reason for Exclusion of Diagnostic Studies After Full-Length Article Review

ID Number	Author(s)	Year	Rejection Reason
2877	Alho	1998	Data not abstractable
694	Amedee	1995	Diagnostic procedure and gold standard greater than 24 hours apart.
887	Block	1999	Not addressing OME
912	Boswell	1993	No gold standard
968	Buhrer	1985	No gold standard
1015	Chang	1998	Not a diagnostic study
1149	Douniadakis	1993	No gold standard
1167	Duncan	1982	Diagnostic procedure and gold standard greater than 24 hours apart.
1233	Fields	1993	Diagnostic procedure and gold standard greater than 24 hours apart.
1236	Fiellau-Nikolajsen	1979	Diagnostic procedure and gold standard greater than 24 hours apart.
1239	Fiellau-Nikolajsen	1980	Diagnostic procedure and gold standard greater than 24 hours apart.
1281	Fria	1980	Procedure not in scope
4749	Kaleida	1992	Data not abstractable
2014	Nozza	1997	Not all referrals had gold standard
2070	Palmu	1999	Only 42/242 ears had myringotomy
2145	Pellett	1997	No gold standard
2385	Schwartz	1987	No gold standard
2434	Silman	1992	No gold standard
2435	Silman	1994	No gold standard
2438	Silva	1997	Data not abstractable
2442	Silverman	1995	No gold standard
2556	Takahashi	1999	Data not abstractable
2786	Williams	1977	Diagnostic procedure and gold standard greater than 24 hours apart.

Table 43: Number of Articles by Diagnostic Method and Reference Standard

Diagnostic Method	Reference Standard			
	Myringotomy	Tympanocentesis	Validated pneumatic otoscopy	Total
Acoustic reflectometry	6	1	3	10
Audiometry-air and bone conduction thresholds	2			2
Audiometry-air conduction threshold	4	1		5
Binaural micro-tympanoscopy	2			2
Non-pneumatic otoscopy	4			4
Pneumatic otoscopy-examiner validation not specified	3			3
Pneumatic otoscopy-unvalidated examiner	9			9
Pneumatic otoscopy-validated examiner	1			1
Portable tympanometer	8			8
Professional tympanometry	35	6	6	47
Quantitative tympanometry	4			4
Signs/symptoms	2			2
Total	80	8	9	97

Note: A record can be counted more than once within a cell (i.e. controlling for intervention group.)

Table 44: Acoustic Reflectometry (>=5 vs <5 RU) versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Fried-1985	44	62	71.0				
	Macknin-1987	84	128	65.6				
	Babonis-1991	68	118	57.6				
	Total	196	308	63.6	64.2	(57.0, 71.5)	3.6	0.168
Specificity	Fried-1985	36	40	90.0				
	Macknin-1987	43	70	61.4				
	Babonis-1991	90	102	88.2				
	Total	169	212	79.7	80.4	(65.0, 95.9)	18.4	<0.001
Prevalence	Fried-1985	62	102	60.8				
	Macknin-1987	128	198	64.6				
	Babonis-1991	118	220	53.6				
	Total	308	520	59.2	59.6	(52.5, 66.7)	5.4	0.067

Table 45: Pneumatic Otoscopy versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Paradise-1976	136	138	98.6				
	Cantekin-1977	213	230	92.6				
	Bluestone-197	242	256	94.5				
	Karma-1989	726	753	96.4				
	Mains-1989	102	116	87.9				
	Toner-1990	108	124	87.1				
	Finitzo-1992	107	115	93.0				
	Total	1634	1732	94.3	93.8	(91.4, 96.3)	28.8	<0.001
Specificity	Paradise-1976	56	75	74.7				
	Cantekin-1977	113	140	80.7				
	Bluestone-197	131	169	77.5				
	Karma-1989	277	339	81.7				
	Mains-1989	84	93	90.3				
	Toner-1990	87	98	88.8				
	Finitzo-1992	28	48	58.3				
	Total	776	962	80.7	80.5	(75.1, 86.0)	27.2	<0.001
Prevalence	Paradise-1976	138	213	64.8				
	Cantekin-1977	230	370	62.2				
	Bluestone-197	256	425	60.2				
	Karma-1989	753	1092	69.0				
	Mains-1989	116	209	55.5				
	Toner-1990	124	222	55.9				
	Finitzo-1992	115	163	70.6				
	Total	1732	2694	64.3	62.8	(58.3, 67.2)	30.7	<0.001

Table 46: Portable Tympanometry (Mixed Criteria) versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	21	39	53.8				
	Babonis-1991	92	118	78.0				
	Rees-1992	260	260	100.0				
	Vaughan-Jones-1992	120	135	88.9				
	van Balen-1994	147	156	94.2				
	Koivunen-1997	52	66	78.8				
	Total	692	774	89.4	84.5	(76.0, 93.1)	39.6	<0.001
Specificity	Orchik-1978	35	37	94.6				
	Babonis-1991	84	102	82.4				
	Rees-1992	9	50	18.0				
	Vaughan-Jones-1992	41	65	63.1				
	van Balen-1994	37	77	48.1				
	Koivunen-1997	137	175	78.3				
	Total	343	506	67.8	64.4	(44.3, 84.4)	167.1	<0.001
Prevalence	Orchik-1978	39	76	51.3				
	Babonis-1991	118	220	53.6				
	Rees-1992	260	310	83.9				
	Vaughan-Jones-1992	135	200	67.5				
	van Balen-1994	156	233	67.0				
	Koivunen-1997	66	241	27.4				
	Total	774	1280	60.5	58.5	(40.3, 76.7)	268.9	<0.001

Table 47: Professional Tympanometry (Acoustic Reflex at 500 or 1000 Hz) versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	35	39	89.7				
	Orchik-1980	34	39	87.2				
	Nozza-1992	71	81	87.7				
	Nozza-1994	106	124	85.5				
	Total	246	283	86.9	87.1	(83.2, 91.0)	0.6	0.901
Specificity	Orchik-1978	29	37	78.4				
	Orchik-1980	26	37	70.3				
	Nozza-1992	26	30	86.7				
	Nozza-1994	61	94	64.9				
	Total	142	198	71.7	74.8	(64.6, 85.0)	8.2	0.041
Prevalence	Orchik-1978	39	76	51.3				
	Orchik-1980	39	76	51.3				
	Nozza-1992	81	111	73.0				
	Nozza-1994	124	218	56.9				
	Total	283	481	58.8	58.6	(48.5, 68.6)	14.9	0.002

Table 48: Professional Tympanometry (Static Compensated Acoustic Admittance at 0.1) versus Myringotomy

(A) Including both Nozza articles

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Fiellau-Nikolajsen-1980	9	46	19.6				
	Nozza-1992	25	81	30.9				
	Nozza-1994	37	137	27.0				
	Barnett-1998	95	175	54.3				
	Total	166	439	37.8	33.2	(17.5, 48.9)	38.1	<0.001
Specificity	Fiellau-Nikolajsen-1980	42	42	100.0				
	Nozza-1992	29	30	96.7				
	Nozza-1994	109	112	97.3				
	Barnett-1998	104	124	83.9				
	Total	284	308	92.2	95.0	(88.5, 100)	13.9	0.003
Prevalence	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1992	81	111	73.0				
	Nozza-1994	137	249	55.0				
	Barnett-1998	175	299	58.5				
	Total	439	747	58.8	59.7	(51.8, 67.7)	14.2	0.003

(B) Excluding Nozza-1992 study

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Fiellau-Nikolajsen-1980	9	46	19.6				
	Nozza-1994	37	137	27.0				
	Barnett-1998	95	175	54.3				
	Total	141	358	39.4	33.9	(12.7, 55.0)	36.9	<0.001
Specificity	Fiellau-Nikolajsen-1980	42	42	100.0				
	Nozza-1994	109	112	97.3				
	Barnett-1998	104	124	83.9				
	Total	255	278	91.7	94.1	(83.9, 100)	13.7	0.001
Prevalence	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1994	137	249	55.0				
	Barnett-1998	175	299	58.5				
	Total	358	636	56.3	56.3	(52.5, 60.2)	1.4	0.510

Table 49: Professional Tympanometry (Static Compensated Acoustic Admittance at 0.2) versus Myringotomy

(A) Including Both Nozza Studies

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Fiellau-Nikolajsen-1980	21	46	45.7				
	Nozza-1992	74	81	91.4				
	Nozza-1994	63	137	46.0				
	Barnett-1998	110	175	62.9				
	Total	268	439	61.0	61.8	(39.0, 84.7)	93.4	<0.001
Specificity	Fiellau-Nikolajsen-1980	40	42	95.2				
	Nozza-1992	21	30	70.0				
	Nozza-1994	103	112	92.0				
	Barnett-1998	93	124	75.0				
	Total	257	308	83.4	84.5	(74.0. 95.0)	23.0	<0.001
Prevalence	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1992	81	111	73.0				
	Nozza-1994	137	249	55.0				
	Barnett-1998	175	299	58.5				
	Total	439	747	58.8	59.7	(51.8, 67.7)	14.2	0.003

(B) Excluding Nozza-1992 Study

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Fiellau-Nikolajsen-1980	21	46	45.7				
	Nozza-1994	63	137	46.0				
	Barnett-1998	110	175	62.9				
	Total	194	358	54.2	52.2	(39.5, 64.8)	10.7	0.005
Specificity	Fiellau-Nikolajsen-1980	40	42	95.2				
	Nozza-1994	103	112	92.0				
	Barnett-1998	93	124	75.0				
	Total	236	278	84.9	87.7	(76.8. 98.5)	17.9	<0.001
Prevalence	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1994	137	249	55.0				
	Barnett-1998	175	299	58.5				
	Total	358	636	56.3	56.3	(52.5, 60.2)	1.4	0.510

Table 50: Professional Tympanometry (Static Compensated Acoustic Admittance at 0.3) versus Myringotomy

(A) Including both Nozza articles

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	35	39	89.7				
	Fiellau-Nikolajsen-1980	16	46	34.8				
	Nozza-1992	59	81	72.8				
	Nozza-1994	96	137	70.1				
	Total	206	303	68.0	67.4	(49.2, 85.7)	41.6	<0.001
Specificity	Orchik-1978	15	37	40.5				
	Fiellau-Nikolajsen-1980	10	42	23.8				
	Nozza-1992	24	30	80.0				
	Nozza-1994	90	112	80.4				
	Total	139	221	62.9	56.4	(27.5, 85.3)	69.4	<0.001
Prevalence	Orchik-1978	39	76	51.3				
	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1992	81	111	73.0				
	Nozza-1994	137	249	55.0				
	Total	303	524	57.8	58.2	(48.1, 68.3)	15.9	0.001

(B) Excluding Nozza-1992 study

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	35	39	89.7				
	Fiellau-Nikolajsen-1980	16	46	34.8				
	Nozza-1994	96	137	70.1				
	Total	147	222	66.2	65.4	(39.1, 91.7)	41.5	<0.001
Specificity	Orchik-1978	15	37	40.5				
	Fiellau-Nikolajsen-1980	10	42	23.8				
	Nozza-1994	90	112	80.4				
	Total	115	191	60.2	48.6	(10.2, 87.0)	64.7	<0.001
Prevalence	Orchik-1978	39	76	51.3				
	Fiellau-Nikolajsen-1980	46	88	52.3				
	Nozza-1994	137	249	55.0				
	Total	222	413	53.8	53.8	(49.0, 58.6)	0.4	0.811

Table 51: Professional Tympanometry (B curve as abnormal) versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	46	84	54.8				
	Shaw-1978	48	49	98.0				
	Johnson-1980	55	74	74.3				
	Ben-David-1981	195	250	78.0				
	Kennedy-1982	44	51	86.3				
	Gersdorff-1986	61	81	75.3				
	Park-1988	182	248	73.4				
	Mitchell-1990	57	65	87.7				
	Toner-1990	107	124	86.3				
	Finitzo-1992	65	72	90.3				
	Vaughan-Jones-1992	91	135	67.4				
	Ovessen-1993	310	342	90.6				
	Sassen-1994	225	279	80.6				
	Tom-1994	100	153	65.4				
	Renvall-1996	87	101	86.1				
	Watters-1997	679	745	91.1				
	Total	2352	2853	82.4	80.9	(76.1, 85.7)	196.6	<0.001
Specificity	Orchik-1978	52	58	89.7				
	Shaw-1978	3	10	30.0				
	Johnson-1980	31	41	75.6				
	Ben-David-1981	39	61	63.9				
	Kennedy-1982	21	24	87.5				
	Gersdorff-1986	27	47	57.4				
	Park-1988	15	38	39.5				
	Mitchell-1990	10	19	52.6				
	Toner-1990	91	98	92.9				
	Finitzo-1992	19	22	86.4				
	Vaughan-Jones-1992	61	65	93.8				
	Ovessen-1993	37	51	72.5				
	Sassen-1994	59	101	58.4				
	Tom-1994	47	60	78.3				
	Renvall-1996	25	26	96.2				
	Watters-1997	166	210	79.0				
	Total	703	931	75.5	74.5	(66.9, 82.0)	147.8	<0.001
Prevalence	Orchik-1978	84	142	59.2				
	Shaw-1978	49	59	83.1				
	Johnson-1980	74	115	64.3				
	Ben-David-1981	250	311	80.4				
	Kennedy-1982	51	75	68.0				
	Gersdorff-1986	81	128	63.3				
	Park-1988	248	286	86.7				
	Mitchell-1990	65	84	77.4				
	Toner-1990	124	222	55.9				
	Finitzo-1992	72	94	76.6				
	Vaughan-Jones-1992	135	200	67.5				
	Ovessen-1993	342	393	87.0				
	Sassen-1994	279	380	73.4				
	Tom-1994	153	213	71.8				
	Renvall-1996	101	127	79.5				
	Watters-1997	745	955	78.0				
	Total	2853	3784	75.4	73.6	(69.1, 78.1)	156.6	<0.001

Table 52: Professional Tympanometry (B or C2 curve as abnormal) versus Myringotomy

					Random Effect Estimate		Test of Heterogeneity	
Measure	Author-Year	X	N	%	%	95% CI	Q	P-Value
Sensitivity	Orchik-1978	31	39	79.5				
	Fiellau-Nikolajsen-1980	42	46	91.3				
	Kennedy-1982	51	51	100.0				
	Vaughan-Jones-1992	120	135	88.9				
	Ovessen-1993	323	342	94.4				
	Sassen-1994	253	279	90.7				
	Total	820	892	91.9	93.8	(91.1, 96.4)	9.44	0.093
Specificity	Orchik-1978	32	37	86.5				
	Fiellau-Nikolajsen-1980	37	42	88.1				
	Kennedy-1982	11	24	45.8				
	Vaughan-Jones-1992	41	65	63.1				
	Ovessen-1993	27	51	52.9				
	Sassen-1994	33	101	32.7				
	Total	181	320	56.6	61.8	(41.5, 82.1)	89.8	<0.001
Prevalence	Orchik-1978	39	76	51.3				
	Fiellau-Nikolajsen-1980	46	88	52.3				
	Kennedy-1982	51	75	68.0				
	Vaughan-Jones-1992	135	200	67.5				
	Ovessen-1993	342	393	87.0				
	Sassen-1994	279	380	73.4				
	Total	892	1212	73.6	67.3	(56.3, 78.2)	90.1	<0.001

Table 53: Summary of Meta Analysis for Diagnostic Comparisons, Excluding Duplicated Studies by Same Author

Measure	ID	Diagnostic Comparison versus Myringotomy	Number Articles	Number Cases	Measure %	Random Effect Estimate %	Random Effect Estimate 95% CI	Test of Heterogeneity Q	Test of Heterogeneity P-Value
Sensitivity	**1**	Acoustic reflectometry (>=5 vs <5)	3	308	63.6	64.2	(57.0, 71.5)	3.6	0.168
	2	Pneumatic otoscopy	7	1732	94.3	93.8	(91.4, 96.3)	28.8	<0.001
	3	Portable tympanometry	6	774	89.4	84.5	(76.0, 93.1)	39.6	<0.001
	5	Professional tympanometry (using static compensated acoustic admittance at 0.1)	3	358	39.4	33.9	(12.7, 55.0)	36.9	<0.001
	6	Professional tympanometry (using static compensated acoustic admittance at 0.2)	3	359	54.2	52.2	(39.5, 64.8)	10.7	0.005
	7	Professional tympanometry (using static compensated acoustic admittance at 0.3)	3	222	66.2	65.4	(39.1, 91.7)	41.5	<0.001
	8	Professional tympanometry (using flat or B curve as abnormal)	16	2853	82.4	80.9	(76.1, 85.7)	196.6	<0.001
	9	Professional tympanometry (using flat or B or C2 curve as abnormal)	6	892	91.9	93.8	(91.1, 96.4)	9.4	0.093
Specificity	**1**	Acoustic reflectometry (>=5 vs <5)	3	212	79.7	80.4	(65.0, 95.9)	18.4	<0.001
	2	Pneumatic otoscopy	7	962	80.7	80.5	(75.1, 86.0)	27.2	<0.001
	3	Portable tympanometry	6	506	67.8	64.4	(44.3, 84.4)	167.1	<0.001
	5	Professional tympanometry (using static compensated acoustic admittance at 0.1)	3	278	91.7	94.1	(83.9, 100)	13.7	0.001
	6	Professional tympanometry (using static compensated acoustic admittance at 0.2)	3	278	84.9	87.7	(76.8, 98.5)	17.9	<0.001
	7	Professional tympanometry (using static compensated acoustic admittance at 0.3)	3	191	60.2	48.6	(10.2, 87.0)	64.7	<0.001
	8	Professional tympanometry (using flat or B curve as abnormal)	16	931	75.5	74.5	(66.9, 82.0)	147.8	<0.001
	9	Professional tympanometry (using flat or B or C2 curve as abnormal)	6	320	56.6	61.8	(41.5, 82.1)	89.8	<0.001
Prevalence	**1**	Acoustic reflectometry (>=5 vs <5)	3	520	59.2	59.6	(52.5, 66.7)	5.4	0.067
	2	Pneumatic otoscopy	7	2694	64.3	62.8	(58.3, 67.2)	30.7	<0.001
	3	Portable tympanometry	6	1280	60.5	58.5	(40.3, 76.7)	268.9	<0.001
	5	Professional tympanometry (using static compensated acoustic admittance at 0.1)	3	636	56.3	56.3	(52.5, 60.2)	1.4	0.510
	6	Professional tympanometry (using static compensated acoustic admittance at 0.2)	3	636	56.3	56.3	(52.5, 60.2)	1.4	0.510
	7	Professional tympanometry (using static compensated acoustic admittance at 0.3)	3	413	53.8	53.8	(49.0, 58.6)	0.4	0.811
	8	Professional tympanometry (using flat or B curve as abnormal)	16	3784	75.4	73.6	(69.1, 78.1)	156.6	<0.001
	9	Professional tympanometry (using flat or B or C2 curve as abnormal)	6	1212	73.6	67.3	(56.3, 78.2)	90.1	<0.001

Note: Comparison #4 had only two studies and thus not included in the summary

Table 54: Study Quality and Test Performer of Diagnostic Studies Used in Meta-Analysis

Diagnostic Comparison	Author-Year	Study Quality[a]	Test Performer
1. Acoustic reflectometry (>=5 vs <5 RU) with myringotomy	Fried-1985 Macknin-1987 Babonis-1991	1(100000) 4(111001) 5(111011)	Not specified Pediatrician One of the authors, specialty not specified
2. Pneumatic otoscopy with myringotomy	Paradise-1976 Cantekin-1977 Bluestone-1979 Karma-1989 Mains-1989 Toner-1990 Finitzo-1992	4(111001) 1(100000) 2(100001) 3(100101) 1(100000) 2(100001) 4(111001)	Pediatrician Not specified Not specified Otolaryngologist/pediatrician Senior registrar and senior house officer One of the authors, specialty not specified Pediatric otolaryngologist
3. Portable tympanometry (mixed criteria) with myringotomy	Orchik-1978 Babonis-1991 Rees-1992 Vaughan-Jones-1992 van Balen-1994 Koivunen-1997	4(111001) 5(111011) 1(100000) 2(100001) 4(111010) 3(110001)	Not specified One of the authors, specialty not specified Not specified Not specified General practitioner with special training from ENT department Trained nurse
4. Professional tympanometer (using acoustic reflex at 500 or 1000 Hz) with myringotomy	Orchik-1978 Orchik-1980 Nozza-1992 Nozza-1994	4(111001) 4(111001) 4(111001) 4(111001)	Not specified Not specified Audiologist/nurses Clinically certified and licensed audiologist
5. Professional tympanometer (using static compensated acoustic admittance at 0.1) with myringotomy	Fiellau-Nikolajsen-1980 Nozza-1992 Nozza-1994 Barnett-1998	4(111001) 4(111001) 4(111001) 4(111001)	Author Audiologist/nurses Clinically certified and licensed audiologist Research assistant
6. Professional tympanometer (using static compensated acoustic admittance at 0.2) with myringotomy	Fiellau-Nikolajsen-1980 Nozza-1992 Nozza-1994 Barnett-1998	4(111001) 4(111001) 4(111001) 4(111001)	Author Audiologist/nurses Clinically certified and licensed audiologist Research assistant

[a] The first number is the total score of the six components. The six components of study quality score are: (1) appropriate reference standard; (2) test and reference standard assessed independently of each other; (3) blinded reading of results; (4) patient sample included an appropriate spectrum as in clinical practice; (5) reproducibility and interpretation of test results determined; and (6) description of test method sufficient to permit replication. '1' indicates presence and '0' indicates absence of the criterion.]

Table 54: Study Quality and Test Performer of Diagnostic Studies Used in Meta-Analysis (Continued)

Diagnostic Comparison	Author-Year	Study Quality [a]	Test Performer
7. Professional tympanometer (using static compensated acoustic admittance at 0.3) with myringotomy	Orchik-1978	4(111001)	Not specified
	Fiellau-Nikolajsen-1980	4(111001)	Author
	Nozza-1992	4(111001)	Audiologist/nurses
	Nozza-1994	4(111001)	Clinically certified and licensed audiologist
8. Professional tympanometer (using flat or B curve as abnormal) with myringotomy	Orchik-1978	4(111001)	Not specified
	Shaw-1978	1(100000)	Not specified
	Johnson-1980	2(110000)	Audiologist
	Ben-David-1981	1(100000)	Not specified
	Kennedy-1982	1(100000)	Audiologist
	Gersdorff-1986	1(100000)	Not specified
	Park-1988	1(100000)	Not specified
	Mitchell-1990	1(100000)	Not specified
	Toner-1990	2(100001)	Not specified
	Finitzo-1992	4(111001)	Certified audiologist
	Vaughan-Jones-1992	2(100001)	Not specified
	Ovessen-1993	4(111001)	Otolaryngologist
	Sassen-1994	3(111000)	Not specified
	Tom-1994	4(111001)	Certified audiologists
	Renvall-1996	1(100000)	Not specified
	Watters-1997	2(110000)	Paediatric audiologist
9. Professional tympanometer (using flat or B or C2 curve as abnormal) with myringotomy	Orchik-1978	4(111001)	Not specified
	Fiellau-Nikolajsen-1980	4(111001)	Author
	Kennedy-1982	1(100000)	Audiologist
	Vaughan-Jones-1992	2(100001)	Not specified
	Ovessen-1993	4(111001)	Otolaryngologist
	Sassen-1994	3(111000)	Not specified

[a] The first number is the total score of the six components. The six components of study quality score are: (1) appropriate reference standard; (2) test and reference standard assessed independently of each other; (3) blinded reading of results; (4) patient sample included an appropriate spectrum as in clinical practice; (5) reproducibility and interpretation of test results determined; and (6) description of test method sufficient to permit replication. ‘1’ indicates presence and ‘0’ indicates absence of the criterion.]

Table 55: Country of Origin of Studies Included in Evidence Tables

Country of Origin	All Questions (n=112)	Question 1: Natural History (n=33)	Question 2: Speech and Language (n=20)	Question 3: Hearing (n=7)	Question 4: Diagnostic Methods (n=52)
Belgium	2				2
Canada	1	1			
Denmark	18	14			4
England	9	3			6
Finland	4			1	3
France	1				1
Israel	2	1			1
Italy	1	1			
Korea	1				1
Kuwait	1	1			
Northern Ireland	2				2
Scotland	2	1			1
Sweden	6	3	1	2	
The Netherlands	4	2			2
Turkey	1				1
USA	53	6	19	4	24
not specified	4				4
Non-USA	**55 (51%)**	**27 (82%)**	**1 (5%)**	**3 (43%)**	**24 (50%)**
USA	**53 (49%)**	**6 (18%)**	**19 (95%)**	**4 (57%)**	**24 (50%)**