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Mini symposium Otitis Media and Rhinosinusitis

The wicked problem of otitis media: summary of recent systematic reviews on otitis media with effusion

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Educational aims

The reader will be able to better understand the:

- Complexities of otitis media diagnosis.
- Evidence based for otitis media with effusion management.
- Risks associated with current management strategies for otitis media.

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ABSTRACT

Otitis media (OM) is a wicked problem. Millennia ago, middle ear disease was described in the ancient Egyptian Ebers Papyrus and Indian Sushruta Samhit ('Compendium'). Centuries ago, Italian anatomists (Bartholomaeus Eustachius ~ 1563; and Antonio Valsalva ~ 1704) described the structures and technique for draining middle ear pus that still bear their names. Recently, immunological studies have broadened our understanding of the important inflammatory and immune responses in middle ear disease. Despite all of this knowledge, we have made no real progress eliminating this disease that nearly every child will still experience, although the severe life threatening forms are much less common.

Colonised High Income Countries have recorded evidence of middle ear disease among the indigenous populations for centuries and the massive disparities in disease burden persist. We have made little progress, indeed may have gone backwards, managing OM with priority populations, such as First Nations children. More broadly, OM is one of the commonest reasons for children to attend healthcare, be prescribed antibiotics and undergo surgery. Therefore, it has a significant impact on health-spending and antibiotic resistance as well as morbidity for children, including hearing impairment, balance disturbance, behavioural disruption, speech and language and other delays with all the consequent life-course impacts, including justice system contact. Perhaps OM is not eradicable, but we must do better to contain the recurrent, persistent and severe forms.

IDENTIFICATION

Otitis media has confounded healthcare professionals for millenia [1–4]. As highlighted by Ludbrook and Wannasuphoprasit [5,6], accurate diagnosis of specific upper respiratory tract infection subtypes is difficult. Trials often use validated otoscopists or specialist otolaryngologists using the gold standard techniques of pneumatic otoscopy or tympanometry [7]. Whereas most OM is diagnosed in primary care with simple otoscopy performed by healthcare practitioners with little or no training in pneumatic otoscopy and without access to tympanometry [8]. We found only 10 % usage of these gold standard techniques even among Aboriginal Community Controlled Health Service practitioners, caring for children with the highest rate of middle ear disease in the world [9]. Primary care physicians in urban settings found pneumatic otoscopy difficult but affordable, whereas Tympanometry was easy but expensive [10]. These barriers are likely to be generalisable to other healthcare settings globally. Without better training of pneumatic otoscopy techniques, or more affordable/available tympanometers, it is likely that otitis media with effusion (OME) will continue to be missed in the primary care setting along with the

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associated hearing deficits putting children at risk of developmental delays and educational disadvantage.

Unfortunately, the alternative approach of population screening is not supported by evidence [11]. OM is intermittent and transient and so a child with recurrent severe disease who happens to be well on the day of screening can be missed, whereas a child who has their only episode on the day of screening is identified. The better approach, particularly for First Nations children at high risk [5,8], is eternal vigilance; with every child having their ears examined at every opportunity and findings documented so prolonged and recurrent disease can be monitored [12]. Then, the children with recurrent and persistent disease, who are at risk of significant hearing loss, can be identified, and case managed, to prevent them falling through the healthcare system gaps.

A search for systematic review level evidence for OME shows the paucity of high-quality research for early identification, therapies and risk/protective factors (Table 1). The randomised controlled trials funded are almost exclusively in High Income Countries, but not among the populations most at risk in those countries. Study populations are often those least likely to benefit (e.g., easily approached, otherwise well children with OME definitively diagnosed by experts). Whereas the children most likely to benefit (and those most likely to need targeted population-level interventions) are the children with risk factors, such as midface abnormalities, Eustachian Tube dysfunction, immunocompromise and children from First Nations backgrounds and socioeconomic challenges [4,5].

To AB* or not to AB (*antibiotics):

"One of the first duties of the physician is to educate the masses not to take medicine."
–Sir William Osler (1849–1919)

Perhaps a little paternalistic, but this quote from a century ago, is still relevant today. We continue to focus on management approaches centred on medications and surgery. OM requires vigilant monitoring and focussing on improved identification of the few children who require intervention, rather than immediately resorting to antibiotic therapy for the many. Dozens of trials have examined whether antibiotics improve outcomes for acute OM [13]. They do- but only a little. For OME, the evidence shows an even weaker effect from antibiotics. However, decisions about whether to use antibiotics, are not solely determined by evidence of efficacy. The magnitude of the effect [14], the frequency and severity of side effects and harms in general (e.g., cost and the difficulty administering antibiotics in young infants) and population-level considerations (such as the approaching tsunami of antibiotic resistance) must all be considered. International guidelines do not recommend antibiotic therapy at presentation for acute OM, OME [5] or rhinosinusitis [6] based on a wholistic assessment of risk and benefit, not because of the absence of any evidence of benefit [12,15–17].

Modern 'Fast-food medicine' tempts healthcare professionals to adopt the management option that is most efficient in time, but not necessarily for cost. This is often felt to be antibiotic prescription. This may be to avoid what is perceived as the difficult conversation to explain the difference between bacterial and viral pathologies and that even some bacterial infections (e.g., acute OM), do not necessarily need immediate antibiotic therapy; as distinct from meningitis and pneumonia. When asked, parents, including First Nations parents [18], actually report a willingness to adopt watchful waiting when engaged in respectful shared decision making. Watchful waiting doesn't mean not taking antibiotics ever. It means not taking antibiotics immediately. An alternative option is to provide a script ('delayed antibiotics') and educate the family when to fill it. A Cochrane review found 'delayed antibiotics' for upper respiratory infections massively reduces antibiotic use (OR 0.04, 95 % CI 0.03–0.05) without reducing satisfaction compared with immediate antibiotics (OR 0.65, 95 % CI 0.39–1.10) [19]. However, our healthcare systems are designed to financially reward clinicians who are quick, not clinicians who dedicate time to search evidence or follow synthesised evidence from guidelines.

Table 1
Systematic reviews of OME protective factors, risk factors, and early identification through screening.

Study & population	Risk or protective factor	Outcome	Effect (95 % CI)	Studies
Risk factors				
Paing A 2024 Modifiable risk factors for OME in High Income Country settings [28]	Exposure to other children: childcare 20 h + per week	OME	OR 5.21 (2.9 to 9.36)	1
	Exposure to other children: attending daycare	OME	RR 2.79 (1.98 to 3.93)	1
	Exposure to other children: attending church	OME	OR 2.78 (1.05 to 7.4)	1
	Fluid or pus ear discharge in past year	OME	OR 2.1 (1.01 to 4.35)	1
	Ear infections in the past year	OME	RR 1.95 (1.39 to 2.72)	1
	5 + coughs/colds in past year	OME	OR 1.91 (1.22 to 2.99)	1
	5 + breathing problems in past year	OME	RR 1.78 (1.26 to 2.53)	1
	Adenoid hypertrophy	Recurrent OME	OR 9.96 (5.17 to 19.19)	1
Protective factors				
Paing A 2024 Modifiable risk factors for OME in High Income Country settings [28]	Pneumococcal vaccination (PCV7) vs. not	OME	Peto OR 0.9 (0.83 to 0.98)	1
	Pneumococcal vaccination (PCV13) vs. not	OME	Peto OR 0.85 (0.79 to 0.92)	1
	Breastfeeding	OME	Scarce evidence*	–
Identification of children for early OME treatment				
Simpson S 2007 Screening for children with OME 0-4y [29]	Screening vs. no screening	OME	No evidence	0
	OME interventions for children identified through screening	Language development	No evidence of clinically important benefits in language development from screening and treating children early	3

95 % CI = 95 % confidence interval; RR = Relative risk; OR = Odds ratio *A recent systematic review including 10 cohort studies shows 43 % reduction in AOM with longer exclusive breastfeeding vs. shorter [30].

Table 2
Systematic reviews of OME treatments.

Study & population	Comparator	Outcome	Effect (95 % CI)	Studies
Ventilation tubes				
MacKeith 2023 Ventilation tubes (grommets) for 6-12y children with OME for 3 months [31]	Watchful waiting	Normal hearing at 10 years	RR 0.98 (0.94 to 1.03)	1
		Persistent OME after 18 m-6y	RR 1.21 (0.84 to 1.74)	3
		Perforation after 3.75 years	RR 3.65 (0.41 to 32.38)	1
	6 m sulphisoxazole	Final Hearing thresholds	**6 dB better (−9 to −3)**	1
	Myringotomy	Return to normal hearing at 12 m	RR 1.22 (0.59 to 2.53)	2
	Laser myringotomy	Persistent OME at 6 m	RR 0.27 (0.19 to 0.38)	1
Topical & oral steroids				
Mulvaney 2023 Topical and oral steroids for OME in children [32]	Oral steroids vs placebo	Proportion with normal hearing after 12 m	RR 1.14 (0.97 to 1.33)	1
		Mean difference OM8-30 quality of life score	0.07 higher (−0.2 to 0.34)	1
	Oral steroids vs. no treatment	Persistent OME after 3–9 m	RR 1.02 (0.89 to 1.17)	2
	Intranasal steroids vs. placebo	Mean change in hearing thresholds after 2 m	−0.3 dB (−6.05 to 5.45)	1
		Mean difference OM8-30 quality of life after 9 m	0.05 higher (−0.36 to 0.46)	1
	Intranasal steroids vs. no treatment	Mean difference to hearing thresholds after 4w	**1.95 dB lower (−3.85 to −0.05)**	1
		Persistent OME after 8w	**RR 0.72 (0.57 to 0.91)**	2
Antihistamines and/or decongestants				
Griffin G 2011 Antihistamines and/or decongestants for children with OME [33]	No antihistamines or decongestants	*Resolution of fluid, hearing problems, necessity of additional referral to specialists*	*No benefit and approximately 10 % suffered harms (gastrointestinal upset, irritability, drowsiness or dizziness*	*16*
Autoinflation				
Webster KE 2023 Autoinflation for OME in children 6 m to 12 years [34]	Autoinflation vs. no treatment	Return to normal hearing at 11w	**RR 2.67 (1.73 to 4.12)**	1
		Mean difference OMQ-14	**0.42 better (0.22 to 0.62)**	1
		Pain and distress with autoinflation	RR 3.50 (0.74 to 16.59)	1
		Persistence of OME at 3 m	**RR 0.88 (0.80 to 0.97)**	4
Antibiotics				
Mulvaney CA 2023 Antibiotics for children 6 m to 12 years with OME [35]	Antibiotics vs. placebo	Return to normal hearing by 2 m	**OR 9.59 (3.51 to 26.18)**	1
		Presence/persistence of OME at 6–12 m	RR 0.89 (0.68 to 1.17)	2
	Antibiotics vs. no treatment	Hearing threshold at 3 m	**−5.38 dB (−1.64 to −9.12)**	1
		Present/persistence of OME at 3 m	**RR 0.64 (0.50 to 0.80)**	6
Adenoidectomy				
MacKeith S 2023 Adenoidectomy for children 6 m to 12 years with OME [36]	Adenoidectomy vs. no treatment/watchful waiting	Return to normal hearing after 12 m	RR 0.97 (0.65 to 1.46)	1
		Haemorrhage*	**Peto OR 6.77 (0.13 to 342.54)**	1
		Persistent OME after 2 years	**RR 0.90 (0.81 to 1.00)**	3
	Adenoidectomy and bilateral ventilation tubes vs. bilateral ventilation tubes	Return to normal hearing after 6–9 m	RR 1.36 (0.98 to 1.89)	1
		Surgical haemorrhage**	**Peto OR 6.68 (0.42 to 107.18)**	2
		Persistent OME	RR 0.96 (0.86 to 1.07)	??
	Adenoidectomy and unilateral ventilation tubes vs. unilateral ventilation tubes	Return to normal hearing	RR 1.24 (0.79 to 1.96)	1
		Persistent OME after 12 m	RR 0.67 (0.35 to 1.29)	1
	Adenoidectomy and ventilation tubes vs. no treatment/watchful waiting	Mean difference in hearing thresholds after 2y	**−3.40 dB (−5.54 to −1.26)**	1
		Persistent OME after 2y	RR 0.91 (0.82 to 1.01)	1

95 % CI = 95 % confidence interval; RR = Relative risk; OR = Odds ratio; *Absolute risk was very small (1/251 surgeries); **Absolute risk was very small (2/416).

SURGICAL MANAGEMENT

OM is one of the most common reasons for elective surgery among children. Yet there are scant data on efficacy or appropriate indications or correct timing. Table 2 shows the evidence for surgery is based on very few studies and the effect sizes are small, with documented increased hazards that must also be taken into consideration even though they are not common. A pivotal study from Philadelphia decades ago followed up children for over a decade showing no benefit from ventilation tube surgery for the outcome measures of speech and language development or IQ [20]. However, the comparison was early ventilation tube insertion vs. late so it does not answer the question about whether ventilation tubes are effective, just whether they are needed urgently (no). A more recent study from Philadelphia suggested ventilation tubes are not indicated in recurrent AOM [21]. However, half the children in the control arm actually underwent ventilation tube insertion eventually, so it is hard to justify the sweeping conclusion that the similar outcomes with medical therapy prove surgery is ineffective [21]. Contamination is a common problem with surgical trials in middle ear disease as ventilation tubes are so common. Often children in non-surgical arms undergo surgery and the standard intention-to-treat approach may not be appropriate as it would compare children who had surgery with children who were not meant to have surgery, but did. OM is such a wicked problem it even confounds standard research analyses!

ALLIED HEALTH MANAGEMENT

Ludbrook et al. highlight the need for audiological rehabilitation strategies outlined in the Australian guidelines [12]. Hearing should be checked in all children with recurrent (>3 confirmed episodes per year) and prolonged (>3 months) disease. This requires a partnership between parents, teachers and all healthcare professionals (medical, nursing and allied health) to ensure children with OM are not missed and hearing loss impacts are mitigated with individual level (e.g., talking face to face or using hearing aids) and population level (e.g., classroom soundfield devices and increased awareness) strategies. Speech pathology interventions are also critical to minimise harms from blocked sensory inputs while over one million neural connections are being laid down on average in the first 2000 days.

SOCIAL AND CULTURAL DETERMINANTS OF HEALTH

If antibiotics and surgical intervention are not panaceas, alternative approaches such as addressing the social and cultural determinants of health are needed. Ludbrook et al. [5] have highlighted the challenges with healthcare for First Nations children globally. Cultural safety in healthcare is critical. Australia's universal healthcare system should mean children are managed without out-of-pocket expenses. However, that is not the case. There are always expenses accessing practitioners, missing work, the co-payments needed for medications and very high gap payments to see private specialists or exceptionally long waits (many years) for publicly funded surgery. Australian Institute of Health and Welfare data show Aboriginal and Torres Strait Islander people have 2.3 times the overall burden of disease, but only 1.5 times the per capita health spend [22,23]. For two decades Australian governments (of both sides) claimed to prioritise "closing the gap", but this funding gap has been evident since data were first captured. There are many reasons for this underspend, but racism in healthcare delivery is one of them.

Addressing social determinants must also be prioritised. A recent review [23] found almost no published studies investigating these interventions for OM, although overcrowding and being in foster care were important predictors [24]. These are modifiable but require decision makers to be willing to close the funding gap in order to close the health gap.

SUMMARY

OM is hard to diagnose, lacks highly effective management strategies and requires eternal vigilance with healthcare systems that facilitate high quality care rather than quick turnaround care. It is an endemic problem, a major cause of hearing loss globally, antibiotic resistance and costs span several billion dollars annually [25–27].

It truly is a wicked problem.

However, innovative solutions such as those covered by Ludbrook et al. [5] may provide some answers for the priority populations of First Nations children globally, who are most at risk of early, frequent, recurrent and severe disease.

We must do better to ensure different trajectories for children born this generation to address what Australia's first surgeon from a First Nations background (Professor Kelvin Kong) describes as a "Developmental Emergency".

FUTURE DIRECTIONS FOR RESEARCH

- Identification of children most at risk of otitis media and its complications.
- High quality evidence on management strategies broader than antibiotic and surgical options.
- Trials to better delineate indications and timing of surgery.

Declaration of competing interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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