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Glue ear: an ongoing global program – closing the audiology gap among First Nations children

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Educational aims

The reader will gain an improved understanding of:

- The prevalence of OME and factors associated with recurrent or severe disease.
- Priority populations globally requiring different management strategies.
- Horizon scanning for the best evidence for novel diagnostic strategies (e.g. artificial intelligence diagnostic support tools) and emerging therapies (autoinflation etc).

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ABSTRACT

Most children globally (~80%) are affected by Otitis Media with Effusion (OME; 'serous otitis media' or 'glue ear') by four years of age. Most episodes resolve in a timely manner are brief and uncomplicated. Chronic, recurrent and complicated OME has been linked to social disadvantage, with poorer educational and employment outcomes and increased criminal justice system contact. Specific populations are particularly at risk, even in High Income Countries, including children with craniofacial abnormalities, immunocompromise and First Nations children in colonised regions (e.g., Australia, New Zealand, and the Arctic Circle).

OME is a significant cause of childhood morbidity, particularly during infancy. Mortality should not occur in High-Income-Countries. However, in Low-Middle-Income Countries, lack of access to health programs can lead to devastating, preventable complications, including death from meningitis, brain abscesses, and sepsis. This emphasises the importance of equitable access to medical resources globally, a universal and ongoing problem for First Nations people.

Upper respiratory tract infections (including OME), are the most common reason for children to present to healthcare services, be prescribed antibiotics, and undergo surgery. Although OME is often managed by with antibiotics, guidelines recommend observation for uncomplicated cases, given potential harms for the child (e.g., rash and diarrhoea), and for healthcare (e.g., cost and antibiotic resistance). OME is also the most common reason for hearing impairment among children, and peaks at the time that auditory processing neural pathways, the foundations of cognitive development, are being laid down. Causative effect between OME and impaired cognitive function is hard to prove because of the challenges of designing and analysing rigorous observational studies to emulate clinical trials.

Recurrent OME cannot be left untreated due to the potential for its effect on hearing loss and both severe physical harm and significant long-term social consequences. Clinicians should be aware that children's behavioural and developmental outcomes and balance disturbance may indicate middle ear disease or its sequelae and remain vigilant. Children's ears should be checked and findings documented at every healthcare visit to ensure close surveillance for this insidious condition, particularly for those most at-risk.

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INTRODUCTION

OME can develop following acute otitis media (AOM) and other viral and bacterial infections of the upper respiratory tract. Following the resolution of acute inflammation and infection, fluid can stagnate in the middle ear space forming a physical barrier to sound reception usually leading to short-term mild conductive hearing loss. In some 'otitis prone' children the effusion can last for months or recur frequently causing moderate to severe hearing loss and biofilm development. OME is the most common cause of paediatric hearing loss (~80 % of children worldwide affected by four years). There is significant overlap between children prone to OME and other inflammatory conditions such as allergic rhinitis, asthma, and eczema [1].

Half of OME cases resolve within three months, and 95 % within 12 months. However, persistent cases can be debilitating for young children developing speech and language skills [2,3]. The first 2000 days of life are critical for speech and language development, as over one million neuronal connections are forming every second [4,5]. Children aged six to twelve months with persistent OME are particularly at risk of speech and language delay [6]. It follows that long term, untreated, and chronic OME has been linked to significant social disadvantage, such as poorer outcomes in levels of education, employment, and increased contact with the criminal justice system [3,7,8].

In Australia, if a three-year-old with hearing impairment scored more than one standard deviation below the mean of normal-hearing children in receptive and expressive language, then functional and social outcomes will do poorly; even when controlled for other contributing factors including socioeconomic status, other disabilities, engagement with formal education, and language spoken at home [8]. The trend continues into adult life. The average high school graduate with hearing loss in the United States in 2001 had language and reading scores of a student seven years their junior; predicting lower long-term employment potential [8]. A 2012 study of 134 incarcerated Aboriginal Australians identified hearing loss in 95 % of participants, with 9.7 % experiencing severe hearing loss and many describing how their hearing issues negatively impact their relationship with social supports and navigating the justice system [3].

It is crucial that parents, carers, and teachers consider OME when addressing speech delays or behavioural issues in early childhood to facilitate early diagnosis and treatment.

DIAGNOSIS

Identification of OME is challenging. OME is acquired and not identified by routine newborn screening tests. One-off population-based screening is ineffective due to the transient and recurrent nature of the disease [9–11]. Challenges in diagnoses are further compounded by ineffective and culturally insensitive healthcare systems. Therefore, diagnosis depends on thorough history taking, physical examination, and best practice diagnostic methods to detect middle ear fluid (e.g., tympanometry; see Fig. 1 and pneumatic otoscopy) and hearing impairment. A logical approach can assist, but some subjective expertise is needed for accurate diagnosis as signs and symptoms are subtle (See Fig. 2).

In the primary care setting, the most reliable examination findings on otoscopy include an amber coloured tympanic membrane (suggestive of middle ear effusion behind the membrane) or a visible air-fluid level seen behind the tympanic membrane (pathognomonic for middle ear effusion). In reality, these findings are uncommon, and otoscopy has very low sensitivity and specificity, despite being the most common technique for middle ear diagnosis [12]. In older, more cooperative children, bedside Weber and Rinne tuning fork testing can identify bone conduction being better than air conduction, suggesting a middle ear problem. A Valsalva manoeuvre (or pneumatic otoscopy) should elicit tympanic membrane immobility with middle ear effusions.

The gold standard diagnostic techniques for OME are pneumatic otoscopy (sensitivity 94 %, specificity 80 %) and professional tympanometry (sensitivity 81 %, specificity 74.5 %) [12]. Both measure tympanic membrane mobility to detect middle ear fluid and can be done in the primary care setting with the right equipment.

Tympanometry

A **Type A** peaked tympanogram is reliable evidence for an aerated healthy middle ear space. **Type B** or 'flat' tympanograms

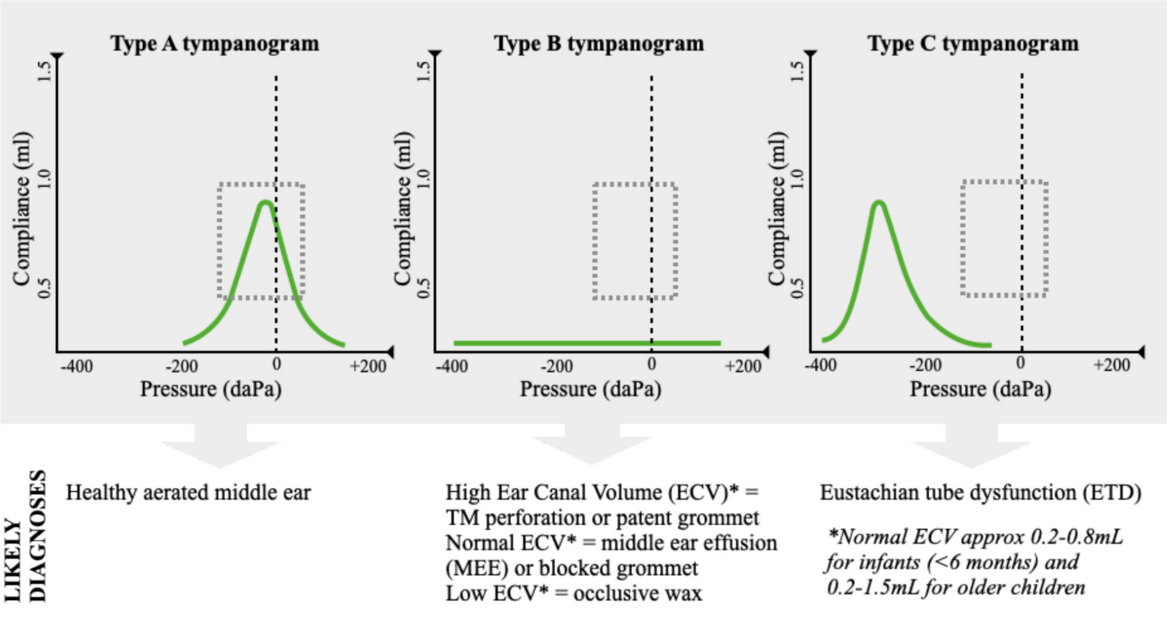
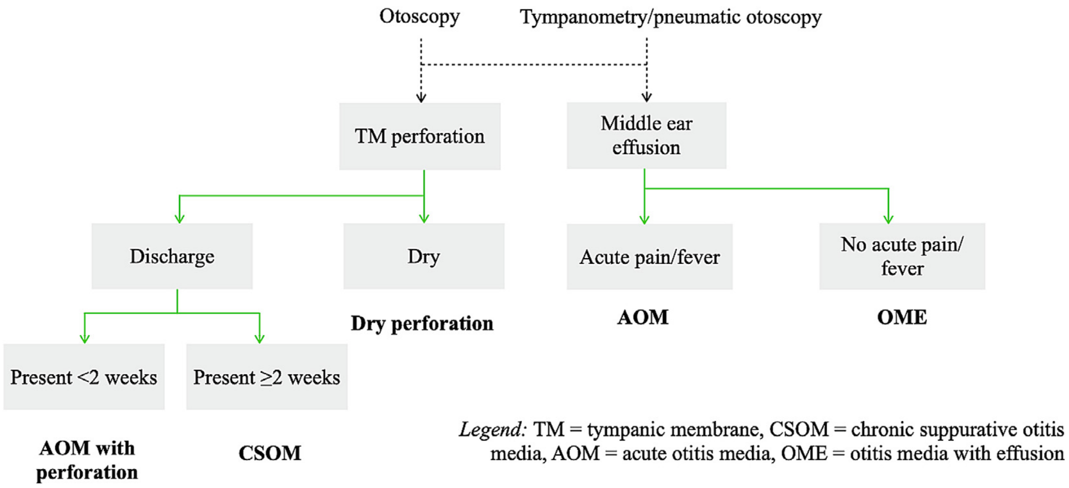


Fig. 1. Tympanogram findings and likely associated middle ear diagnoses [13,71].



Legend: TM = tympanic membrane, CSOM = chronic suppurative otitis media, AOM = acute otitis media, OME = otitis media with effusion

Fig. 2. Likely middle ear diagnosis based on a logical approach to best practice diagnostic technique findings.

represent absent tympanic membrane compliance and are reliable evidence for middle ear effusion with normal ear canal volume. However, Type B tympanograms with high ear canal volume (ECV) indicate tympanic membrane perforation (e.g., patent ventilation tubes or 'grommets') and with low ear canal volume indicate occlusive wax. Normal ranges for ECV are important for tympanogram interpretation but are difficult to find, differ with the size of the child, and are sometimes not provided with the report. Ear Canal Volume guide: <0.2 mL is low; <0.8 mL is normal for infants (<6 months); and <1.5 mL for older children [13]. A **Type C** tympanogram indicates negative middle ear pressure suggesting Eustachian Tube Dysfunction (a predisposition to OME, tympanic membrane retraction and cholesteatoma).

Pure tone audiometry

Often tested alongside tympanometry and usually done by an audiologist, Pure Tone Audiometry (PTA) measures hearing levels through both air and bone conduction. PTA requires compliance, so specialised techniques are needed for children six months to three years developmental age (e.g., using puppets). Conductive hearing loss >15 dB can be identified but reports often state hearing adequate for speech and language development if hearing loss <25 dB.

MANAGEMENT

Below is a summary of the detailed management guidelines for all forms of otitis media are available from the Guidelines for the Management of Aboriginal and Torres Strait Islander Populations (for other settings use the 'low risk' category): https://www.otitismediaguidelines.com [14].

Medical

Most international guidelines do not recommend antibiotics in the management of OME [15]. However, the latest Australian guideline for Aboriginal and Torres Strait Islander children recommends a trial of oral antibiotics for chronic and persistent OME, given the severe burden of disease among this population [14].

Oral and intra-nasal corticosteroids or decongestants are not recommended for OME, due to ineffectiveness and associated risks [16]. Autoinflation (using a Valsalva manoeuvre or devices) has mostly been studied in low-risk populations, and is not currently recommended due to limited evidence. Nonetheless, autoinflation trials are ongoing, given it is low cost, non-invasive and with few reported side effects [17,18].

Surgical

The mainstay of management of OME is clinical monitoring. Surgery is usually not required but indicated with persistent unilateral effusion (>6 months), persistent bilateral effusion (>3 months), or when the child is high risk (e.g., recurrent disease or speech delay concerns). Myringotomies and ventilation tube insertion is one of the most common surgeries performed in High Income Countries. The procedure drains middle ear effusions and aerates the middle ear. Grommets have a typical lifespan in children of three to 12 months and are generally helpful at eradicating effusions for the initial two years post-operatively [3,19]. Concurrent adenoidectomy is an option in guidelines but needs more trial evidence [14,20].

Audiology and speech pathology

Children should be referred for audiometry if hearing or language concerns or for chronic bilateral OME [14]. For all children with persistent OME, strategies to improve quality of communication should be recommended. As well as facilitating gold standard diagnostic testing though tympanometry and PTA, audiologists can provide access to short or long-term hearing aids, education, support for schools (e.g., classroom amplification), and in some cases, streamlined referral pathways to surgery. Children should be referred to speech pathologists for long-term hearing loss and any concerns regarding language delay [14].

Sociocultural considerations

Social determinants of health predict OME risk. Children exposed to passive smoking in the home, from low socioeconomic status families, in overcrowded homes, and exclusively bottle fed develop OME more often. Addressing underlying social determinants of health is critical for prevention. First Nations children globally experience many of these determinants. This contributes

Table 1

Prevalence of otitis media with effusion and middle ear disease/hearing loss among First Nations children compared with other children [30,31,42,48,51,60,72–82].

Setting	Author year	sample (N)	Population setting	Age range (years)	Diagnostic criteria	Prevalence OME		Prevalence middle ear disease/hearing loss	
						(n/N)	(%)	(n/N)	(%)
Australia									
Aboriginal and Torres strait islander children	Morris 2005	709	Primary care	0.5–2.5	Type B tymp + otoscopy by GP	291/709	41.0	647/698	92.7
	Thorne 2004	185	Primary schools	4–12	Type B tymp + otoscopy by audiologist + PTA	137[*]/370[***]	37.0	142[*]/185	76.7
	Watson 1992	642	Primary schools	3–15	Type B tymp + otoscopy by GP + PTA	34/642	5.3	403/642	62.8
	Lewis 1977	3568	Primary care	4–15	Type B tymp	367/5174[**]	7.1	1269[*]/2358	53.8
	Latzel 2002	166	Primary and secondary schools	0–15	Type B tymp + otoscopy by ENT reg + PTA by audiologist	37/332[**]	11.1	196/332[**]	59.0
	McPherson 1997	150	Primary schools	–	Type B tymp + otoscopy by audiologist + PTA	27/299[**]	9	31/155	20.0
Whole population	*Brennan-Jones 2020*	*1344*	*Maternity unit cohort*	*5–7*	*Type B tymp <0.1 mL compliance*	*302/1344*	*22.0*	–	–
New Zealand									
Māori children	Becker 2019	1085	Primary care	1–14	Otoscopy by GP	–	–	72[*]/513	14.0
	Giles 1991	275	Primary care	0–15	Otoscopy by paediatrician	–	–	76/550[**]	13.8
	Giles 1991	194	Primary and secondary schools	4–15	Pneumatic otoscopy by paediatrician + PTA	29/194[*]	15.0	66/194	34.0
	Stanhope 1978	554	Secondary schools	12–17	Otoscopy by paediatrician, RN or GP	9/554	1.6	47/554	8.5
	Stanhope 1978	735	Primary schools	5–12	Otoscopy by paediatrician, RN or GP	81/735	11.0	112/735	15.2
Whole population	*Becker 2019*	*1085*	*Primary care*	*1–14*	*Otoscopy by GP*	*33/1085*[*]	*3.0*	*163/1085*[*]	*15.0*
Greenland									
Inuit people	Homøe 1996	591	Primary care	3–8	Type B tymp	131/518	25.3	254/591	43.0
Whole population	*Pedersen 1986*	*142*	*National register*	*11–20*	*Otoscopy + type B tymp*	*28/284*[**]	*9.9*	*23/142*	*16.2*
North America									
Alaskan Inuit people	Emmett 2023	1634	Primary and secondary schools	3–21	Otoscopy by audiologist + type B tymp	165/1634	10.1	286[*]/1634	17.5
Canadian Inuit and Métis people	Kramer 1998	126	Primary schools	6–17	Otoscopy + type B tymp	26/126	21.0	63[*]/126	50.0
	Baxter 1982	704	Primary schools	–	Otoscopy by otolaryngologist + PTA	60/1408[**]	4.3	670[*]/1408[**]	47.6
USA whole population	*Casselbrant 1990*	*56*	*National survey*	*2–6*	*Otoscopy by audiologist + type B tymp*	*4/56*	*7.1*	*13/56*	*23.2*

[*] Data extrapolated from prevalence reported.
[**] Unit of analysis is prevalence by ears not prevalence by child.

to higher prevalence among these populations (see Table 1), but may not explain the increased risk entirely [21] given the systemic cultural barriers to healthcare access for First Nations children.

GLOBAL FIRST NATIONS POPULATIONS

The high prevalence of OME in First Nations populations globally is multifactorial. First Nations populations in different countries face similar inequities, including housing insecurity, lower socioeconomic status, and exposure to tobacco smoke [22]. However, many populations with low socioeconomic status around the world (e.g., slum dwellers and child labourers) do not see similarly high rates of middle ear disease [23,24]. Biological factors affecting susceptibility to disease, such as host immunity and pathogenicity of bacteria are likely implicated. It is theorised there may be an evolutionary element of higher susceptibility to introduced bacteria following colonisation centuries ago, exposing these populations to new infective pathogens [25] which their immune systems had never previously encountered. First Nations populations also experience higher rates of AOM and related complications including tympanic membrane perforation. As shown in Table 1, OME prevalence alone does not capture the full extent of middle ear pathology in priority populations as it is often replaced by much more severe forms.

Aboriginal and Torres Strait Islander (Australia)

Australian Aboriginal and Torres Strait Islander people comprise 3.8 % of Australia's population [9]. *There are hundreds of individual groups with distinct languages, cultures, and traditions, together comprising the oldest surviving cultures in the world. Most Aboriginal and Torres Strait Islander people live in urban settings, but a quarter live in remote/very remote settings. They are also a comparatively young population, approximately one third <15 years* [9].

Aboriginal and Torres Strait Islander people experience significant disparities in health outcomes, including an eight-year gap deficit in life expectancy [26]. *Colonisation is recognised as a major contributor to ongoing health and wellbeing inequities, including multigenerational trauma and systemic racism. Connection to Country and community, self-determination and cultural expression have been shown to positively influence Indigenous peoples' health and wellbeing* [9].

Australian Aboriginal and Torres Strait Islander children suffer the highest burden of middle ear diseases globally [27–29]. OME affects 5 %–41 % of Indigenous children, depending on age group and degree of remoteness, though this number may be significantly underestimated [26,30,31]. OME is often transient, and these children in particular face increased sociocultural barriers to healthcare services where such data are collected [32,33]. In Australia, approximately 300,000 children suffer OME-related mild to moderate temporary hearing loss [32].

The social impact of hearing loss on Indigenous communities is particularly palpable. Aboriginal history is oral, storytelling is a crucial tie to culture, and hearing loss can lead to community isolation [29]. There is a strong link between the presence of childhood middle ear disease with associated hearing loss and economic and educational disadvantage. Due to factors including multigenerational trauma and racist healthcare systems, risk factors for OME resulting from the 'social determinants of health' such as high housing density and low socioeconomic status are more common. The high rates of OME among these populations therefore perpetuates an ongoing cycle of disadvantage [29].

OME treatment also poses group-specific challenges for Aboriginal and Torres Strait Islander children. Antibiotic selection differs, as pathogens for AOM differ [33,34]. Compliance with prescribed management regimens is difficult, partly attributed to a lower health literacy base but also involving practical issues such as less access to healthcare professionals who can prescribe, no fridge to store antibiotic syrups and also bigger picture issues such as lack of culturally safe care. For example, antibiotic adherence has been reported at ~50 %, but improves with better models of care sensitive to individual cultures, a focus on education and empowering parents [35]. While ventilation tubes are simple and cost-effective, geographical and cultural barriers compound the long wait times for surgery [21].

First Nations, Inuit, and Métis (Canada)

First Nations, Inuit, and Métis are the three recognized indigenous peoples of Canada, each with unique languages, cultural practices and spiritual beliefs that have been sustained for thousands of years. These populations represent 5 % of Canada's total population: First Nations 3.2 %; Métis 2 %; and Inuit 0.2 % [36]. *While many First Nations and Métis people live in urban and regional settings, many reside in rural and remote communities. Most of the Inuit population live in 'Inuit Nunangat', their traditional homeland in the Arctic. They are relatively young with approximately 25 % of Inuit and First Nation individuals <14 years* [36].

Canadian indigenous people face significant disparities in health, education, and economic outcomes compared to other Canadians. The Inuit have the lowest life expectancy, approximately 10 years below the national average. First Nations and Métis populations also face higher rates of chronic disease, mental health challenges, and reduced life expectancy [37,38]. *These disparities are deeply rooted in the ongoing legacy of colonisation which has involved land displacement, systemic racism, and oppressive policies, resulting in significant inter-generational trauma. High housing density, high unemployment rates, limited access to health care, and persistent discrimination has further exacerbated health inequities* [37–39]. *Despite these challenges, Canadian indigenous populations maintain a strong connection to land, language, and cultural practices. Indigenous-led initiatives in healthcare, education, and governance are vital in promoting wellbeing and improving healthcare outcomes these groups* [40,41].

The high prevalence of OME in children in the Eastern Canadian Arctic may be a recent trend following rapid urbanisation in the mid-20th century. Early records by Arctic explorers document a largely healthy, resilient nomadic people. Following World War II, more permanent settlements formed with exposure to overcrowding and greater communicable disease spread. One survey of several hundred children across rural Inuit schools in the 1970 s identified OM-related hearing loss prevalence between 3 and 20 % [42]. In more remote communities, the prevalence was as high as 30 %. While anecdotal evidence suggests conditions are improving, geographical and sociocultural barriers to health service access limit opportunities for robust data collection. A 2020 study found an average incidence of 6 OM episodes for Inuit children in the first 5 years [43]. Population-level public health interventions are likely to have the largest impact on these discrepancies, as well as community consultation to determine the cultural and spiritual priorities of these indigenous communities [44].

Inuit (Alaska)

Alaskan Inuit people are part of the broader indigenous peoples of the Arctic, comprising several distinct communities with unique languages, cultures, and traditions sustained over thousands of years. Alaskan indigenous people represent ~15 % of Alaska's population with roughly 35 % of the population being <15 years [45]. *While many Inuit people live in urban and regional areas, a significant proportion reside in remote communities where traditional practices such as hunting, fishing, and gathering remain central to cultural identity.*

Alaskan Inuit experience significant health disparities compared to the broader United States population, with a life expectancy approximately 10 years lower [46]. *These disparities are deeply rooted in the historical and ongoing impacts of colonisation, forced relocation, and systemic barriers to healthcare and economic opportunity, all of which contribute to intergenerational trauma* [46]. *Despite these challenges, Alaskan Inuit people demonstrate strength and resilience by maintaining deep connections to the land and community. Culturally grounded healthcare programs and Inuit-led governance play a crucial role in promoting health and wellbeing* [45].

Historical texts report OME as being the second highest cause of acute illness among Alaskan native peoples [25,47]. A 1970 observational study of 50 Inuit settlements followed the progress of children's hearing over 12 months through regular audiometry and parental interviews. Then, a typical household consisted of six people living in a single room in the harsh arctic climate. Of 404 children interviewed, 63 % had a prior OME history. Nearly half experienced OME in the first year of life, and 7 % experienced recurrent infections. Over a quarter had conductive hearing loss, and of this population a further 25 % had bilateral deafness [47]. Through a combination of robust public health measures and improving social safety nets, updated research demonstrated improving hearing outcomes. A 2019 study of 1,634 children aged 3 to 21 years identified conductive hearing loss in 10 %. OME was present in 17.6 % of cases, and in nearly a quarter of children aged 3 to 6 years [48].

Inuit (Greenland)

Greenland is an autonomous territory of Denmark and Greenlandic Inuit people ('Kalaallit') represent 89 % of the population [49]. *Like other Inuit groups in the Arctic, they have maintained rich cultural traditions and languages that have evolved over thousands of years to support survival in harsh environments* [50]. *Most Kalaallit reside in urban or coastal areas, while a minority continue to live in remote regions* [48].

Kalaallit experience vast disparities in health, education and economic outcomes compared to the broader Danish Population. Life expectancy among Greenlandic Inuit people is ~10 years lower than that of Denmark, reflecting health inequities that stem from colonization, rapid social change, and systemic barriers to healthcare access [51]. *Policies such as forced relocation and cultural suppression have contributed to intergenerational trauma among Kalaallit populations. In response, Inuit-led healthcare programs and community driven solutions are integrating traditional knowledge with modern medicine to address these challenges and support long term health and wellbeing* [52].

Kalaallit have faced upheaval of lifestyle and living situations since colonisation in the last 60 years. A 1996 study of 591 children measured middle ear effusion prevalence between 23 % and 28 %, depending on the specific community [51]. This is comparative with chronic otitis media, for which the prevalence has been reported as 7–31 % [53]. There are scant data on OME risk factors in this population, but the severe Arctic environment and social factors likely exacerbate the spread of respiratory infections leading to OME [52]. A two-year cohort study of 288 Inuit children from 1996 found child-care centre attendance, sharing a bedroom with adults, and sharing a bedroom with a child aged <5 years increased upper respiratory tract infections [54]. Comparing these with a study from 10 years previously showed minimal improvements, but more current evidence is lacking. Recent improvements in general socio-economic and medical comorbidities among these communities suggest that underlying social determinants of health should continue to be prioritised [55].

Māori (New Zealand)

Māori, the indigenous people of New Zealand (Aotearoa), have a rich cultural heritage and traditions that have endured for 700 years since migrating from Polynesia. Māori comprise approximately 16.5 % of New Zealand's population [56]. *Most Māori people reside in urban and regional settings. Approximately 17 % live in rural communities. Cultural practices, language, and traditional knowledge remain central to daily life. The Māori population are relatively young with nearly one third of the population <15 years* [56].

Māori people continue to experience significant health disparities compared to the wider New Zealand population. These disparities include a life expectancy gap of seven years, higher rates of chronic disease, and increased mental health challenges [57]. *These health inequalities are linked to ongoing effects of colonisation, land disposition, systemic racism, and socioeconomic inequalities* [57]. *Despite this, a strong cultural identity, family connections, language revitalisation efforts, and Māori led healthcare initiatives have been a critical factor in supporting Māori health and wellbeing* [58,59].

There are scant OME prevalence data for Māori children, however, approximately one quarter <5 years are affected by AOM annually, with 4 % experiencing recurrent infections. A 2023 study of 1128 European New Zealander versus Māori children during the COVID pandemic found comparable rates of OME [60]. A 2024 qualitative survey of Māori parents reported all participants felt the diagnosis of their child's middle ear disease was delayed due to barriers accessing healthcare. As a result, families described an inability to participate in cultural and recreational activities that fostered connection to *'Te Ao Māori'* (the Māori world) [61]. Education and development were also affected, citing a significant physical and mental burden.

INNOVATIVE APPROACHES TO IMPROVE ACCESS TO HIGH QUALITY CARE

There is a discordance between burden of disease and access to care. For example, middle ear disease is most common among remote Aboriginal and Torres Strait Islander populations with the fewest healthcare professionals (e.g., audiologists and ENT specialists). We need innovative solutions to address healthcare access barriers.

Use of technology and novel screening tools

Wireless microphones are used to transmit teachers' voices in Australian classrooms, with the option to transmit directly to a child's hearing aid or implant [21]. Image-based artificial intelligence is increasingly speculated to have a future role in diagnosing middle ear disease in isolated environments with fewer healthcare professionals. The current average diagnostic accuracy (with otolaryngologists' diagnosis as gold standard) is 91 % [62,63]. Simplified hearing screenings are increasingly available in the form of children's books and tablet games available in patient's homes around the world [3]. In Australia, the Parent-evaluated Listening and Understanding Measure (PLUM) and the Hearing and Talking Scale (HATS) have recently been introduced to establish whether a child would benefit from referral to speech and language and/or audiology services. The scale was developed with Aboriginal and Torres Strait Islander healthcare workers and involves a total of 15 simple questions that can be asked by any healthcare worker to parents and carers of a child who uses any spoken language [64]; (Table 2, Table 3).

Community leadership and culturally safe care

Australian Aboriginal Community Controlled Health Organisations are community-operated primary care centres that deliver holistic and culturally safe care and have demonstrated improved patient engagement [65]. Successful funding programs for Indigenous ear health in Australia centre community leadership, such as training Aboriginal project officers to coordinate patient care across siloed health services [66]. Similarly, a series of interviews with seven *Māori* people with ear disease in 2024 identified a consensus that mainstream healthcare staff with a better understanding of *Te Ao Māori* (*Māori* culture) could reduce the morbidity associated with middle ear disease [65].

Support of allied health leadership in underserviced regions

Audiologists are allied health professionals specialised in hearing testing and hearing aids and devices and often a first point of contact for patients with ear disease into the health system. Audiologists have an increasing role as advocates for ear health, removing barriers to ear care and working to reduce long wait times for ENT surgery access [21]. In Australia, promising recent pilot studies have streamlined referral pathways to ENT surgery using audiologist assessment with otolaryngologist oversight [67,68]. Rural Canadian Inuit communities found improved education outcomes when audiology services were channelled directly through schools and individual teachers are allocated to assist hard-of-hearing students [42].

Table 2
Parent-evaluated Listening and Understanding Measure (PLUM). Each question is scored as Not Yet (0 points), A Little (1 point), Sometimes (2 points), A Lot (3 points) or Always (4 points), Scores are stratified to age and classified as on track (reassess in one year), borderline (reassess in three months), or not yet on track (refer to audiologist). Instructions for use and scoring can be found at: https://plumandhats.nal.gov.au [58].

Ages 6 months to >30 months
1. When it's quiet and you call your child, and they can't see you, do they hear you?
2. And when it's noisy?
3. When it's quiet, if you ask your child to do something easy, can they do it?
4. And when it's noisy?
5. When it's quiet, does your child join in conversation with you, or with someone they know?
6. And when it's noisy?
7. When it's quiet, and you're talking, singing, or telling a story, does your child join in and follow?
8. When it's noisy, does your child understand you when they can't see you?
9. Without seeing them, does your child know people by their voices?
10. Does your child notice other sounds around them?

Table 3
Hearing And Talking Scale (HATS)). Each question is scored as Not Yet/A Little (0 points), Sometimes (5 points), or A Lot (10 points), Scores are stratified to age and classified as on track (reassess in one year), borderline (reassess in three months), or not yet on track (refer to audiologist). Instructions for use and scoring can be found at: https://plumandhats.nal.gov.au [58].

Ages 4–6 months	1. Does your child react to loud sounds or toys that make sounds?	2. Does your child show you they can hear your voice?	3. Does your child make sounds to show that they are happy?	4. Does your child respond with their voice when you talk to them?	5. Does your child make different sounds or babble?
Ages 7–12 months	1. Does your child turn to where familiar voices or sounds are coming from?	2. Does your child understand words you say a lot?	3. Does your child use gestures to communicate?	4. Does your child 'take turns' where you talk, and they respond with their voice?	5. Does your child make sounds that are like talking?
Age 1 year	1. Does your child understand simple instructions?	2. Does your child understand simple questions like 'who's that'?	3. Does your child enjoy playing games and taking turns with you?	4. Does your child copy works or sing along to songs?	5. Does your child say some words?
Age 2 years	1. Does your child understand simple instructions, like 'point to your nose'?	2. Does your child listen to simple stories and understand what's happening?	3. Does your child enjoy pretend play?	4. Does your child say two words at a time?	5. Do family or close friends understand what your child says?
Age 3 years	1. Does your child respond when you call their name when they can't hear you?	2. Does your child answer questions like 'who came yesterday'?	3. Does your child tell you simple stories they know?	4. Does your child talk about what they are doing, like 'look Mum I'm jumping'?	5. Do people who don't know you understand what your child says?
Age 4 & 5 years	1. Does your child follow long instructions like 'brush your teeth then choose a story'?	2. Does your child understand when you read them a story?	3. Does your child start or join in conversations?	4. Does your child make up simple stories, or talk about what they did during the day?	5. Do most people understand what your child says?

Rural and remote specialist outreach

Due to an overwhelmed universal public health system, wait times for access to public otolaryngology services in Australia can be four years [21] Australian outreach programs deliver regular specialist services to rural and regional areas, with clinics or operating lists hosted out of rural or regional schools, hospitals, or Aboriginal Community Controlled Health Services [69]. Outreach programs for specialised health services in general are associated with an increased number of children treated, treatment compliance, health literacy, and reduced travel costs for families [70].

CONCLUSION

This review highlights the burden of OME, particularly among First Nations communities globally. This is largely due to common threads of low socioeconomic status resulting from displacement and intergenerational trauma, urbanisation and subsequent residential overcrowding, and racist systems of healthcare creating barriers to timely diagnosis and treatment. Social determinants of health are slowly improving in many of these communities, and as a result rates of OME and relating hearing loss are gradually declining. However, the 'gap' of hearing loss in these communities compares with their non-indigenous counterparts remains significant, and extensive action is required at a local and national level to prioritise the populations most needing interventions.

FUTURE DIRECTIONS FOR RESEARCH

- Prophylactic therapies for recurrent OM (e.g., eustachian tube dilatation)
- Feasibility of AI diagnosis of OM in underserviced regions
- Implementation of at-home hearing and speech testing (e.g., PLUM and HATS)
- Feasibility of widespread audiology-led referral pathways to grommet surgery
- Effectiveness of widespread school-led referral to audiology services

Artificial Intelligence Statement: The authors attest that Artificial Intelligence was not used in the writing of this manuscript.

Declaration of competing interest

The authors declare 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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