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Hear our Heart Ear Bus Project: Supporting families of Australian Indigenous and non-Indigenous children with Otitis Media

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ABSTRACT

Otitis Media (OM) is an important global issue that can have a long-lasting impact on a child's life. There is no easy fix! For a family who has a child with OM, the ramifications can be short term and have minimal consequences, or they can be very complex and involve medical, educational, behavioural and wellbeing issues, and may even be life-threatening. Navigating diagnosis and then the combinations of interventions in all areas is just the start of a very daunting journey. As a preventable disease, we have the opportunity to make a difference. This paper presents the development and implementation of the Hear our Heart Ear Bus Project (HoHEBP) within a regional city in western New South Wales (NSW), Australia. The HoHEBP supports families of Australian Indigenous and non-Indigenous children with OM through a transdisciplinary approach incorporating health and education, in partnership with families and communities to ensure the best possible outcomes for children and young people. We present how the HoHEBP provides a unique vehicle for change in the way we approach OM as a transdisciplinary team. Longitudinal data from 2014 to 2019 shows that numbers of children and young people being tested and diagnosed with OM, and referred to medical and educational specialists through the HoHEBP have increased, with over one third identifying as Indigenous (in this paper Indigenous is used respectfully to refer to Australian Aboriginal and Torres Strait Islander peoples).

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Introduction

Otitis Media (OM) is an important global issue that refers to a spectrum of pathologies affecting the middle ear (Brennan-Jones et al., 2020; Coleman et al., 2018; Gunasekera et al., 2018; Kong & Coates, 2009). These pathologies encompass a continuum from the presence of middle ear fluid without signs of infection, to include inflammation and/or infection of the middle ear that is caused

by bacterial and viral pathogens (Australian Institute of Health and Welfare, 2018; Burns & Thomson, 2013). Hearing loss often results from OM including mild to moderate short-lasting loss during uncomplicated OM to more long-term or permanent hearing loss as a result of chronic and complicated infections (Australian Institute of Health and Welfare, 2018; Williams & Jacobs, 2009). OM has different classifications which include otitis media (OM), otitis media with effusion (OME: also known as glue ear), acute otitis media (AOM), chronic suppurative otitis media (CSOM) and otitis externa which is also known as swimmer's ear (Brennan-Jones et al., 2020; Simon et al., 2018).

OM is one of the most common childhood illnesses with an estimated 80% of children experiencing OM before the age of 4 years (Brennan-Jones et al., 2020; Williams & Jacobs, 2009). Burns and Thomson (2013) report that the incidence of OM in children is highest in the age group of 6–24 months and again in children 4–5 years of age. More recently, a study by Brennan-Jones et al. (2020) reported that there was a high prevalence of OM in a cohort of 1344 five to seven year olds in Western Australia, suggesting that the issue of OM persists well into the early years of schooling.

It is well documented in the literature that OM is highly prevalent in Australian Indigenous populations, particularly in rural and remote areas, and that the clinical presentation differs between Indigenous and non-Indigenous children (DeLacy et al., 2020; Jervis-Bardy et al., 2017; Kong & Coates, 2009; Sibthorpe et al., 2017; Westphal et al., 2019). Specifically, Burns and Thomson (2013) reported that there is a prevalence of chronic suppurative OM up to 10 times higher in some Indigenous communities than the 4% that the “World Health Organisation identifies as being a massive public health problem” (p. 3). Similarly, Jones et al. (2018) reported that in 2001 the prevalence of OM among 709 Australian Aboriginal children across 29 remote communities was 91% in the 6–30 month age group and that OM complication, as a result of perforated eardrums, affected 40% of children in the birth to 18 month age group. However, in a review of ear health and hearing among Indigenous Australians, Burns and Thomson (2013) reported that the prevalence of OM continues to exist in children throughout schooling, with 4% of Indigenous children aged birth to 14 years with OM compared with 3% of non-Indigenous children of the same age.

Research has shown that there are many contributing factors to ear disease in Indigenous communities (Burns & Thomson, 2013; Jones et al., 2018; Kong & Coates, 2009). DeLacy et al. (2020) reported in their systematic literature review, that OM is one of the leading causes of hearing loss among Australian Indigenous children, including both Aboriginal and Torres Strait Islanders. They also found that there were key risk factors associated with poverty, social disadvantage, passive smoking, overcrowded housing, and limited access to ear health/hearing services. Results also showed that housing-related social determinants for OM were the most frequently reported in the literature (56%), with access to services reported at 18%.

In Australia, the impact of OM on public health, educational outcomes and social-emotional development, particularly for Aboriginal and Torres Strait Islander children, is well documented (Coleman et al., 2018; Sibthorpe et al., 2017; Williams & Jacobs, 2009). For example, Coleman et al. (2018) reported that OM could impact on children's speech perception, language and social skills development. Similarly, the Australian Institute of Health and Welfare (2018) highlights the impact of the hearing loss associated with OM on children's cognitive development, which as a result can impact on children's communication, speech and language development, leading to challenges for these children in making friends, accessing the curriculum and obtaining later employment opportunities. A further impact of OM in Indigenous populations include lower school attendance and high interschool mobility compared with non-Indigenous children with OM. Findings from a recent study by Su et al. (2019), which investigated school attendance in 3744 Year-1 Aboriginal children in remote Northern Territory, showed that hearing loss was negatively correlated with rates of attendance for these students. Specifically, these findings suggest that many of these children, as a result of suffering ongoing episodes of OM, will have low rates of attendance at school leading to reduced literacy and numeracy results, limited interactions with teachers and peers, isolation and increased behaviour /anti-social issues which may lead to involvement in the criminal justice system. Furthermore, He et al. (2019) explored the link between hearing impairment and offences committed by aboriginal youth in the Northern Territory and found that hearing impairment and other markers of social wellbeing are precursors of youth offending. OM continues to be a significant health problem in Australia, hence the necessity to support families of Australian Indigenous and non-Indigenous children and young people with OM.

There have been numerous attempts by governments to achieve equality for Aboriginal and Torres Strait Islander people, with a recent commitment to focus on partnerships between governments and Aboriginal and Torres Strait Islander people on *Closing the Gap* (Australian Government, 2020). In addition, there have been intensive efforts to improve ear health outcomes for Indigenous children through more accurate testing (Gunasekera et al., 2018); and intervention programmes such as the "Healthy Ears, Happy Kids"; "Deadly Kids, Deadly Futures" "Hearing, Ear, Health and Language Services" (HEALS) (DeLacy et al., 2020) and Learning to Talk, Talking to Learn (LiTTLe) Program (Jones et al., 2018). However, many of these programmes, while successful in meeting the needs of their communities, address medical, health and education issues as well as interventions as separate entities, they often focus on specific age groups. In the context of the current study, there have been numerous attempts in the past to trial these supports, and review and adapt them where needed, however resulting in mixed outcomes in addressing the broader issues associated with OM. Clearly, there is a need to provide a more trans-disciplinary and community-based approach in supporting families of children and young

people with OM. With the aim of closing the gap, this approach should involve supporting families across a child's life from birth into adolescence, and include prevention, intervention, access to relevant support services, community awareness and education.

Aims

The primary aims of this paper are to present the development and implementation of the Hear our Heart Ear Bus Project (HoHEBP) within a regional city in western New South Wales (NSW), Australia. Specifically, we will explore how this programme supports families of both Australian Indigenous and non-Indigenous children with otitis media (OM). In addition, we will present the longitudinal data tracking the number of children tested and the number of hearing tests between the years 2014–2019. We will also present the number of 3, 4, and 5-year-old children and the number of hearing tests within a one-year period, including those children who received multiple hearing tests.

Method

This paper begins with a qualitative narrative of the development, implementation and refinement of the HoHEBP undertaken over six years. This narrative presents the stories of two volunteer directors who worked tirelessly with the community to develop a sustained programme to support families of Australian Indigenous and non-Indigenous children with otitis media (OM) in Dubbo and surrounding areas, NSW, Australia. Dubbo is in Wiradjuri country and has an Indigenous name of Dhubu. Specifically, we present the stories of the strong partnerships that were established between medical, audiological and education professionals, parents, philanthropic organisations and community groups – all striving for the same goal of supporting families of young Australians with OM. This paper also presents quantitative data in the form of descriptive statistics to explore: the number of children who attended the HoHEBP; the frequency of tests; the number and types of sites visited; the number of referrals to specialist services, and the percentage of tests that were passed, required follow-up, and reviewed. The final section of this paper presents community accounts of the impact of the HoHEBP in supporting Australian Indigenous and non-Indigenous families and young people.

Participants

Volunteer directors of the HoHEBP

Two volunteer directors of the HoHEBP, Donna and Rachel, provide their narratives of the processes that they undertook to develop and implement the

programme. They also present accounts of how the HoHEBP has supported families of Australian Indigenous and non-Indigenous children and adolescents with otitis media.

Donna and Rachel are teachers of the deaf and hard of hearing (ToDHH) working in regional and rural NSW, Australia, specialising in the role of conductive hearing loss (ToDHH/CHL). Neither are Indigenous but both support children and families of Indigenous children with OM and hearing loss. Both Donna and Rachel are the founding directors of the HoHEBP and in June 2017 they both received a NSW Premiers Award for Community Service. They dedicated this prestigious award to the whole HoHEBP team.

Donna, being pro-active and seeking greater knowledge in the area of deafness, became a ToDHH when her daughter was three years old and has been working in the field for 24 years. Her interest in deafness began during her own experiences with her two children. Her daughter was diagnosed with a severe to profound permanent hearing loss at the age of 2 years, and her son experienced both chronic suppurative otitis media (CSOM) and otitis media for the first five years of his life. Like so many parents, she wanted “what’s best for her children but she simply didn’t know what she didn’t know!” For her son, raging temperatures and long nights of screaming in pain followed by multiple visits to the doctors and hospitalisations were common. Perforated eardrums were frequent and severe, and when the condition reached its peak, she stated that “it was welcomed ... as ‘better out than in’ was the advice”.

Donna’s work as a ToDHH has shifted away from teaching Health and Physical Education as a mainstream teacher to developing expertise in speech perception, speech production and language (signed and spoken) skills. She works with DHH children and young people from birth through to late adolescence who have a wide range and types of hearing loss; use spoken and signed communication; use a range of assistive listening technologies such as hearing aids and cochlear implants; and attend educational settings across early childhood, primary and secondary education. The prevalence of OM in Dubbo and surrounding areas has meant that her teaching role has extended into supporting a more significant number of children and young people with conductive hearing loss. Donna currently holds an executive position (assistant principal) and volunteers as an executive on state and national ToDHH committees.

Rachel was a mainstream classroom teacher for 13 years with an interest in children with behaviour difficulties and children with disabilities. While on maternity leave, she joined Donna’s team for a proposed period of six months to experience what it was like working with DHH children. These six months have extended to 10 years in the field.

Rachel’s ongoing interest in OM is a result of her experiences with one of her children who suffered from what she calls the “silent but deadly glue ear”. She experienced the challenges associated with the lack of hearing testing services in her hometown and the frustration of having to wait for six months for a

hearing test for her child who had a constant runny nose and was showing signs of Attention Deficit Hyperactivity Disorder. Finally, after this 6-month wait she was told that his “hearing is fine, don’t come back!” After two more years of poor ear health and numerous trips to the doctors, her son was diagnosed with glue ear. These experiences led to Rachel’s passion for exploring ways to establish a hearing screening programme in schools and to educate other families about glue ear. In her local community Rachel is known as the “Snot Lady”, a title of which she is proud as it was given to her out of respect by a local school with a high Indigenous population who, thanks to Rachel’s involvement, are proactive about their prevention strategies of otitis media.

Children and young people

Parents and caregivers of children and young people aged six months to 18 years consented to their data being shared. Each parent/caregiver signed a consent form at the first visit before having their child’s hearing tested through the HoHEBP. The de-identified data presented in this paper is aggregated over the period 2014–2019.

The Hear our Heart Ear Bus Project

Statement of the problem

The community of Dubbo identified the growing issue with the increase in the number of children and young people experiencing OM who were not being identified early, treated effectively and were not achieving age-appropriate educational outcomes. Gaps in access to ear health and intervention programmes were evident. Prior to 2010, there had been some local hearing screening programmes, but these operations had ceased. There was an urgent need to improve awareness and understandings of the impact of OM; provide resources and processes for identification and treatment pathways; and develop and implement intervention programmes to improve the educational outcomes of Indigenous and non-Indigenous children and young people in Dubbo and surrounding areas. As both Donna and Rachel noted, “Kid’s ears are worth caring for and something needed to happen!”

Donna and Rachel’s extensive experience in working with children and young people with OM highlighted the need for addressing the issues associated with OM and the urgent need to implement ways to close the gap and avoid “quick fixes”. They reported that there was a need for a transdisciplinary approach involving medical, educational, and audiological disciplines along with families and community. A programme was required that provided prevention and support, targeted referrals, hearing assessments, pathways of support and targeted intervention. They used the analogy of a rickety bridge (see [Figure 1](#)).

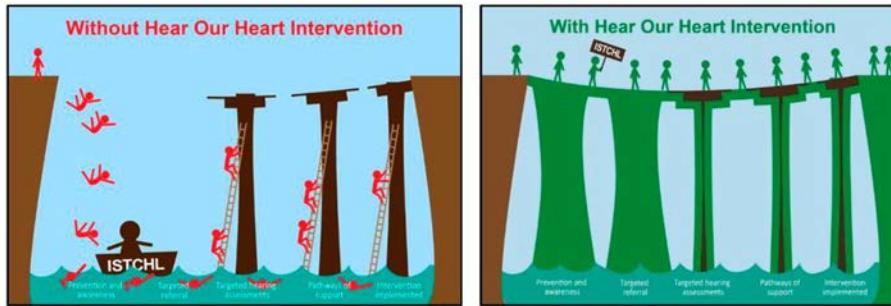


Figure 1. The analogy of the rickety bridge to highlight the need for the provision of adequate pillars of support.

The first picture in [Figure 1](#) represents what Donna and Rachel have experienced over their careers as ToDHH while trying to support children with OM (they are also referred to as Itinerant Support Teacher for Conductive Hearing Loss [ISTCHL in this picture]). Donna and Rachel stated that,

For many children with ear health issues, they were falling into, and struggling in, the sea of issues associated with OM. The ISTCHL teacher tries to support these children but is faced with endless barriers and a lack of support. The bridge pillars (supports) are not in place.

The second picture in [Figure 1](#) represents Donna and Rachel's view of what was needed. They stated that,

If all pillars of support are in place, then so too are the children's chances of being able to get on and enjoy their lives and reach their potential.

Launch of the Hear our Heart Bus Project: A community approach

In 2012, the planning started to create a local solution to an international issue commenced. In the early days planning was all about exploring and critiquing current research and programmes, and brainstorming ideas "to try and get it right for our area". Creating a like-minded committee of supporters was paramount. The HoHEBP was developed within the charitable organisation, Dubbo and District Parent Support Group for the Deaf and Hearing Impaired Inc. (known as Dubbo District Deaf Club or DDD). The main aims of the HoHEBP are to raise awareness of OM and improve health and educational outcomes for deaf and hard of hearing (DHH) children and young people in Dubbo and surrounding districts. Specifically, the project aims to remove barriers to early learning and life-long complex support needs, with preventive hearing testing, ear health education and supported pathways to care.

The DDD team gave the name of the project much consideration and deliberation. It had to reflect the specific type of hearing loss that was prevalent in their area and the passion of the two founders in making a difference to the

children they worked with, as well as raising community awareness about OM. In discussion with Donna and Rachel, one of the parents stated that she wanted their hearts to be heard – and the name “Hear our Heart!” was established.

The team of volunteers worked tirelessly to seek funds through philanthropic organisations, community donations, and community fund-raising events, as well as organising campaigns within the community to raise awareness. In 2014, the first set of hearing testing equipment was purchased, and local screening commenced with visiting audiologists testing in quiet classrooms in schools. On the first site visit, almost 68% of the children did not pass their screening test. Another site, 45 min from Dubbo, had over 70% of the children fail their first hearing screening test. There was a significant problem. By 2015, the team were visiting over 30 sites including schools, preschools, education settings and other nominated sites across many of the local towns. It was evident that the work of the HoHEBP needed a greater focus on education, prevention, and community awareness.

In 2016, Kathy, a local primary school teacher and proud Wirradjuri Aboriginal woman began working for the HoHEBP. Her role was to support visiting audiologists with hearing testing and to begin healthy ears education sessions in schools. The combination of audiology and education teams working together was a significant benefit for both disciplines as it provided the opportunity for both to witness the challenges that mainstream teachers faced while supporting so many of the children in their class with OM.

Kathy was a passionate addition to the HoHEBP team. Her days were long and exhausting as she travelled across thirty sites in eight towns with equipment for both testing and healthy ears education, loaded into the back seat of her car. On one of her busy days, her husband commented on the absurdity of her “office in the back seat of your car ... you need a bus!!!” As Donna noted,

This bus was still the dream ... , a topic of many conversations with fundraisers, philanthropists, the committee and directors ... , but unfortunately funds were only available for the delivery of the program not for the purchase of a bus.

Kathy’s husband continued to work behind the scenes to find a solution. As the principal owner of a local automotive business, he decided that he would donate the vehicle to the community. This was a moment to celebrate ... , such a humble generous gift. Successful fund-raising continued throughout the community with many “locals helping locals” to purchase the equipment needed to fit out the bus. One of the local engineering companies volunteered their time and resources over six months to meticulously fit out the bus to ensure it met the needs of the programme. In 2017, the Ear Bus was officially launched. Currently, the Ear Bus is fitted with a certified soundproof booth at the rear, which can seat a child, the clinician and another adult. It has a large monitor for video otoscopy in the booth as well as a monitor on the outside to promote the community sponsors, supporters and messages about ear

health. Also, there is an administration area at the front of the bus with a sink, running water, heating and cooling, and storage cupboards (<https://www.hearourheart.org/our-ear-bus.html>).

In 2018, the HoHEBP received a phone call from the Chief Executive Officer of the Walter and Eliza Hall Charitable Foundation (WEHall), to provide funding over five years to support children's ear health. Based in Sydney, WEHall stated,

We have been looking for a special organisation to partner with for some time that has a genuine focus on Indigenous health. Our board commends the Orana Regional Community for initiating and supporting this project and providing funding for its establishment. The difference this organisation has made through the Hear Our Heart Ear Bus Project to the hearing health of children cannot be underestimated and we are very proud to be a part of the continuation and expansion of its programs.

The current HoHEBP

The HoHEBP is based in Dubbo, New South Wales, with a committee of 10 volunteers, and four dedicated staff led by Donna and Rachel. Dubbo is situated 400 km west of Sydney. Data from the 2016 Australian census showed that Dubbo had a population of 38,943 with 14.6% identifying as Aboriginal or Torres Strait Islander people (Australian Bureau of Statistics, 2016). The HoHEBP is implemented in an additional eight towns across a wide geographical area in over 40 sites, including public and private childcare centres, primary and secondary schools, community health centres, preschools, and Aboriginal Medical Services (AMS). In addition, HoHEBP attends community events such as Children's Days in the Park, National Aborigines and Islanders Day Observance Committee (NAIDOC) Day, sporting events, health awareness promotions, and local shows. Table 1 shows the population at the latest Australian census, the percentage of Indigenous people, and the distance from Dubbo for each of the eight towns (Australian Bureau of Statistics, 2016).

The HoHEBP provides access to Indigenous and non-Indigenous children, young people and their families through (1) onsite hearing screening; (2) telemedicine for remote diagnosis with remote otoscope; (3) multi-facet referral pathways for education and health/wellbeing, parent support and follow-up; (4) ToDHH who work to support children and young people, and to advocate for

Table 1. Details of the eight towns visited by the HoHEBP in order of distance from Dubbo.

Town	Population	% of Indigenous people	Distance from Dubbo (approx. km)
Nyngan	2159	18.9%	171 km
Warren	2732	14.5%	128 km
Gulargambone	591	32%	123 km
Trangie	1188	21.9%	79 km
Gilgandra	3126	14.1%	73 km
Yeoval	430	12.2%	67 km
Wellington	4077	27.8%	58 km
Narromine	6444	19.9%	46 km

an adjusted and differentiated curriculum to improve education outcomes; (5) early childhood, school and community education and awareness programmes; (6) ear, nose and throat specialist liaison and local hospital support; and (7) pre and post-operative support for children, young people, families and educators.

HoHEBP provides two main programmes: (1) Targeted Hearing Testing Program; and (2) the Education Program.

Hearing testing programme

Prior to testing, professional development around hearing loss, is provided to school staff to assist the school in identifying children with possible ear health and hearing loss issues. These children are then prioritised for hearing testing. Schools and parents provide valuable information within the permission note and hearing loss checklist (a checklist with indicators of hearing loss within categories of behaviour, learning, speech, and physical identifiers) along with their knowledge of the child in the classroom setting. This helps the HoHEBP staff to prioritise children for targeted testing in the Ear Bus, in schools, by qualified audiologists and audiometrists. Testing includes otoscopy, tympanometry, audiometry (screened at 20 dB across frequencies 500, 1000, 2000, 4000 Hz) and clinical diagnostic tests in the Ear Bus if required. A summary report at the end of testing as well as a full report is provided to the family and schools. The HoHEBP teacher or ToD/CHL will discuss these findings with staff and parents. To capture children not attending formal schooling, Community Day Clinics are also provided for any child at the Dubbo HoHEBP office, the Dubbo AMS and community health centres throughout the eight towns.

The education programme

The HoHEBP teacher delivers the Education Program in partnership with the Department of Education ToD/CHL. The programme has a multi-faceted approach supporting children and young people, teachers, school support staff and the wider community.

The age-appropriate education programme for children is inclusive and interactive. It aims to foster children's knowledge of the importance of healthy ears, how to care for their ears, how to prevent OM, understanding hearing loss and aims to reduce the stigma attached to children wearing hearing devices. A major focus for the children aged 2–9 years, is the nose-blowing puppets, "snotty" Sam and Lucy, who teach the children correct techniques for nose blowing and hand cleaning necessary for healthy ears. Children throughout the district know and love the puppets as they appear regularly in the programme and at all hearing testing, Ear Specialist days, and community events and are featured as larger than life images on the outside of the Ear Bus! All children participate in the preventative nose blowing programme "Breathe, Blow, Cough, Wash, Chew (BBCWC)".

Professional learning programmes for teachers and school support staff have been developed with the aim to build knowledge about OM, including the impact of the disease on a child's ability to learn in the classroom. The programme provides strategies and skills for identifying children in the classroom who exhibit signs and behaviours of OM, strategies to help prevent and support children impacted with OM as well as plans to provide adjustments for children affected by hearing loss to enable them to hear/learn in their classroom environment.

The education programme for the wider community aims to provide relevant information to support understanding of the critical and widespread issues associated with OM, to provide strategies to promote prevention and to understand the pathways to care. These activities include supporting parents at Ear Specialist/Hearing Australia Clinics, providing displays at local community events, and strategically displayed hearing loss information on the exterior of the Ear Bus.

Longitudinal results from 2014 to 2019

A total of 1290 children and adolescents were seen by the HoHEBP across the six years, 2014–2019. However, many of those tested are seen more than once, with some having over five tests completed in a given year. Over half of these children and adolescents ($n = 720$; 56%) were provided with further support services. Table 2 shows that 373 (61% Indigenous; 39% non-Indigenous) were referred to an Ear Nose and Throat specialist while 104 (55% Indigenous; 45% non-Indigenous) were referred to Australian Hearing for further testing. 163 children and adolescents (71% Indigenous; 29% non-Indigenous) required surgery and 43 (63% Indigenous; 37% non-Indigenous) were provided with ToDHH support. A small number ($n = 37$) were provided with hearing devices such as hearing aids by Hearing Australia (59% Indigenous; 41% non-Indigenous). Children and adolescents who are eligible for ToDHH support are those who are diagnosed with a bilateral sensorineural or permanent conductive hearing loss with an average of 30 dB or greater across frequencies of 250, 500, 1000, 2000 Hz. These children and adolescents are then assessed for functional ability in receptive and expressive language, speech perception, speech

Table 2. Follow-up services for children and adolescents seen by HoHEBP 2014–2019 after first visit.

Services	2014		2015		2016		2017		2018		2019	
	I ^a	N-I ^b	I	N-I								
ENT	53	24	37	29	42	27	38	26	20	21	37	19
Surgery	15	4	23	6	27	11	19	10	9	6	23	10
Australian hearing	6	2	6	3	5	5	18	16	2	12	20	9
ToDHH support	7	2	4	1	4	2	6	4	1	3	5	4

^aI = Indigenous.

^bN-I = non-Indigenous.

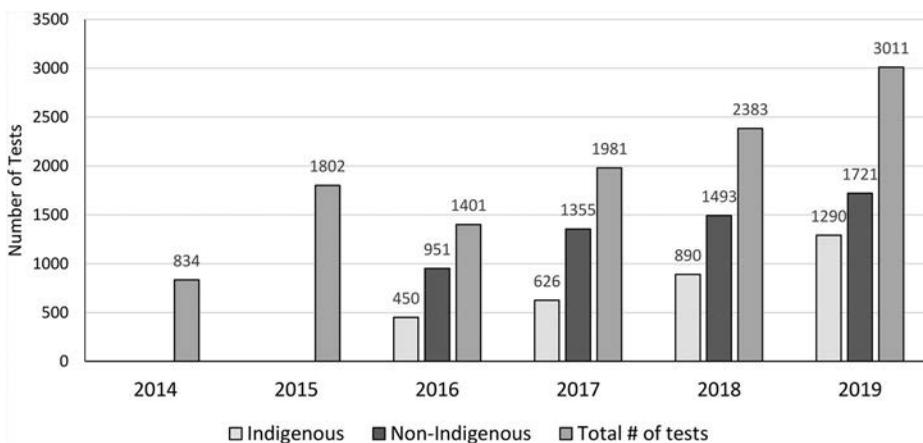


Figure 2. Number of tests conducted by HoHEBP (2014–2019) across 6 months-18 year-olds.

articulation, reading, and writing skills. For some younger children, if assessment tools are not appropriate, or their results are very low, they may not tell much about the child's development of specific milestones. In these situations, they have used checklist recordings – words/gestures/sentences, and or scales of development in areas of speech, language, pragmatics, cognition and listening to determine areas of strength and areas that need support. In situations where long term conductive hearing loss or a unilateral hearing loss that impacts on their development and access is evident, these children and adolescents can be considered for specialised ToDHH support for a short period of 12–24 months.

Figure 2 shows longitudinal data collected across the six-year period with a total of 11,412 hearing tests conducted by the HoHEBP. From 2016 to 2019, results show that 3256 (37%) tests were completed with Indigenous children and adolescents, while 5520 (63%) were completed with non-Indigenous children and adolescents.

In order to explore the prevalence of young children being tested by the HoHEBP, further analysis of the data was conducted at one point in time (2019) on the three age groups of 3, 4 and 5-year-old children. These age groups were chosen for analysis due to the critical period of a child's development during this time, and to explore the trend prior to formal schooling. Figure 3 shows that 832 children across these age groups were tested in the year, with the highest proportion evident in the 5-year-old group (44%). Data trends show that Indigenous children comprised approximately a third of each age group that were tested by the HoHEBP in 2019.

Further analysis of these three age groups was conducted to explore the number of tests undertaken in 2019. Results presented in Figure 4 show that 40% of the total number of tests conducted in this year were with these age groups, with almost half (44%) in the 5-year-old group. Less than half (41%)

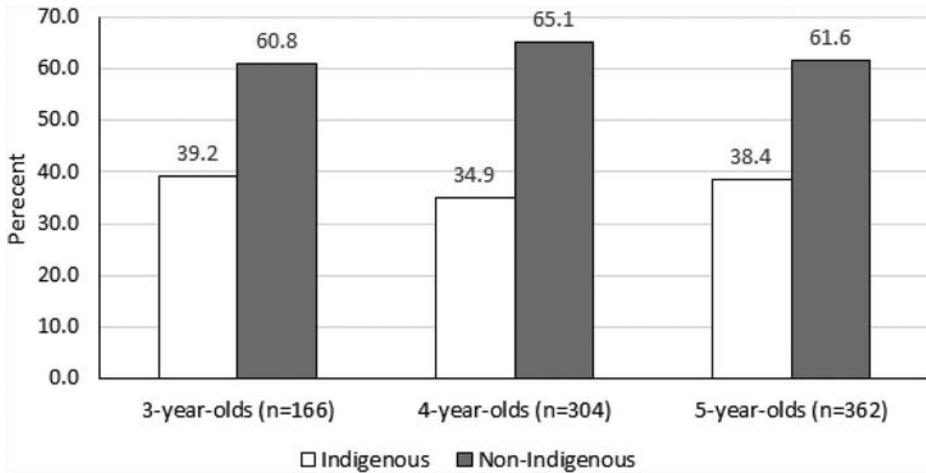


Figure 3. Percentage of 3-year-old, 4-year-old and 5-year-old Indigenous and non-Indigenous children tested by HoHEBP in 2019 ($N = 832$).

of the tests carried out with this age group were with Indigenous children, with a similar pattern observed in the 4-year-old (37%) and 3-year-old (41%) groups.

In order to explore the results of tests within each age group, further analysis was undertaken to determine the number of Indigenous and non-Indigenous children who had undertaken one or more tests in the year, and the percentage of tests passed and those that required further follow-up. Furthermore, the percentage of tests that were categorised as a review test was also investigated. [Table 3](#) presents the number of tests and the test results for the 3-year-old

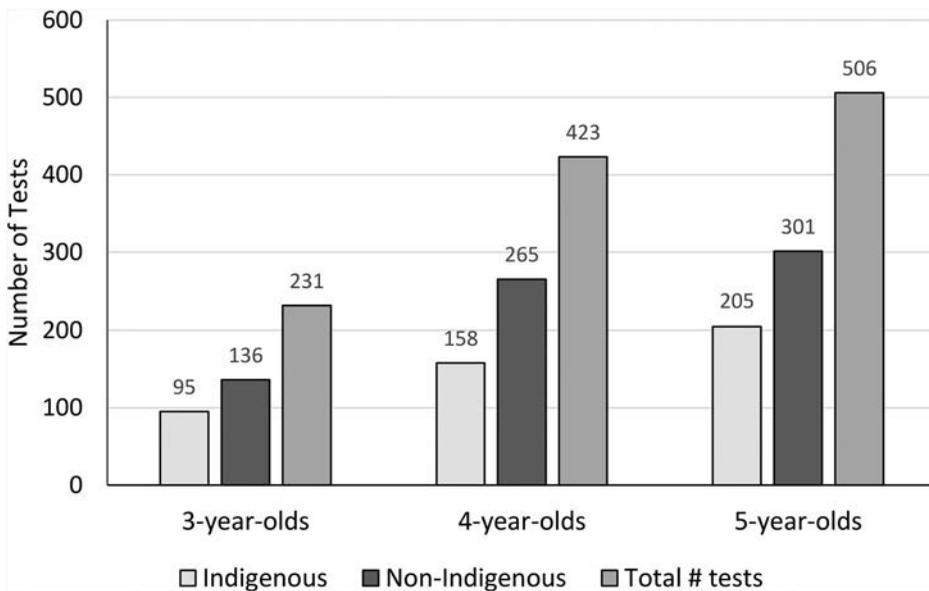


Figure 4. Number of tests conducted by HoHEBP in 3-year-old, 4-year-old and 5-year-old Indigenous and non-Indigenous children in 2019 ($N = 1160$; 40% of total number of tests).

Table 3. HoHEBP tests and test results for 3-year-olds in 2019 ($N = 166$).

Number of 3-year-olds	Tests in 2019	Number of tests	% pass tests	% follow-up tests	% review tests
Indigenous ($n = 43$)	1	43	26%	74%	19%
Non- Indigenous ($n = 73$)		73	32%	68%	32%
Indigenous ($n = 16$)	2	32	25%	75%	59%
Non- Indigenous ($n = 22$)		44	18%	82%	64%
Indigenous ($n = 4$)	3	12	0%	100%	66%
Non- Indigenous ($n = 5$)		15	20%	80%	73%
Indigenous ($n = 2$)	4	8	0%	100%	75%
Non- Indigenous ($n = 1$)		4	0%	100%	75%

group undertaken by the HoHEBP. Results show that a high percentage of tests that required follow-up were evident for both Indigenous and non- Indigenous 3-year-old children who completed 1 to 4 tests within the year. Also, for children who had completed 4 tests within the year, 75% of these tests were follow-up review tests, suggesting the ongoing prevalence of OM in this group of children.

Table 4 presents the findings from the tests conducted with the 4-year old group in 2019. Results show a similar pattern of findings as the 3-year-old group. However, there was a smaller number of Indigenous children who were tested but a relatively similar percentage of Indigenous children who required follow-up hearing tests when compared with non- Indigenous children, including all those who had more than one test conducted within this same year.

Table 5 presents the results of hearing tests conducted by the HoHEBP for the 5-year-old group during 2019. A similar pattern of results was evident in the

Table 4. HoHEBP tests and test results for 4-year-olds in 2019 ($N = 304$).

Number of 4-year-olds	Tests in 2019	Number of tests	% pass tests	% follow-up tests	% review tests
Indigenous ($n = 63$)	1	63	44%	56%	43%
Non- Indigenous ($n = 143$)		143	32%	68%	32%
Indigenous ($n = 34$)	2	68	35%	65%	68%
Non- Indigenous ($n = 45$)		90	26%	74%	71%
Indigenous ($n = 9$)	3	27	19%	81%	78%
Non- Indigenous ($n = 8$)		24	20%	80%	73%
Indigenous ($n = 0$)	4	0	–	–	–
Non- Indigenous ($n = 2$)		8	25%	75%	87%

Table 5. HoHEBP tests and test results for 5-year-olds in 2019 ($N = 362$).

Number of 5-year-olds	Tests in 2019	Number of tests	% pass tests	% follow-up tests	% review tests
Indigenous ($n = 97$)	1	97	76%	24%	40%
Non- Indigenous ($n = 161$)		161	63%	37%	29%
Indigenous ($n = 23$)	2	46	37%	63%	74%
Non- Indigenous ($n = 49$)		98	33%	67%	67%
Indigenous ($n = 16$)	3	48	15%	85%	87%
Non- Indigenous ($n = 10$)		30	30%	70%	83%
Indigenous ($n = 2$)	4	8	25%	75%	87%
Non- Indigenous ($n = 3$)		12	17%	83%	92%
Indigenous ($n = 1$)	5 or more	6	0%	100%	83%
Non- Indigenous ($n = 0$)		0	–	–	–

group of children when compared with the 3 and 4-year-old groups, with similar percentages of both Indigenous and non- Indigenous children undertaking repeated hearing tests and those who required follow-up tests and review tests. However, the percentage of Indigenous children undertaking three or more than five tests was higher, with a higher percentage requiring follow-up tests, suggesting the need for intervention after the first test.

Impact of the HoHEBP: What is the data telling us?

Findings from the longitudinal data collected by the HoHEBP demonstrates that the number of children and young people tested and reviewed has increased over the six years, suggesting a strong awareness and impact of the Hearing Testing Program. Results also show that a higher percentage of Indigenous children and young people are referred to ENTs (61%), Australian Hearing (55%), ToDHH support (63%) and required surgery (71%). These findings show the importance of the transdisciplinary approach in providing ongoing support to families of Australian Indigenous children with OM.

Trends in the data also showed that Indigenous children make up approximately one third of the children tested in the 3, 4, and 5-year-old age groups, with a higher percentage in the 5-year-old group requiring three or more than five tests. These findings support previous findings reported by Brennan-Jones et al. (2020) and Burns and Thomson (2013) regarding the high prevalence in OM in children under 5 years of age, but also confirms the ongoing prevalence in children entering school.

Impact of the HoHEBP: Perspectives from community

The Education Program has also seen an increase in the number of early childhood settings, schools, and families they have supported across Dubbo and the eight surrounding towns. Further evidence of the impact of the HoHEBP in achieving its aims has been reported by families, specialists and partners in the community.

Donna and Rachel reflected on their many experiences as volunteer directors of the HoHEBP. They reported,

A mother cried after her child had a hearing test and the HoHEBP team got together to help her in her child's hearing journey. She was actually crying tears of joy as this was the first time anyone was willing to support her. She had been to see so many medical professionals with no answers, lacked confidence and was at her 'wits end'. Within a week and in partnership with the Department of Education Hearing Support, we had the child going to the Ear Specialist, Paediatrician and Early Intervention.

Donna and Rachel also report the impact of reliable partnerships in supporting families of Indigenous children with OM. One example of the impact of the HoHEBP partnerships was highlighted.

Shane (pseudonym) age 4 years was referred to HoHEBP from our local AMS Child and Family Health Nurse (CFHN) for a hearing test. The CFHN called the ToDHH for advice regarding supporting Shane's speech and pragmatic skills, and for ideas to help build his parent's knowledge on the importance of nose blowing for healthy ears. At the hearing test, the ToDHH conducted observational assessments while providing support to the parents with Shane's communication skills. At the same time, the audiologist in the Ear Bus provided comprehensive, diagnostic hearing testing. Fast forward two weeks and the outcomes were amazing. The three local services worked together to attend an appointment with a local Ear Specialist (ENT) who fast-tracked Shane for grommet surgery, referred him to Hearing Australia for a hearing device, and ToDHH support ... The power of partnerships!

Donna and Rachel also receive many emails and letters from people within the community reporting the impact of the HoHEBP. For example, a principal in one of the towns reported that,

Your collective care, determination, hard-working ethic and your tenacity in providing and bringing hearing services to Dubbo and regional schools is amazing ... You have brought a free service to screen our students' hearing ... It must be very frustrating battling the limited financial support ... but you can take stock of your achievements and be very proud of how many children are now getting the assessments and ongoing support they need. You are enhancing the quality of life for so many young people and you are bringing hope, where otherwise it may not be.

The impact of the HoHEBP was also reported by one of the local ear specialists. He wrote that,

I'm strongly standing behind the HoHEBP as I'm the one that can really feel the difference it's making as early capture prevents advanced ear disease and disability. This is what the team at HoHEBP is all about, it's a totally new concept in approaching children with ear disease ... it has led to early diagnosis of throat and nose diseases ... This project gives the kids in our region access to services that they otherwise would not get.

Conclusion

The HoHEBP is a vehicle for change that has been a successful, workable response to the preventable disease of OM in Australian Indigenous and non-Indigenous children in the Dubbo and district area. From the get-go, we believed that "kid's ears" are definitely "worth caring for", as is proudly displayed on our Ear Bus, and if we do this well, we will have happy healthy children who have opportunities to fulfil their potential in all areas of life. This sustained, holistic community-based programme has made a substantial impact as a successful transdisciplinary intervention strategy that supports families of young Australians with OM throughout their child's life. Data evidences the percentage of Australian Indigenous and non-Indigenous children, the number of education settings accessing the programme and the growth in numbers of children and young people being involved with educational activities, tests, referrals, reviews,

specialist appointments, device fittings and surgeries. Where to from here? We are very keen to continue our proven strategy of working with the child being at the centre. We welcome the transdisciplinary method of responding to Australian Indigenous and non-Indigenous children's OM to be shared. "Every community is different, but as we've found, dreams actually can come true".

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No potential conflict of interest was reported by the author(s).

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