

4 Follow-up: audiology

4.1 Introduction

Otitis media and hearing loss are more prevalent and severe among Aboriginal and Torres Strait Islander children compared with other Australian children. The higher prevalence of these conditions among Indigenous children is associated with poverty, crowded housing conditions, inadequate access to water and to functioning sewerage and waste-removal systems (increasing the risk of bacterial and viral infections), passive smoking, nutritional problems and lack of access to primary health care and treatment (AHMAC 2008; Wiertsema & Leach 2009).

Otitis media and hearing loss can have significant impact on children's life. For children in the early years of life, the presence of persistent hearing loss (greater than 3 months) affects speech and language development and learning, and may have serious and ongoing developmental and educational effects. In school aged children, hearing loss associated with otitis media impacts on literacy and numeracy attainment, and behavioural and social development, with life-long consequences for employment, income, and social success (Couzos & Murray 2008).

The effective care of otitis media requires integrated access to primary, diagnosis and assessment; ENT, audiological and rehabilitation, including hearing devices; speech therapy and hearing impaired education specialist program. Chronic suppurative otitis media (CSOM) can be challenging to treat effectively requiring intensive, long-term ear cleansing and antibiotics, which is labour intensive for primary health care staff. Older children, with chronic tympanic membrane (ear drum) perforations with hearing loss may benefit from surgery (Coates et al. 2002).

In response to the high prevalence of ear conditions and their potentially serious long-term consequences for Indigenous Australians, the Australian Government funded the Northern Territory Government to provide the following:

- primary treatment
- community hearing workers
- audiologists
- ear, nose and throat (ENT) surgery
- infrastructure, such as hearing booths.

The NT DHF developed a follow-up model for ear conditions that addressed engagement with communities, provided community based family support, enhanced PHC capacity and delivered community and hospital based audiological and ENT specialist services.

Aboriginal Community Controlled Health Organisations (ACCHOs) also provide PHC follow-up services for children with ear diseases. They used the training provided by NT DHF, and adapted ear health programs according to local needs and priorities within funding guidelines.

As part of the evaluation framework for the Child Health Check Initiative (CHCI), the Australian Government is working with the NT DHF and ACCHOs to monitor whether children received the follow-up services they required. Monitoring of follow-up services

required for ear conditions is being done through the Audiology data collection reported on in this chapter.

This chapter provides information on the Audiology data collection, data on audiology checks for this and previous reporting periods, and data about hearing collected through the general CHCs. The audiology services described in this report are those that were provided up to and including 30 June 2009. In addition, it provides some insight into the interpretation and limitations of the CHCI audiology data collection. A glossary of audiology data terms used throughout this chapter is provided at the end of this report.

4.2 Information about the collection

Audiology checks are required to assess middle ear function, diagnose hearing loss and recommend rehabilitation such as communication strategies, classroom amplification, individual hearing aids, speech therapy, and educational support. Repeated audiological assessment monitors peripheral hearing system improvements associated with primary and surgical management of otitis media.

The design of the Northern Territory Emergency Response (NTER) audiology follow-up to the CHCs is based on a model of three visits to each community. Hence, a child may have multiple audiology checks across time as appropriate in monitoring clinic management of otitis media. All Indigenous children in the prescribed areas are eligible for audiology checks in recognition that children with some ear conditions were not identified through the CHC process.

Information for the Audiology data collection is transferred to the Australian Institute of Health and Welfare (AIHW) on paper forms. The data items that are included in the Audiology data collection include:

- details about the child (Hospital Registration Number (HRN), date of birth and sex)
- community identification (ID) and date of service
- whether the child had received previous audiology checks and, if so, the type of intervention and extent of change in hearing level since that check
- outcomes from the audiology check
- whether further action was required.

Each record in the Audiology data collection corresponds to a single assessment of middle ear function and peripheral hearing (audiological assessment). A course of care for otitis media may consist of one or a series of audiological assessments to monitor hearing loss and assess middle ear function. Because otitis media in Indigenous children is recurrent, persistent and chronic in nature, and most treatments, including surgery, will show changes over time a child may receive a number of audiological assessments and a child can have more than one record in the Audiology data collection.

4.3 Limitations

Data coverage for the CHCI Audiology data collection is limited to data collected from the audiology services provided by the NT DHF Helping Hands Australian Government Initiative Team. This collection does not capture follow-up audiology services provided through other means. Furthermore, the scope of this collection is limited to children between

the aged under 16 years at the time of their audiology check, unless they had received a previous CHC when they had been aged 15 or less.

Children who received an audiology check were not a random sample of Indigenous children in the prescribed areas or of children who had a CHC. Firstly, audiology checks were only provided to children who volunteered for them. Secondly, although all Indigenous children in prescribed areas of the Northern Territory were eligible to receive a CHCI audiology check, children with audiology referrals from the CHC data collection were targeted for follow-up by the audiology outreach team. Thus, the findings from the Audiology data collection are not representative of the Northern Territory Aboriginal child population or the Aboriginal population of children within prescribed areas of the NTER CHCI. The prevalence of ear conditions among NT Aboriginal children in general is likely to be much lower than among children in the Audiology data collection.

It should be also noted that some children who received the audiology services did not give consent for sharing their audiology check information with the AIHW. The NT DHF therefore provided total numbers for these audiology services to the AIHW for the purpose of monitoring audiology services, rather than data consisting of individual records. Because of this, data for these children were not able to be linked to the CHC database. As such, apart from Table 4.2, the data in this chapter are only derived from audiology service information for which consent was obtained, and therefore the true proportion of children who had audiology referrals at their CHC and received follow-up audiology services may be higher than what is reported here.

More information about data quality and interpretation can be found in Appendix 2 of this report.

4.4 Audiology forms received and processed

By the cut-off date, 4,317 audiology records related to services conducted on or before 30 June 2009 were received by the AIHW. After removing duplicate records and records for children outside the applicable age range, 4,091 processed records remained, representing 4,091 audiology services provided to 3,165 children.

By region, the largest proportion of audiology forms were received from Central Australia (39%), followed by Darwin Rural (23%), Arnhem region (21%) and Barkly/Katherine (18%) (Table 4.1). Data from the regions of Barkly and Katherine are combined owing to small numbers. This regional distribution in part reflects the fact that NTER-funded audiology services commenced in the Central Australia region and started later in other regions.

Table 4.1: Number of audiology forms received^(a), by region

Region	Number	Per cent
Central Australia	1,583	38.7
Arnhem	837	20.5
Barkly/Katherine	749	18.3
Darwin Rural	922	22.5
All Regions	4,091	100.0

(a) This excludes duplicate forms and forms for children outside of the applicable age range that were found during the processing stage.

Source: AIHW Community log for services on or before 30 June 2009.

Using a child's HRN as provided on the audiology form, the data indicate that 2,446 children had one audiology check, 540 children had two checks, 154 children had three checks, 22 children had four checks, and three children had five checks (Table 4.2). In addition to this, 404 audiology checks were provided to 352 children who did not provide explicit consent for their unit record data to be given to the AIHW, so forms for these checks were not passed on to the AIHW and they were not included in the data collection.

To enable a description of the findings from the audiology checks according to the number of children who had various problems, the unit of analysis for the information presented in the remainder of this chapter is a 'child' and relates to 3,165 children.

Table 4.2: Number of audiology checks per child, Indigenous children who had an audiology check as part of the NTER CHCI

	Checks		Children	
	Number	Per cent	Number	Per cent
Audiology checks with consent^(a)				
<i>1 audiology check^(b)</i>	2,446	54.4	2,446	77.3
<i>2 audiology checks</i>	1,080	24.0	540	17.1
<i>3 audiology checks</i>	462	10.3	154	4.9
<i>4 audiology checks</i>	88	2.0	22	0.7
<i>5 audiology checks</i>	15	0.3	<5	0.1
Total checks with consent	4,091	91.0	3,165	100.0
Audiology checks without consent	404	9.0	352	..
Total	4,495	100.0	3,517	..

(a) Consent to transfer children's information to AIHW.

(b) Includes thirteen cases where HRN was missing.

.. Not applicable

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.5 Demographic characteristics

Just over half of the 3,165 children who had an audiology check were male (52%) and just under half were female (48%) (Table 4.3). Over half (53%) of those who had an audiology check were aged 6 to 11 years, while 29% were aged 0 to 5 years and 18% were aged 12 to 16 years. The distribution of children who had had an audiology check across age groups reflects the availability of appropriate testing facilities for children less than 4 years of age. The largest proportion of children had their check in Central Australia (37%), followed by Darwin Rural (24%), Arnhem (20%) and Barkly/Katherine (19%) (Table 4.3).

Table 4.3: Demographic characteristics, Indigenous children who had an audiology check^(a) as part of the NTER CHCI

	Number	Per cent
Region		
Central Australia	1,166	36.8
Arnhem	630	19.9
Barkly/Katherine	601	19.0
Darwin Rural	768	24.3
Total	3,165	100.0
Age group		
0–5 years	922	29.1
6–11 years	1,675	52.9
12–16 years ^(a)	554	17.5
Missing	14	0.4
Total	3,165	100.0
Sex		
Male	1,631	51.5
Female	1,531	48.4
Missing	3	0.1
Total	3,165	100.0

(a) Based on the latest checks.

(b) Includes children aged 16 years at the time of their audiology check who were aged 15 at the time of their Child Health Check.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.6 Ear health and requirements for further action

The data presented in this section are based on results from the latest audiology check for each child to ensure that the most up-to-date information is provided.

4.6.1 Hearing loss status

As part of the audiology check, audiologists were asked to indicate whether the child had hearing loss and the type of hearing loss present. Just over half (54%) of the children who had an audiology check by 30 June 2009 had hearing loss. Thirty-nine per cent of children had no hearing loss and this information was missing for 7% of children. Among those children with hearing loss, bilateral hearing loss was recorded for 66% and unilateral hearing loss for 33% (Table 4.4).

Table 4.4: Hearing loss, Indigenous children who had an audiology check with consent ^(a)

Hearing status	Number	Per cent of children who had an audiology check	Per cent of children with hearing loss
No hearing loss	1,240	39.2	..
Hearing loss	1,718	54.3	..
Unilateral	573	18.1	33.4
Bilateral	1,132	35.8	65.9
As tested by sound field ^(b)	13	0.4	0.8
Information about hearing loss status missing ^(c)	207	6.5	..
Total	3,165	100.0	..

.. Not applicable

(a) Consent to transfer children's information to AIHW.

(b) Children tested for hearing loss using a sound field are presented separately, because it is not possible to distinguish unilateral and bilateral hearing loss using this method of testing.

(c) Missing includes not stated, unsure, invalid and not tested responses.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

The most common type of hearing loss identified was conductive (91%), whereas only a small proportion of children had sensorineural or mixed hearing loss (both 3%) (Table 4.5). Type of hearing loss status missing includes those children who were not tested. This includes those who were either too young for the test battery or were uncooperative and all of these children will be targeted for retesting.

Table 4.5: Type of hearing loss in Indigenous children for whom hearing loss was not ruled out during an audiology check^(a)

Type of hearing loss	Number	Per cent of children with hearing loss	Per cent of children who had an audiology check
Conductive	1,564	91.1	49.5
Sensorineural	50	2.9	1.6
Mixed (both conductive and sensorineural)	52	3.0	1.6
Type of hearing loss missing ^(b)	52	3.0	1.6
Total	1,718	100.0	54.3

(a) Only includes children who were found to have hearing loss during an audiology check or for whom hearing loss information was missing, not stated, invalid, or indicated as unsure or not tested.

(b) Missing includes not stated, unsure, invalid and not tested responses to the question of what type of hearing loss the child had.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

With the introduction of specialised audiological facilities housed inside shipping containers Visual Reinforced Orientation Audiometry (VROA) was used for assessment of children aged 3 years and less. Testing using VROA does not give detailed separate ear information but uses speaker presentation of sound stimuli to provide measure of hearing ability in the 'better ear' (at least). During the CHCI audiology checks sound field measurements identified 13 additional children with hearing loss (Table 4.4). As this response indicates the

'better ear' it represents a bilateral hearing loss. This category is therefore presented separately.

For children with hearing loss audiologists were also asked to indicate the degree of hearing loss present in their better ear.

It is important to bear in mind that the scoring for hearing loss and degree of hearing impairment were quantified differently. Hearing impairment classification in the Audiology data estimates degree of difficulty associated with hearing loss and links directly to level of recommended rehabilitation support. Hearing impairment classification applies a graded scale mild, moderate, severe and profound, based on degree of deviation in the 'better ear' as recorded through audiometry. During data collection it is calculated as a 3 frequency average (3FA) of the threshold of hearing loss (HTL) at 500Hz, 1000Hz and 2000Hz and is only applied to further describe bilateral hearing loss. Hearing loss includes children with unilateral hearing loss or those with hearing loss that is outside the averaged range used in this calculation, such as very low or high frequency hearing loss. It is therefore possible for a child to be found to have hearing loss (Table 4.4) but no degree of hearing impairment (Table 4.6).

Among children with hearing loss, just under than 40% had no hearing impairment, about 39% had a mild level of hearing loss, 20% had a moderate level, and less than 1% had a severe or profound level of hearing loss (Table 4.6). Eleven of the thirteen children with hearing loss detected by sound field test had mild to profound degree of hearing impairment.

Table 4.6: Degree of hearing impairment in Indigenous children with hearing loss

Degree of hearing impairment	Number	Per cent of children with hearing loss	Per cent of children who had an audiology check
None ^(a)	684	39.8	21.6
Mild ^(b)	670	39.0	21.2
Moderate ^(c)	343	20.0	10.8
Severe ^(d)	11	0.6	0.3
Profound ^(e)	5	0.3	0.2
Missing ^(f)	5	0.3	0.2
Total	1,718	100.0	54.3

(a) Includes some children found to having hearing loss (Table 4.4), because the degree of hearing impairment is calculated as an average across particular frequencies whereas hearing loss in Table 4.4 is assessed from the worst-performing frequency.

(b) Defined as 16–30 dB in soundproof conditions and 26–35 dB in non-soundproof conditions.

(c) Defined as 31–60 dB in soundproof conditions and 36–60 dB in non-soundproof conditions.

(d) Defined as 61–90 dB in soundproof conditions and 61–90 dB in non-soundproof conditions.

(e) Defined as 91 dB+ in soundproof conditions and 91 dB+ in non-soundproof conditions.

(f) Missing includes not stated, unsure, invalid and not tested responses.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.6.2 Middle ear conditions

A question on the audiology form asked whether the child had a middle ear condition in either ear. Three in four (75%) children who had an audiology check had a middle ear condition in at least one ear (Table 4.7). By contrast, 30% of children aged 0–15 years who had a general CHC were found to have ear conditions (Table 2.4). Differences between the ways ear conditions are defined in the CHCs and in the audiology checks are explored in Section 4.8.

Middle ear conditions were also examined by type (Table 4.7). The most common type of middle ear condition present among those children who had had an audiology check was otitis media with effusion (31%), followed dry perforation (19%). The proportion of children with chronic suppurative otitis media (12%) was more than 3 times the level WHO described as a massive health problem. Note that because eustachian tube dysfunction was only specifically listed as an option in version 5 of the form which was used from 16 June 2008 (for other versions, it could be indicated in the 'other' response option), the prevalence of this condition is likely to be understated.

Table 4.7: Type of middle ear condition, Indigenous children who had an audiology check as part of the NTER CHCI

Type of middle ear condition	Yes (%)	No (%)	Unsure (%)	Missing (%)	Total (%)	Total (no.)
Eustachian tube dysfunction ^(a)	12.3	82.7	3.6	1.4	100.0	3,165
Acute otitis media	7.1	88.2	3.3	1.4	100.0	3,165
Chronic suppurative otitis media	11.7	83.5	3.3	1.5	100.0	3,165
Otitis media with effusion	31.2	64.1	3.3	1.4	100.0	3,165
Dry perforation	19.4	76.1	3.0	1.5	100.0	3,165
Other	13.4	82.3	2.9	1.4	100.0	3,165
At least one type of middle ear condition ^(b)	74.5	22.8	1.6	1.0	100.0	3,165

(a) This response option was included in version 5 of the audiology form but not in earlier versions; however, this response could be given in the 'other' response option in the earlier versions.

(b) Includes middle ear conditions in either the right or left ear.

Note: This is a single response item; however, some children were reported to have more than one type of middle ear condition in either their right or left ear.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.6.3 Requirements for further action

As part of the audiology check, audiologists were asked to indicate what further follow-up the child required. Overall, at least one type of further action was required for 76% of children after their audiology check (Table 4.8). The most common types of further action required were: case management by PHC (50%); ongoing monitoring by Northern Territory hearing services (46%); and case management by ENT specialists (44%) (Table 4.8). Children may have received referrals to more than one of these services. For instance, a child may have been case managed by a PHC worker and an ENT specialist simultaneously.

Table 4.8: Type of further action required^(a) after audiology check, Indigenous children who had an audiology check as part of the NTER CHCI

Type of further action required	Yes (%)	No (%)	Missing (%) ^(b)	Total (%)	Total (no.)
Case management by Primary Health Care services	50.1	49.4	0.4	100.0	3,165
Case management by Ear, Nose and Throat specialist	43.9	55.6	0.5	100.0	3,165
Ongoing monitoring by Northern Territory hearing services	46.4	53.1	0.5	100.0	3,165
Referral to Australian Hearing (rehabilitation)	11.7	87.8	0.5	100.0	3,165
Referral to Department of Education, Employment and Training hearing advisory support	24.2	75.3	0.5	100.0	3,165
Other	17.9	81.5	0.5	100.0	3,165
At least one further action required	75.6	23.9	0.4	100.0	3,165

(a) This is a multiple response item; some children had more than one further action required.

(b) Includes invalid and not stated responses.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.7 Changes over time

The results from the first audiology checks were compared with the results from the child's latest audiology check to determine whether any measures changed over time. As mentioned previously, there was an item on the audiology form that asked whether or not the child had a previous audiology check and whether any change in hearing levels had occurred since this check; however, given the large proportion of missing responses (as discussed in Appendix 2), this item was not used for its intended purpose.

Whether or not a child had two audiology checks was determined by identifying audiology checks with the same HRN. There were 719 children who had two or more audiology checks by 30 June 2009 as part of the CHCI (Table 4.2). In order to present the most current information, the data presented compare the first audiology check with the latest check for each child. It should be noted that the average period of time between the first and last check was approximately five and a half months (164 days).

4.7.1 Hearing loss status

Among children who had had at least two audiology checks, 25% had no hearing loss at the time of their first check compared with 31% at the time of their latest check. The proportion of children who had bilateral hearing loss decreased from 46% at first check to 42% at latest check) (Table 4.9).

Table 4.9: Hearing loss at first and latest check, Indigenous children who had at least two audiology checks as part of the NTER CHCI

Hearing loss	First check		Latest check	
	Number	Per cent	Number	Per cent
None	178	24.8	220	30.6
Unilateral	167	23.2	160	22.3
Bilateral	332	46.2	305	42.4
Missing ^(a)	42	5.8	34	4.7
Total	719	100.0	719	100.0

(a) Missing includes unsure, invalid, not stated and not tested responses.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

The change in the degree of hearing impairment among children who had at least two audiology checks was also examined. The proportion of children with no degree of hearing impairment at their first check (51%) increased to 59% at their most recent check (Table 4.10). The proportion of children with a mild or moderate degree of hearing impairment at their first check (29% and 15% respectively) decreased at their latest check (25% and 11% respectively).

Table 4.10: Degree of hearing impairment^(a) at first and latest check, Indigenous children who had at least two audiology checks as part of the NTER CHCI

Degree of hearing impairment	First check		Latest check	
	Number	Per cent	Number	Per cent
None ^(b)	365	50.8	427	59.4
Mild ^(c)	205	28.5	177	24.6
Moderate ^(d)	106	14.7	81	11.3
Severe ^(e)	2	0.3	2	0.3
Profound ^(f)	0	0	<5	0.1
Missing ^(g)	41	5.7	31	4.3
Total	719	100.0	719	100.0

(a) Based on the better ear.

(b) Defined as 0–15 dB in soundproof conditions and 0–25 dB in non-soundproof conditions.

(c) Defined as 16–30 dB in soundproof conditions and 26–35 dB in non-soundproof conditions.

(d) Defined as 31–60 dB in soundproof conditions and 36–60 dB in non-soundproof conditions.

(e) Defined as 61–90 dB in soundproof conditions and 61–90 dB in non-soundproof conditions.

(f) Defined as 91 dB+ in soundproof conditions and 91 dB+ in non-soundproof conditions.

(g) Missing includes unsure, invalid, not stated and not tested responses.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

In order to determine exactly what changes in hearing impairment had occurred at an individual level, Table 4.11 presents data for children who had at least some hearing impairment at the time of their first audiology check, and shows whether their level of hearing impairment had improved, deteriorated, or stayed the same from their first to latest check. An improvement in hearing impairment was defined as a degree of hearing

impairment at the child's latest check that had improved by at least one level since their first check, whereas deteriorated hearing impairment was defined as a degree of hearing impairment at the child's latest check that had worsened by at least one level since their first check.

The results show that the degree of hearing impairment improved for more than half (56%) of all children who had some level of hearing impairment at the time of their first check. The level of hearing impairment deteriorated between their first and latest check in one third (33%) of the children with hearing impairment at their first check. Hearing impairment did not change in 7% of the children.

It is not clear what factors caused the changes in degree of hearing impairment among these children. These changes may be attributed to the medical treatment and intervention, and may be also due to the fluctuating nature of hearing loss associated with otitis media.

Table 4.11: Changes in degree of hearing impairment^(a) between first and latest check, Indigenous children with some hearing impairment

Degree of hearing impairment	Number	Per cent
Improved ^(b)	175	55.9
Deteriorated ^(c)	102	32.6
No change ^(d)	23	7.4
Missing ^(e)	13	4.2
Total	313	100.0

(a) Based on better ear. Includes only those children who had some degree of hearing impairment at their first check.

(b) Defined as a degree of hearing impairment at the child's second check that had improved by at least one level since their first check.

(c) Defined as a degree of hearing impairment at the child's second check that had worsened by at least one level since their first check.

(d) Defined as a degree of hearing impairment at the child's second check that was the same as the degree of hearing loss at their first check.

(e) Includes children for whom information on the degree of hearing impairment was missing on their latest check.

Source: AIHW analysis of NTER CHCI Audiology data for services on or before 30 June 2009.

4.8 Audiology and Child Health Check data collection linkage

Since the December 2008 progress report, the analysis of the Audiology data collection has focused more directly on those children who were identified as having an ear condition at the time of their CHC. Of special interest is the extent to which children with ear disease who were referred for audiology services at the time of their CHC actually received these services. 'Ear disease' is a derived variable created by the AIHW to capture children who suffer any of the following symptoms in either ear: wet perforation, dry perforation, bulging ear drum, otitis media, otitis externa and/or inflamed ear drum.

Note that the proportion of children with otitis media with effusion (OME) identified during CHC may not be as reliable as that diagnosed during an audiology assessment. This is

because the two data collections used different methods to diagnose OME: during an audiology test, a child was tested using tympanometry which can detect OME more accurately than the otoscopy which was used in some CHCs.

In order to link the Child Health Check and Audiology data collections, valid and unique HRNs are required in both collections. Among the 10,605 children who had received a CHC as at 30 June 2009, 366 CHC forms with missing or 'incorrect'² HRNs were removed for linkage purposes. The number of children in the final CHC data set used for the linkage of collections differs between sections 4.8.1 and 4.8.2. That is, because Section 4.8.1 incorporates the use of ear conditions and referral status information from the CHC, children who had completed a non-standard CHC form were excluded from the final data set because this information was not available. Section 4.8.2, on the other hand, does not incorporate the information from the CHC, so children who had completed a non-standard CHC form were able to be included in analyses. For children who had had two valid CHCs, only their first valid CHC was used for linkage purposes because follow-up services are based on the referrals that were made during the child's initial health check. The total number of children included in the final CHC data sets for sections 4.8.1 is 9,137 and for section 4.8.2 is 10,239.

Of the 3,165 children who had had at least one audiology check as at 30 June 2009, there were 11 children for whom the HRN was missing on thirteen of these forms and these could not be linked with the CHC database. In total, data from the Audiology collection for 3,154 children could be used in the linkage of data sets. As was done for the CHC data, for those children who had had more than one audiology check, only the first audiology check was included for data linkage purposes.

4.8.1 Audiology check status: Ear health and audiology referrals made at Child Health Check

After excluding children with invalid or missing HRN and non-standard CHC forms, there were 9,137 children who had had a CHC as at 30 June 2009. Based on the information on their first CHC forms, 2,746 children were identified as having ear conditions, 6,391 children had no ear condition or information on ear conditions was missing.

Table 4.12 shows audiology referral status and audiology check follow-up of children who had CHCs, split according to whether or not they were identified as having ear conditions at the time of their first CHC. Overall, the proportion of children who had had an audiology check was larger among those who had ear conditions (35%) compared with those who did not (18%), regardless of whether they were referred for such services at their CHC.

As expected, there was a larger number of children with identified ear conditions who were referred for audiology services (923) than those with no ear conditions or missing data about ear conditions (366) at the time of their CHC (Table 4.12). Of those children who had ear conditions identified at the time of their CHC and who were referred for audiology services, 46% received an audiology check (Table 4.12). Of those children who had not been referred for audiology services, there was a larger proportion of children who had received an audiology check who had ear conditions (30%) than those who were not found to have them (17%).

² 'Incorrect' HRNs are those that were identified by the NT DHF as incorrect during data cleaning processes but for which the correct HRN was unknown.

Based on the audiology check forms relating to checks conducted up until 30 June 2009, 44% (561) of children who had received an audiology referral at the time of their CHC had received at least one follow-up audiology check (Table 4.12). This has doubled since the December 2008 progress report, where 20% of children who had an audiology referral had received an audiology check.

Table 4.12: Audiology referral status at CHC by whether audiology check follow-up had been received, ear condition status of Indigenous children who had a Child Health Check

	Children who had an audiology check		Total children ^(a) with or without audiology check
	Number	Per cent	Number
Children with identifiable ear condition at CHC			
Children with an audiology ^(b) referral	420	45.5	923
Children with no audiology referral or for whom referrals information was missing	541	29.7	1,823
<i>Total children with ear condition</i>	<i>961</i>	<i>35.0</i>	<i>2,746</i>
Children with no ear condition or missing ^(c) ear condition data at CHC			
Children with an audiology ^(b) referral	141	38.5	366
Children with no audiology referral or for whom referrals information was missing	1,038	17.2	6,025
<i>Total children with no ear condition or missing data</i>	<i>1,179</i>	<i>18.4</i>	<i>6,391</i>
<i>Total children with referrals</i>	<i>561</i>	<i>43.5</i>	<i>1,289</i>
Total children	2,140	23.4	9,137

(a) Excluding children with missing or invalid HRN and non-standard CHC forms.

(b) Refers to referrals for audiology and/or tympanometry services. The number of referrals was derived based on the first CHC only.

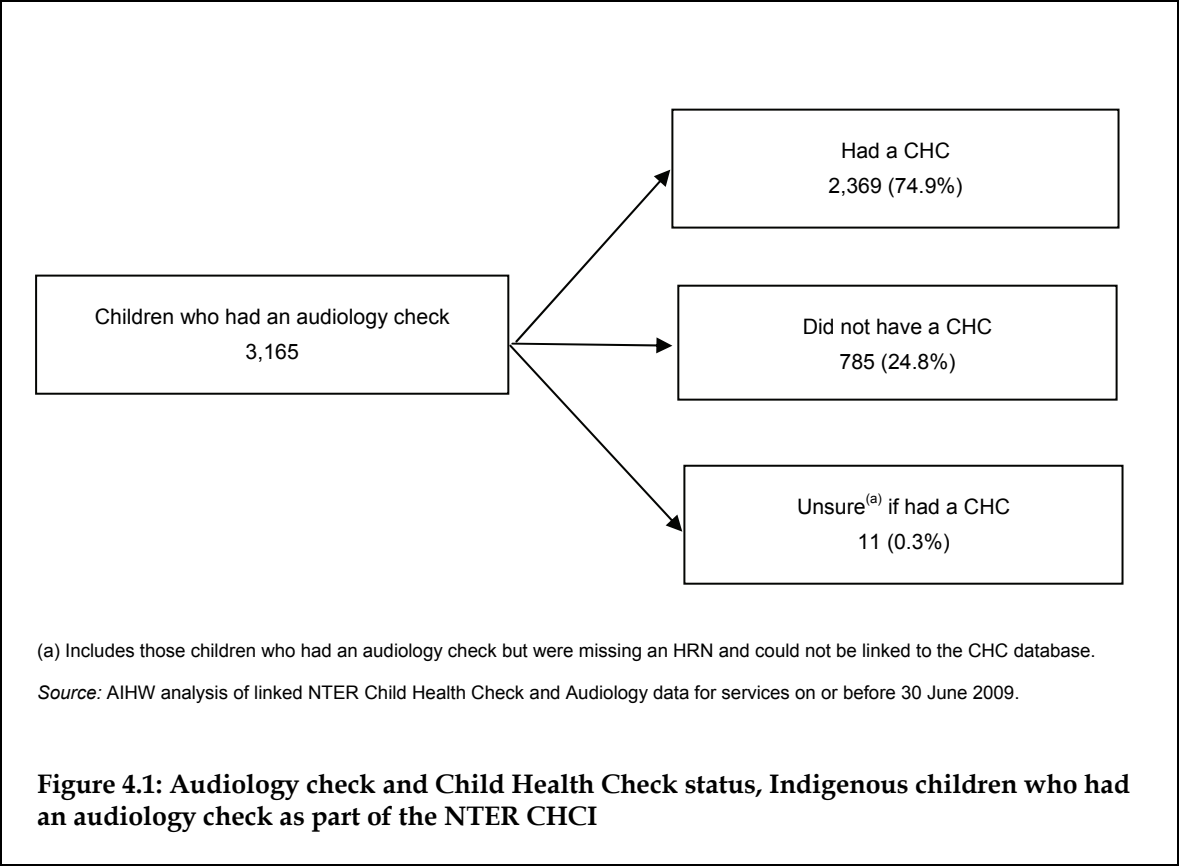
(c) Missing includes unsure, not stated and not tested responses. The number of ear conditions was derived based on the first CHC only.

Source: AIHW analysis of NTER CHCI Audiology data and Child Health Check data for services on or before 30 June 2009.

4.8.2 Child Health Check status: Audiology check follow-up results

Figure 4.1 shows the percentage of children who had had an audiology check and who had also had a previous CHC, based on audiology check forms received by the cut-off date. Just under three-quarter (75%) children who had an audiology check had had a previous CHC. This is higher than the proportion of children in the December 2008 progress report who had an audiology check and a previous CHC (68%). There were 11 audiology checks for which

the HRN was not provided, so it was not known if a previous CHC had been undertaken in these cases.



The proportion of children who had hearing loss was similar among those who had not had a CHC (41%) compared with those who had (37%) (Table 4.13). There was little difference in type of hearing loss and degree of hearing loss among these two groups of children.

Table 4.13: Hearing loss by whether or not a Child Health Check was undertaken, Indigenous children who had an audiology check as part of the NTER CHCI ^(a)

	CHC		No CHC	
	Number	Per cent	Number	Per cent
Hearing loss				
None	876	37.0	318	40.6
Unilateral	441	18.6	137	17.5
Bilateral	884	37.3	271	34.4
Sound field	6	0.25	3	0.38
Missing ^(b)	162	7.1	56	7.5
Total	2,369	100.0	785	100.0
Type of hearing loss				
None	876	37.0	318	40.6
Conductive	1,215	51.3	366	46.7
Sensorineural	37	1.6	21	2.7
Mixed (both conductive and sensorineural)	37	1.6	14	1.8
Missing ^(b)	204	8.6	66	8.3
Total	2,369	100.0	785	100.0
Degree of hearing loss^(c)				
None ^(d)	1,379	58.2	481	61.4
Mild ^(e)	547	23.1	151	19.3
Moderate ^(f)	276	11.7	90	11.5
Severe ^(g)	8	0.3	3	0.4
Profound ^(h)	3	0.1	1	0.1
Missing ^(b)	156	6.6	58	7.4
Total	2,369	100.0	785	100.0

(a) Exclude children with missing or invalid HRNs. Hearing loss, hearing impairment and type of hearing loss were assessed based on the information in the first audiology check, which was different to what was in the last check reported in the previous section of this chapter.

(b) Missing includes unsure, invalid, not stated and not tested responses.

(c) Based on better ear.

(d) Defined as 0–15 dB in soundproof conditions and 0–25 dB in non-soundproof conditions.

(e) Defined as 16–30 dB in soundproof conditions and 26–35 dB in non-soundproof conditions.

(f) Defined as 31–60 dB in soundproof conditions and 36–60 dB in non-soundproof conditions.

(g) Defined as 61–90 dB in soundproof conditions and 61–90 dB in non-soundproof conditions.

(h) Defined as 91 dB+ in soundproof conditions and 91 dB+ in non-soundproof conditions.

Source: AIHW analysis of NTER CHCI Audiology data and Child Health Check data for services on or before 30 June 2009.

The proportion of children with at least one type of middle ear condition was also similar for those children who had had a CHC (76%) compared with those who had not (72%) (Table 4.14).

Table 4.14 Middle ear conditions by whether or not a Child Health Check was undertaken, Indigenous children who had an audiology check as part of the NTER CHCI

At least one middle ear condition ^(a)	CHC		No CHC	
	Number	Per cent	Number	Per cent
Yes	1,790	75.6	563	71.7
No	522	22.0	197	25.1
Unsure	37	1.6	12	1.5
Missing	20	0.8	13	1.7
Total	2,369	100	785	100

(a) If the same middle ear condition was present in both ears, the condition was counted only once.

Source: AIHW analysis of NTER CHCI Audiology data and Child Health Check data for services on or before 30 June 2009.

4.9 Discussion

There were 3,517 children who had an audiology check. The AIHW had detailed data on 3,165 of these children among whom:

- Fifty-four per cent had some hearing loss.
- Seventy-five per cent had at least one middle ear condition, the most common type being otitis media with effusion (31%).
- Nineteen per cent had eardrum perforation.
- Nearly 12% had chronic suppurative otitis media, more than 3 times the level WHO described as a massive health problem.
- Seventy-six per cent of children required further action following their most recent audiology check.
- Case management by Primary Health Care services (50%) was the most common type of follow-up action required.

In relation to those 719 children who received at least two audiology checks:

- The proportion with no hearing loss increased between the first (25%) to latest (31%) check.
- The degree of hearing impairment improved between the first and latest check for more than half (56%) of the children who had some level of hearing loss at their first check. This improvement could be due to ear conditions healing of their own accord, as well as due to treatment.

Among children who had a NTER CHC, 1,289 were referred for audiology follow-up:

- About 44% (561) of these children had received an audiology check by 30 June 2009, double the number in the December 2008 progress report. This proportion is likely to increase as more audiology checks are conducted.