



Clinical Guidelines for Paediatric Cochlear Implantation

Neurosciences and the
Senses Health Network

Developed by the Ear, Nose and Throat
Advisory Group

May 2011



© Department of Health, State of Western Australia (2011).

Copyright to this material produced by the Western Australian Department of Health belongs to the State of Western Australia, under the provisions of the Copyright Act 1968 (C'wth Australia). Apart from any fair dealing for personal, academic, research or non-commercial use, no part may be reproduced without written permission of the Health Networks Branch, Western Australian Department of Health. The Department of Health is under no obligation to grant this permission. Please acknowledge the WA Department of Health when reproducing or quoting material from this source.

Suggested Citation

Department of Health, Western Australia. Clinical Guidelines for Paediatric Cochlear Implantation. Perth: Health Networks Branch, Department of Health, Western Australia; 2011.

Important Disclaimer:

All information and content in this Material is provided in good faith by the WA Department of Health, and is based on sources believed to be reliable and accurate at the time of development. The State of Western Australia, the WA Department of Health and their respective officers, employees and agents, do not accept legal liability or responsibility for the Material, or any consequences arising from its use.

Table of contents

Acknowledgements	i
Summary	ii
1 Clinical Guidelines for Paediatric Cochlear Implantation	1
1.1 Introduction	1
1.2 Definitions	2
1.3 Methodology	2
1.4 Identifying candidates	2
1.5 Timing of Cochlear Implantation.....	3
2 Preoperative Assessment	4
2.1 Entry into Cochlear Implant Program	4
2.2 Audiology Assessment.....	4
2.2.1 PMH Cochlear Implant Referral Criteria.....	4
2.2.2 Special considerations for referral.....	5
2.2.3 Prior to referring, the following is required by PMH / CIC:.....	5
2.2.4 Procedure and responsibilities prior to implant	6
2.3 Speech Pathology	6
2.3.1 Initial Family Meeting	6
2.3.2 Candidacy evaluation and cochlear implant work-up.....	6
2.4 Educational Agencies	7
2.4.1 Educational Agencies' Role in Implant Pathway	7
2.4.2 Professionals involved with Family at Educational Organisation.....	7
2.4.3 Pre Surgery	8
2.5 Otolaryngology	8
3 Post Operative (Incl. Education and Awareness)	9
3.1 Audiology procedure and responsibilities after implant	9
3.2 Battery of tests:	9
3.3 Speech Pathology	9
3.3.1 Key Principles of Habilitation.....	10
3.4 Educational Agencies	10
4 Other Considerations	11
4.1 Bilateral Cochlear Implantation	11
4.2 Evolving Technology	11
5 References	12
Appendices	13

Acknowledgements

The clinical guideline for the Paediatric Cochlear Implantation has been developed by the Ear, Nose and Throat Advisory Group (ENTAG) within the Neurosciences and the Senses Health Network.

Members of the ENT Advisory Group:

Dr Stephen Rodrigues	Chairperson - ENT Advisory Group Consultant Otologist Princess Margaret Hospital
Jay Krishnaswamy	Head of Department (Audiology) Princess Margaret Hospital
Jodi Lipscombe	Head of Department (Speech Pathology) Princess Margaret Hospital
Katherine Cain	Speech Pathologist Princess Margaret Hospital
Jane Blanckensee	Teacher of the Deaf LSLS, Auditory Verbal Therapist, Early Intervention Centre WA Institute for Deaf Education
Dr Brett Robertson	General Manager Ear Science Institute Australia
Mrs Gemma Upson	Business Development Manager Implant Centre Ear Science Institute Australia
Andrew Jones	Senior Development Officer, Health Networks Branch, Office of the Chief Medical Officer, WA Department of Health

The following staff from the Health Networks Branch, Office of the Chief Medical Officer Department of Health contributed to this document:

Joanne Cronin
Senior Development Officer

Pranita KC
Development Officer



Summary

Cochlear implantation provides the single most effective form of hearing rehabilitation in patients with bilateral severe to profound sensorineural hearing loss that is no longer responsive to amplification.

It is without doubt the most significant advance in the treatment of sensorineural hearing loss since the invention of the hearing aid. By definition it provides hearing in those who are no longer receiving benefit from amplification and is a critical step in the management of the hearing impaired. It is well recognised that adequate hearing is a critical requirement for the development of speech and language and therefore cochlear implantation plays a critical role in hearing restoration for those children who are either born with sensorineural hearing loss (congenital) or in those who develop a significant sensorineural hearing loss throughout childhood.

A successful cochlear implant program involves many steps from hearing screening through to post-operative rehabilitation. A coordinated multi-disciplinary approach is essential to ensure optimal outcomes. A successful cochlear implant program cannot occur without a well-resourced neonatal hearing screening program, coordinated assessment programs by audiology, speech pathology, educational and medical services and a dedicated rehabilitation program provided by the same agencies.

It is well recognised that congenital sensorineural hearing loss is a significant public health issue with approximately one per thousand live births affected by sensorineural deafness. There is a prevalence of approximately three per thousand cases of childhood acquired sensorineural hearing loss¹. As yet, there is no universal neonatal hearing-screening program in Western Australia, which will impact on detection rates in this critical period. Of those patients identified those that do not progress after an adequate hearing aid trial should be considered for cochlear implantation.

The aims of implantation are to provide adequate sound information to allow for speech and language development commensurate with a child's normal hearing peers.

1 Clinical Guidelines for Paediatric Cochlear Implantation

Cochlear implantation requires the input of a number of agencies and caregivers. These include but are not limited to Audiologists, Speech Pathologists, Otolaryngologists, Occupational Therapists, Auditory Verbal Therapists and Education Services (Teachers of the Deaf). There is an intensive pre-operative assessment and counselling program, which is then followed through the peri-operative period with up to twelve months of intensive rehabilitation post-operatively.

This clinical guideline supports implementation of a universal neonatal hearing screening program for Western Australia. Those children with significant sensorineural hearing loss should be referred for early assessment and amplification where appropriate. Those children that fail to progress with adequate amplification or are identified with a bilateral severe to profound loss at birth are referred to an appropriately qualified cochlear implant clinic for assessment and management.

The aim of this Guideline is to provide a template for a best practice cochlear implant clinic as per the current literature. The Guideline provides a service pathway from the point of identification through to postoperative rehabilitation. The roles of the various agencies involved in the cochlear implant pathway will be outlined as well as their respective inputs along the cochlear implant timeline. This guideline is intended for those health professionals involved in cochlear implant services as outlined above.

The patient group to whom this guideline applies is children identified with bilateral severe to profound sensorineural hearing loss either at birth or throughout the childhood period (i.e. up to eighteen years of age).

1.1 Introduction

Congenital sensorineural hearing loss is a significant childhood condition with incidence in the order of one per thousand live births. A large Australian population based study confirmed the critical need for early identification of hearing loss in children and adequate intervention to ensure speech and language development.¹ There are significant socio-economic impacts in untreated hearing loss with respect to both schooling and future employment opportunities. Longitudinal studies performed by Australian Hearing Services have shown rates of hearing loss in newborns in the order of 1.2 per thousand births.

The rate of hearing loss in children has been estimated as 2.5 per thousand^{1,2}. The latter figure includes those cases of genetic hearing loss that present later in childhood or hearing loss of an acquired aetiology. The advent of neonatal hearing screening has significantly increased early detection of significant childhood hearing loss and resulted in earlier intervention with respect to both hearing amplification and cochlear implantation. Normal hearing is a pre-requisite for adequate speech and language development and therefore identification and management of hearing loss is critical to ensure an optimal outcome in this regard.

Cochlear implantation has provided a major advance in the treatment of children with severe to profound bilateral sensorineural hearing loss. It continues to provide the only real electro / electro-acoustic hearing rehabilitation when hearing aids are no longer useful. Early identification, intervention and rehabilitation often results in children with significant hearing loss achieving educational and occupational levels commensurate with their normal hearing peers. This results in a significant social dividend with respect to education and employment as well as reducing the impact of a hearing disability.



This clinical guideline provides a template for a paediatric cochlear implant program commencing from patient identification, extending through the assessment and management process and ending with cochlear implant rehabilitation. The guideline also provides public information and education strategies.

1.2 Definitions

Sensorineural hearing loss: a hearing loss related to abnormality in either the cochlea or auditory nerve.

Congenital hearing loss: hearing loss that develops in utero and presents at birth or in early childhood.

Cochlear implant: a biomechanical device that is placed within the cochlea and directly stimulates the auditory nerve providing electrically mediated neural hearing.

Neonatal: referring to the period from birth to the first thirty days of life.

1.3 Methodology

The existing cochlear implant pathway as followed by the Western Australian Children's Cochlear Implant Clinic (based at Princess Margaret Hospital) was used as the clinical pathway for cochlear implantation. A literature review was performed to obtain current best practice with respect to neonatal hearing screening, cochlear implant surgery, bilateral cochlear implantation, and rehabilitation and future directions in implant technology.

The implant pathway currently proposed can be seen in Appendix 1. The implant pathway was developed in conjunction with the findings of the literature review and recommendations have been made accordingly.

1.4 Identifying candidates

There is no doubt that neonatal hearing screening has improved the detection rates for congenital sensorineural hearing loss^{3,4}. Western Australia has made steps to introduce neonatal hearing screening but at present, this is not a universal program.

Clearly universal neonatal hearing screening is the gold standard with respect to early identification of hearing loss. Patients are identified as suffering from hearing loss via a number of routes. These include the neonatal hearing screening program, childhood health screens, and parental concern and via concerns raised by educational agencies.

Assessment and quantification of hearing loss in the neonatal and childhood period can be difficult and we recommend that assessment is carried out at specialised centres with appropriate paediatric audiologists.

Regardless of the manner in which concerns are raised regarding potential childhood hearing loss, the investigation of these concerns follows a fairly routine pattern. Neonatal hearing loss is currently investigated with automated Auditory Brainstem Response (ABR) as part of the screening program. Should the infant fail the screening then a formal referral is made to the appropriate audiological service.

At present these include Princess Margaret Hospital (PMH), Australian Hearing Services and the Telethon Speech and Hearing Centre. Further investigation of suspected congenital hearing loss involves formal diagnostic testing including ABR testing. Once the hearing loss is confirmed and the degree of severity ascertained, the initial management involves a trial of amplification. This is generally carried out by Australian Hearing Services and urgent referral should be made once the diagnosis is confirmed. Those children identified with a severe to profound bilateral hearing loss should be referred to a cochlear implant program at this stage



for assessment and monitoring. All children diagnosed with a significant hearing loss should be referred for appropriate audiological and otological investigation and management.

1.5 Timing of Cochlear Implantation

With the implementation of neonatal hearing screening, children are being identified as cochlear implant candidates below 12 months of age. Published literature on the effect of age of implantation on language development supports the importance of early implantation^{5,6} with more recent literature outlining the benefits of implantation in the first year of life^{7,8,9}. A growing body of research suggests that children who receive a cochlear implant before 12 months of age can develop language skills at a rate more comparable to normal-hearing children^{7,8}. Clearly early intervention for children with hearing loss offers the best possible outcome.

2 Preoperative Assessment

Those children identified with sensorineural hearing loss require close follow-up. As described above, those with severe to profound loss are monitored by an audiological clinic with access to cochlear implant facilities. Those patients with a mild and moderate hearing loss should also be monitored as there is a significant incidence of progressive hearing loss, which may result in requirements for cochlear implantation over the ensuing months to years. It is critical that a multi-disciplinary approach is taken with children suffering significant hearing loss due to the critical effects of the deafness on speech and language development. Frequent liaison between the audiologist, speech pathologist and educational system is paramount for a good hearing outcome.

2.1 Entry into Cochlear Implant Program

Once the child has been identified as a cochlear implant candidate, i.e. they have failed to show adequate response to hearing aids as evidenced by behavioural audiometry and speech and language development, formal cochlear implant assessment is performed. This involves an audiological battery, speech pathology assessment, medical review and initial family meeting outlining the rationale behind cochlear implantation and the expected timeframe with respect to pre-operative assessment, surgical intervention and post-operative rehabilitation. If not already performed, imaging of the temporal bone is generally carried out at this stage and involves Computerised Tomography (CT) scanning with or without Magnetic Resonance Imaging (MRI).

2.2 Audiology Assessment

Assessment of candidacy for cochlear implantation involves a rigorous audiological battery of tests. Repeated testing and assessments are required as response to amplification and possible improvement of hearing thresholds with neuronal maturation must be monitored. Audiological criteria for implantation (as used by Princess Margaret Hospital) as well as the candidacy criteria are as follows:

2.2.1 PMH Cochlear Implant Referral Criteria

Unaided thresholds should be in the moderate to severe range in the low frequencies and severe to profound in the high frequencies. PMH will also consider normal low frequency hearing up to 1kHz, sloping to moderate and profound levels especially at 3 and 4kHz (See below for borderline candidacy).

Aided thresholds should be outside the speech spectrum. PMH will consider borderline cases where results from the functional tests are poor. Audiologists must also consider aid optimisation, compliance of use, ear moulds and listening skills.

Functional tests – Speech testing for older children or those with good speech and language. Appropriate tests include:

- Bamford-Kowal-Bench (BKB) or City University of New York (CUNY) sentences.
- North Western University - Children's Perception of Speech (Nu-Chips) (open set).
- Arthur Boothroyd (AB) word lists.
- Central Institute for Deaf (CID) everyday sentences for very young children.

If results are equal or poorer than 70 per cent in best ear and 40 per cent in poorer ear, they will be considered even if the aided results look to be adequate.

2.2.2 Special considerations for referral

- Progressive losses and meningitis should be referred sooner. Patients with meningitis should be considered for bilateral implantation due to the significant risk of cochlear ossification.
- Pre-lingual and very young children – Functional tests (although not exclusive) should include:
 - Threshold detection of the Ling sounds both through the sound field and live voice at various distances (conversational levels).
 - Meaningful Auditory Integration Scale (MAIS) / Infant Toddler - Meaningful Auditory Integration Scale (IT-MAIS) useful.
 - Early Speech Perception (ESP) low verbal/ standard.
 - Report from the Teacher of the Deaf.
- Auditory Neuropathy/ dys-synchrony (ANSD) – have different criteria. Extensive audiological/ speech and language, ENT investigations are required as part of the cochlear implant suitability. Additional investigation such as Electro cochleography (ECoChG) and electrically elicited ABR (EABR) is also performed. Refer to PMH / Cochlear Implant Clinic (CIC) for assessment.
- Borderline candidates – need more investigation. Including:
 - Aided speech perception testing in competing noise. If speech perception drops significantly in noise, then they may be considered for implant.

2.2.3 Prior to referring, the following is required by PMH / CIC:

- Unaided and aided performance reports:
 - to be provided to PMH / CIC by the Educational Audiologist and/or Australian Hearing.
- Basic overview of Cochlear Implant:
 - The Educational Audiologist provides the parent / caregivers with an overview of the device, speech processor, rehabilitation and outcomes.
 - Optimisation of hearing aids:
 - Optimisation of aids and relevant reports to be completed by Australian Hearing and co-ordinated through the Educational Audiologist.
 - Confirmation of hearing aid optimisation from Australian Hearing along with insertion gain measures and aided test results.
 - Educational Audiologists to ensure all possible measures and devices are trialled to maximise the hearing potential – especially for those borderline candidates.
 - PMH / CIC to provide update on any changes to the audiogram for further optimisation if required.

2.2.4 Procedure and responsibilities prior to implant

- CT and MRI can be fast-tracked through the Otolaryngologist if they are obvious candidates:
 - PMH / CIC to organise.
- Continual functional assessments:
 - PMH / CIC and Educational Audiologist.
- Initial appointment at PMH / CIC:
 - PMH / CIC (Educational Audiologist welcome to attend).
- Audiologists agree on recommendations:
 - PMH / CIC and Educational Audiologist (Australian Hearing Services).
- Joint meeting with parents and surgeon etc:
 - PMH / CIC and Educational Audiologist.

2.3 Speech Pathology

Clients identified as cochlear implant candidates by Audiology, are referred to the Speech Pathologist at PMH/CIC for candidacy evaluation and cochlear implant work-up. Establishing and implementing appropriate intervention prior to cochlear implant is a key factor to a client's success¹⁰.

Pre-implant services offered at PMH include: (please refer to Service Pathway for Cochlear Implant Services Document attached at Appendix 1):

- Initial family meeting with Speech Pathologist
- Candidacy evaluation and baseline assessment of communication and listening skills, and cochlear implant work-up
- Interagency service planning with WA Institute for Deaf Education (WAIDE) or Telethon Speech & Hearing prior to cochlear implant surgery (metropolitan clients)
- Interagency service planning with WAIDE visiting Teacher of the Deaf and local Western Australian Country Health Service (WACHS) Speech Pathologist prior to cochlear implant surgery (rural clients)

2.3.1 Initial Family Meeting

During the client's initial Speech Pathology appointment, the following information is discussed with the client's family:

- Role of Speech Pathologist within the Cochlear Implant Program
- Service delivery pathway and timeline for services
- Principles and expectations for habilitation, including roles of parent and speech pathologist in habilitation
- Realistic expectations for client's progress and maximising outcomes
- Accessing additional information on cochlear implantation and family/parental support and networking

2.3.2 Candidacy evaluation and cochlear implant work-up

Clients are offered up to 5 candidacy evaluation and work-up appointments prior to implant. During candidacy evaluation, the speech pathologist provides the PMH/CIC team with

information regarding the client's current communication skills and the client's ability to develop and maintain verbal communication skills with optimally-fitted hearing aids. This information helps to determine the prognosis for developing verbal language skills following cochlear implant.

Assessment information regarding the child's overall communication skills, including receptive and expressive language, speech production and listening skills, also serves as a baseline for comparison post implant if the child becomes a cochlear implant recipient.

Cochlear implant work-up goals include:

- Encouraging use of residual hearing and hearing aid use for all waking hours.
- Developing the client's listening and communication skills prior to cochlear implant.
- Preparing the client and his/her family for habilitation post implant.
- Liaising with other education/early intervention services to ensure the client and his/her family are receiving appropriate services, and to assist parents in accessing and evaluating these services.
- Developing a positive working relationship with the client's Teacher of the Deaf or Auditory Verbal Therapist, and/or local WACHS Speech Pathologist.

2.4 Educational Agencies

2.4.1 Educational Agencies' Role in Implant Pathway

The role of the educational agencies eg WAIDE, Telethon Speech and Hearing Centre is critical in the Implant Pathway. Pre-operative counselling and post-operative rehabilitation in the school setting are vital parts of the implant program.

2.4.2 Professionals involved with Family at Educational Organisation

- Educational Audiologist.
- Educational Psychologist.
- Playgroup/Kindergarten/Pre Primary teacher (depending on age of child).
- Teacher of the Deaf (T o D) /Listening and Spoken Language Specialist (Case Manager).

The family participates in Parent Guidance and individual therapy sessions. These are facilitated by the T o D and are typically on a weekly basis and an hour in duration. The developmental sequences of early communication are followed with a focus on listening, vocal behaviour and development and communicative linguistic development. These sessions are diagnostic in nature. Progress is reviewed at regular intervals as agreed by the family in the Family Service Plan (minimum every 6 months).

Formal assessment tools, checklists, informal observation, and regular DVD footage are used to document this. The Educational Audiologist coordinates with interagency services and monitors the child's audiological status. The child's pre-implant history covering type of educational support (first language), use of amplification, use of hearing for speech, language acquisition, description of child's communicative competence, linguistic performance, general development and audiological history pre-implant are forwarded by T o D and Educational Audiologist to CIC Audiology / Speech Pathology. If required the Educational Psychologist forwards details to Social Work.



Liaison and ongoing discussion between educational professionals and PMH Implant Team follows (by phone, email or meetings) and the professionals confer as part of the Assessment Process. Particular needs of the family are addressed as required.

The T o D and Educational Audiologist participate in the Final Assessment Planning with the Family and PMH Paediatric Team.

2.4.3 Pre Surgery

As part of individual sessions the T o D familiarises the family and child with CIC mapping procedures and teaches stimulus response tasks where relevant. The hospital /surgery experience is reviewed and depending on the age of the child role play experiences are provided by the T o D as preparation for the child and family.

The Educational Audiologist reviews type of device selected and is available for further discussion with the family on an as needs basis.

2.5 Otolaryngology

The role of the otolaryngologist encompasses preoperative counselling, cochlear implantation and post-operative follow-up. Preoperative assessment of the patient occurs in conjunction with all of the agencies above. Specific attention is paid to the otological history of the patient, perinatal risk factors, family history and associated medical conditions. All patients with congenital hearing loss are referred for ophthalmological and genetic assessment. Serology is performed to exclude possible aetiologies eg intrauterine infections and referral to Clinical Genetecists for further evaluation if syndromic causes are suspected.

Radiological evaluation of the temporal bone and auditory nerve is performed with a combination of CT scan and MRI.

Once a patient is confirmed as a candidate, a preoperative meeting with the family is scheduled and informed consent is obtained. As a general rule, surgery is planned in conjunction with the audiologist to allow for intra-operative Neural Response Telemetry (NRT).

3 Post Operative (Incl. Education and Awareness)

3.1 Audiology procedure and responsibilities after implant

- Neural Response Telemetry and CI Evoked ABR:
 - PMH / CIC
- Device orientation:
 - PMH / CIC
- Switch-on:
 - PMH / CIC (Educational Audiologist or Teacher of the Deaf may attend)
- Mapping for the initial 12 months (longer in some complex cases):
 - PMH /CIC
- Mapping for the next 12 months:
 - Educational Audiologist
 - Annual review with PMH (Educational Audiologist to provide the CDX file)
 - Educational Audiologist to inform PMH / CIC of any significant changes in the child's Maximising Amplitude Parameters (MAP) eg: electrode problems etc.
- Monitoring of non-implanted ear (unaided and aided):
 - Australian Hearing and Educational Audiologist
 - Inform PMH of any changes.

3.2 Battery of tests:

Depending on the age and nature of hearing loss the battery of tests include

- Unaided audiogram – either via psycho acoustic method (audiometry, Visual Reinforcement Audiometry - VRA) or electrophysiological – Auditory Brain Stem Response (ABR) clicks and tone burst, Auditory Steady State Response (ASSR) and Transient-Evoked Otoacoustic Emission (TEOAE).
- Aided audiogram: Individual aided and binaural.
- Functional tests – Speech testing for older children or those with good speech and language. Appropriate tests include:
 - BKB or CUNY sentences
 - Nu-Chips (open set)
 - AB word lists
 - CID everyday sentences for very young children
 - Early Speech Perception (ESP)
 - Phoneme detection.

3.3 Speech Pathology

It is critical that intensive cochlear implant habilitation is provided post implant to develop the client's speech, language and listening skills through the use of the implant. Intensive habilitation is offered to clients for a period of approximately 3 to 6 months post cochlear implant surgery (often weekly or fortnightly depending on parental preference and client progress) with habilitation services offered up to 12-months post-implant.

During the habilitation period, therapy goals are set in collaboration with families, and the client's Teacher of the Deaf or Auditory-Verbal Therapist.

- A 6-month progress review, including interagency planning, is conducted at 6-months post implant. Annual reviews are offered at 1-year and 2-years post cochlear implantation, with a third, optional review offered to clients who are slow to progress upon parental request.

3.3.1 Key Principles of Habilitation

- Provide family-centred services to enable parents/caregivers to become the primary facilitators of their child's listening and communication development.
- Provide an optimal environment to stimulate development of listening as a learning tool for the child.
- Provide a combination of auditory oral and auditory verbal approaches, as appropriate for each child. Clients are supported in a total communication approach if appropriate.
- Facilitate acquisition of listening skills, speech and language skills in normal developmental order through use of the implant.
- Present learning to listen skills in a hierarchy.

3.4 Educational Agencies

Post surgery and prior to device activation the To D provides home /hospital support for the family until individual habilitation sessions at the educational organisation recommence. Following the issue of the device, familiarisation or practice sessions are incorporated into individual sessions. The T o D liaises with the Family, CIC Audiology and Speech Pathology regarding the scheduling of hospital appointments (re device activation*, mapping *and habilitation). Following device activation, observations of the child's mastery of skills are noted and forwarded by educational team to CIC team (particularly child's responses to current map and speech perception). Professionals are sensitive to the changing needs of the family over time regarding preferences for frequency of sessions at either venue.

T o D provides a summary checklist of progress to CIC Audiology and Speech Pathology.

*The T o D is also available to participate or assist in device activation /mapping sessions.

Upon child's discharge from the regular CIC Audiology and Speech Pathology

habilitation sessions: The family continues to participate in weekly individual sessions with the T o D. The Educational Audiologist undertakes mapping support and monitoring. Summaries of child's post implant progress continue to be sent to the CIC team.

Postoperative review involves close monitoring for infective complications as well as prompt attention to problems with the device itself. Again, close liaison with Audiology / Speech Pathology / Educational Agencies is paramount.

4 Other Considerations

4.1 Bilateral Cochlear Implantation

It is well accepted that there are significant benefits with binaural hearing. These include improved hearing in noisy situations and improved sound localisation. Bilateral cochlear implantation in suitable candidates has been shown to replicate these benefits^{11,12}.

Bilateral implantation has become the treatment of choice in people with bilateral severe to profound sensorineural hearing loss, who are unable to obtain bimodal benefit (i.e. CI in one ear and hearing aid in the other). Due to funding constraints, bilateral implantation is not offered to all uninsured paediatric patients in Western Australia. Only those patients who have suboptimal outcomes or special cases e.g. meningitis, monodini are considered for second / bilateral surgery.

This situation is clearly inequitable and we recommend that funding is increased to allow those parents who wish their child to have binaural hearing to be given the opportunity for this to occur.

4.2 Evolving Technology

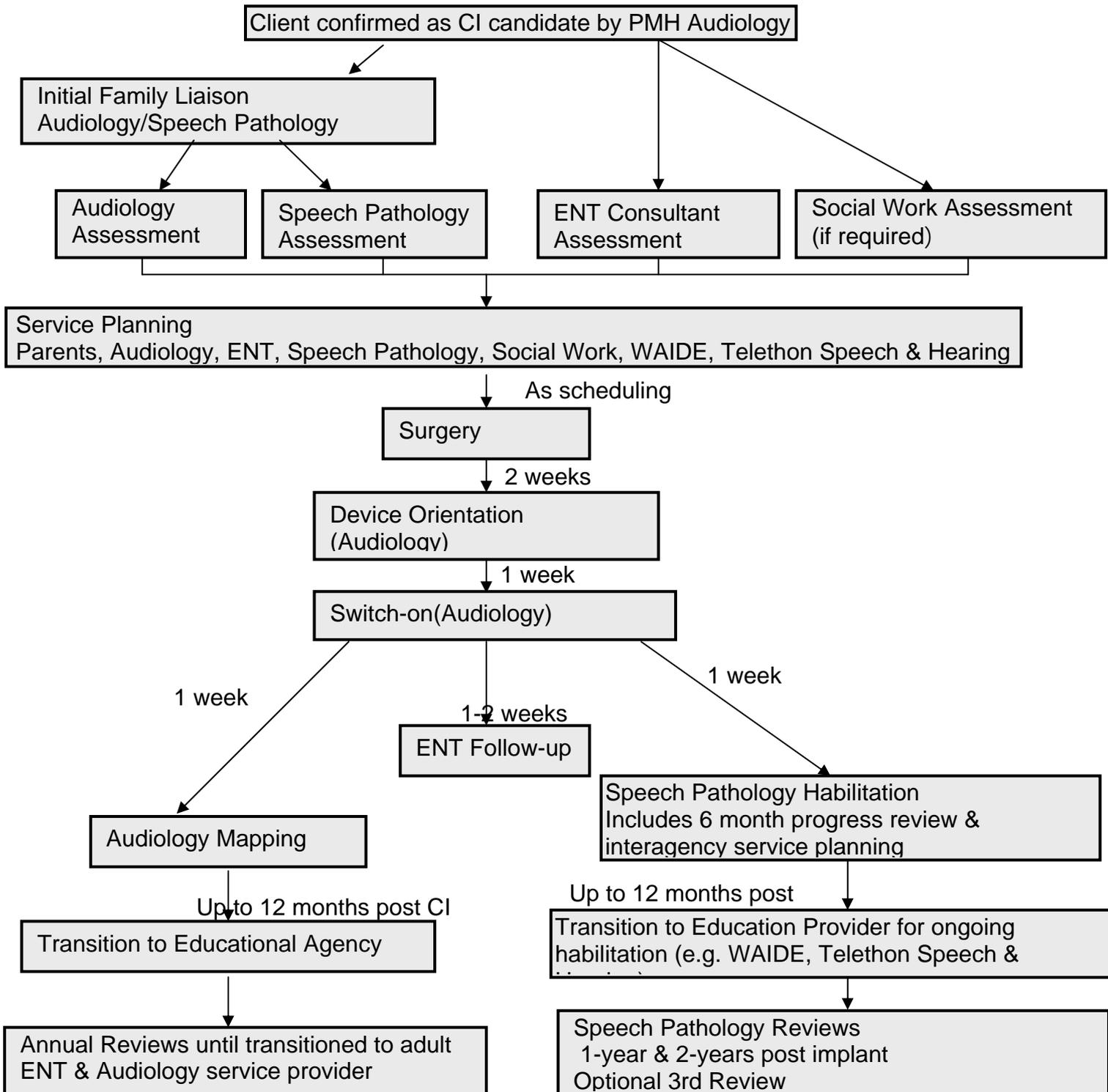
Refinements in cochlear implant design have resulted in widening criteria for implantation. Current technology allows for attempts at preservation of residual hearing and electro-acoustic stimulation in such patients is of significant benefit. Implant programmes and funding guidelines will need to be mindful of newer technologies e.g. middle ear implants for sensorineural hearing loss and be ready to incorporate them into existing programmes.

5 References

1. Economics A. Listen hear! The economic impact and cost of hearing loss in Australia. Access economics 2006(February).
2. Economics A. The cost burden of Otitis Media in Australia. Access economics 2009(February).
3. Bower CM, Martin PF. Infant hearing screening. *Curr Opin Otolaryngol Head Neck Surg* 2008;16(6):562-8.
4. Choo D, Meinzen-Derr J. Universal newborn hearing screening in 2010. *Curr Opin Otolaryngol Head Neck Surg* 2010;18(5):399-404.
5. Miyamoto RT, Hay-McCutcheon MJ, Kirk KI, Houston DM, Bergeson-Dana T. Language skills of profoundly deaf children who received cochlear implants under 12 months of age: a preliminary study. *Acta Oto-Laryngologica* 2008;128(4):373-7.
6. Nicholas JG, Geers AE. Will they catch up? The role of age at cochlear implantation in the spoken language development of children with severe to profound hearing loss. *Journal of speech, language, and hearing research : JSLHR* 2007;50(4):1048-62.
7. Ching TY, Dillon H, Day J, Crowe K, Close L, Chisholm K, et al. Early language outcomes of children with cochlear implants: interim findings of the NAL study on longitudinal outcomes of children with hearing impairment. *Cochlear implants international* 2009;10 Suppl 1:28-32.
8. Tait M, De Raeve L, Nikolopoulos TP. Deaf children with cochlear implants before the age of 1 year: comparison of preverbal communication with normally hearing children. *International journal of pediatric otorhinolaryngology* 2007;71(10):1605-11.
9. Dettman SJ, Pinder D, Briggs RJ, Dowell RC, Leigh JR. Communication development in children who receive the cochlear implant younger than 12 months: risks versus benefits. *Ear and hearing* 2007;28(2 Suppl):11S-8S.
10. Eisenberg LS, ed. *Clinical management of children with cochlear implants*. San Diego, CA: Plural Pub.; 2009.
11. Das S, Buchman CA. Bilateral cochlear implantation: current concepts. *Curr Opin Otolaryngol Head Neck Surg* 2005;13(5):290-3.
12. Brown KD, Balkany TJ. Benefits of bilateral cochlear implantation: a review. *Curr Opin Otolaryngol Head Neck Surg* 2007;15(5):315-8.

Appendices

Appendix 1: Service Pathway for Paediatric Cochlear Implant Services





Delivering a **Healthy WA**



**Health Networks Branch
Level 2C
189 Royal St
East Perth WA 6004**